APPENDIX B

PREVIOUS INVESTIGATIONS
Remedial Investigation/Feasibility Study
Program Work Plan
Leviathan Mine Site
Alpine County, California

Prepared for:
Atlantic Richfield Company
La Palma, CA

Prepared by:
AMEC Geomatrix, Inc.,
Rancho Cordova, CA

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ATTACHMENTS

Attachment A Excerpted Data from Previous Investigations (On CD-ROM)

APPENDIX B
PREVIOUS INVESTIGATIVE DATA COMPILATION
Remedial Investigation/Feasibility Study Program Work Plan
Leviathan Mine Site
Alpine County, California

B1.0 INTRODUCTION

This document describes the previous investigations relating to the Leviathan Mine Site (site). Detailed results pertaining to the previous investigations summarized below are provided in Attachment A. The excerpted information from the previous investigation includes tables, figures, and text. Due to the extensive number of excerpted pages, this information is provided on CD-ROM.

A summary of the previous investigations reviewed during preparation of the Remedial Investigation/Feasibility Study (RI/FS) Program Work Plan (PWP) is provided in the following sections. At the end of each summary is a description of the additional supporting information provided in Attachment A.

B1.1 LETTER TO THE REGIONAL WATER QUALITY CONTROL BOARD (RWQCB): REGARDING WATER SAMPLES COLLECTED FROM ASPEN AND LEVIATHAN CREEKS, PRE-OPEN PIT MINING (WHITE, 1952)

Two surface water samples were collected by the Nevada Department of Health in 1952 (prior to open pit mining activities). One surface water sample labeled ASP1952 was collected from Aspen Creek above the site and had a pH of 7.7. The other surface water sample named LEV1952 was collected from Leviathan Creek immediately downstream of a bridge and had a pH of 7.1. The surface water flow was estimated at 11 cubic feet per second (cfs) at LEV1952. The exact sample locations or details on the sampling methods were not provided. The letter is presented in Attachment A.

B1.2 NEVADA DIVISION OF WILDLIFE STREAM SURVEY - BRYANT CREEK (NDCNR, 1955)

This report includes documentation from an interview with Mr. Brooks Park (land and Bryant Creek water rights owner of the property that includes Bryant Creek from the state line to approximately 1-mile downstream). The report also includes a downstream survey of Bryant and Barney Riley Creeks in July and September 1955. The investigation included measurements of pH, carbonates, bicarbonates, and chlorides. The investigation also included qualitative measurements of stream quality (including turbidity, grain size estimates, spawning conditions, and plant and animal types and abundance). Additionally, data was collected from five fish shocking sections on Bryant Creek. Although the number of fish accounted for during the shocking events were not described in the report.

According to Brooks Park, he was not aware of any fish plantings made in the creek. In an addendum to this report, the records show a thousand, Brook trout averaging 1-1½ - inches in length were planted in Bryant Creek in 1951. Mr. Park recalls successfully fishing trout from the creek over an approximate 35-year period with his family in the vicinity of Barney Riley Creek. Mr. Park claimed that pollution from the Anaconda mine dumps caused trout mortality and possibly the death of livestock when he diverted water from Bryant Creek for irrigation. The data is summarized within the text of the report, which includes a figure of the sample areas. The report is presented in Attachment A.

B1.3 REPORT LEVIATHAN CREEK BIOASSAY (COLI, 1958)

A bioassay was conducted in 1958 to investigate the toxicity of Leviathan Creek on rainbow trout. Four tests were performed on Leviathan Creek and two control tests were performed on Mountaineer and Doud Creeks. All 32 fish tested in Leviathan Creek died after 170 minutes. All 16 fish at the control sites survived after 48 hours. A map and chart of the bioassay test locations and results are presented in Attachment A.

B1.4 LEVIATHAN CREEK WATER QUALITY SAMPLE RESULTS (REINKE, 1958)

On September 27, 1957, surface water samples were collected from five stations along Leviathan Creek. The samples were collected by the California Department of Public Health to investigate the water quality during open pit mining activities. The sampling locations included Leviathan Creek at a road crossing above the mine (now known as Station 1), the weir at the pond outlet (known as LEV-weir), the pond outlet above Mountaineer Creek (now known as Station 25), the irrigation diversion at Brooke Ranch (now known as Station 31), and the road crossing above the confluence of the Carson River (now known as Station 29). Water samples were analyzed for pH, total solids, specific conductance, color, turbidity, acidity, alkalinity, hardness, nutrients, and metals. The pH measured at each of these locations was as follows: Station 1 – pH 7.5; Lev-weir – pH 2.9; Station 25 – pH 3.1; Station 31 – pH 7.6; and, Station 29 – pH 5.1. A tabulation of the laboratory results for these five samples are provided in Attachment A.

B1.5 REPORT ON POLLUTION OF LEVIATHAN CREEK CAUSED BY LEVIATHAN MINE (RWQCB, 1968)

This report describes the conditions of Leviathan Creek in 1969 and its uses at that time. The report also includes a brief history of the mine up until 1969. The RWQCB reports that no aquatic life in Bryant Creek or Leviathan Creek was observed at that time and reports that "Leviathan Creek historically has been acidic in nature because of the mineral deposits in the watershed and because of stories told of using the creek water to shine pennies". It appears, however, that the creek did at that time "support fish life".

The report also describes a violation of waste discharge requirements (Resolution 62-12, established in December 20, 1962). The violation was determined by collecting samples from Leviathan Creek just below the mine and comparing the results to those from samples collected just above the mine. The samples were analyzed for pH, sulfate, and Iron and collected between 1955 and 1965. An analysis of the sample results "show that the water above the mine is not polluted and is of excellent quality for irrigation and for fish life propagation". These results also conclusively show that degradation of the waters of Leviathan Creek occurs in the vicinity of the mine and is a direct result of the mine.

Also included in this report are the results of five surface water samples collected by the RWQCB from a culvert downstream of the site in 1963. The results exceeded the discharge requirements and Resolution 64-3, a Cease and Desist Order for the site was passed and adopted by the Lahotan Regional Water Quality Control Board (LRWQCB) on March 20, 1964.

This report does not include any data tables or figures. The report text summarizes data collected from 1963 through 1965 and is provided in Attachment A.

B1.6 LETTER: TRANSMIT RWQCB MEETING MINUTES; FISH AND GAME REPORT (LEGGETT, 1969)

Surface water quality and bioassays were collected from six sampling stations on December 5, 1968. The six sample stations were described as water from an abandoned mine shaft (assumed to be Adit No. 5), the combination of three springs above the abandoned mine shaft, and from Leviathan Creek above the present day locations of Stations 1, 23, 24, and 31. The surface water quality included an analysis of general chemistry and metals. The bioassessment included a survey of bottom organisms (fish food) and an evaluation of Leviathan Creek toxicity on rainbow trout.

The study concluded that surface waters near the site approach the threshold level of toxicity to rainbow trout, measured by the bioassay test for "acute" or short-term toxicity. It was also concluded that trout would be unlikely to survive the "chronic" or long-term pollution effects from the mine because the fish food organisms were not found near the site. The results of the report indicated the total length of stream polluted by Leviathan Mine is 7.8 miles and the estimated number of fish lost was estimated at 227 pounds per year (the estimate was derived by a comparison to similar streams with known trout production).

Tabulated data from the December 5, 1968 sampling event and a map of the sample locations are presented in Attachment A.

B1.7 INVESTIGATION OF SOIL AND IRRIGATION WATER CONDITIONS ON THE BROOKS PARK - RIVER RANCH (NELSON LABORATORIES, 1969)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

A surface water sample was collected from the Bryant Creek diversion ditch (BCDD), approximately 10 feet (ft.) south of the diversion to the River Ranch (sample named BCDD) and a surface water sample was collected from the Cottonwood Creek diversion ditch (CCDD). The samples were analyzed for general chemistry and metals. Soil samples from 6 locations (A through F) were collected within the top foot of the surface and analyzed for metals, nutrients, and the percentage of sand, clay, and organic material. All samples were collected on November 11, 1969. The exact locations of the samples are not known. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.8 AN APPRAISAL OF THE EFFECTS OF CONTAMINANTS IN IRRIGATION WATER DERIVED FROM BRYANT CREEK ON THE AGRICULTURAL POTENTIAL OF RIVER RANCH (YOUNG, 1970)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

One surface water sample was collected at the River Ranch irrigation ditch at the intersection with a road (named BCDD). This sample was analyzed for general chemistry and metals on September 7, 1970. Four soil samples (1C, 2C, 2L, 1L) were collected from the top four inches of the surface on September 7, 1970, and analyzed for pH and metals. The exact locations of the samples are not known. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.9 REPORT ON POLLUTION OF LEVIATHAN CREEK, BRYANT CREEK, AND THE EAST FORK CARSON RIVER CAUSED BY THE LEVIATHAN SULFUR MINE (RWQCB, 1975)

The report provided a comprehensive history of beneficial uses of receiving waters, history of mine operations, geology, and hydrology of the Leviathan Mine. The report also presented a summary of the historic and water quality condition of Leviathan and Bryant Creeks and the East Fork of the Carson River in 1975. Chemistry data, maps of sampling locations, as well as notes made during the visual inspections of the abandoned mine in July and December 1974 are presented in this report.

The surface water samples were analyzed for general chemistry and metals from the following five locations: Leviathan Creek below an unknown discharge point (sample named LEV-ds), at two unknown discharge points coming from mine features (assumed to be the adit, drainage from tailings and a location named Mine Drainage (1) and Mine Drainage (2)); and in the

present day locations of United States Geological Survey (USGS) Stations 1 and 31. The report suggests the chemistry of the Leviathan Creek did not improve between 1968 and 1974 and remained at concentrations that violated the discharge requirements.

Tabulated data and hydrographs from a 1969 flow measurement program are presented in Attachment A.

B1.10 THE REVEGETATION POTENTIAL OF THE LEVIATHAN MINE SPOILS, MS THESIS UNIVERSITY NEVADA RENO (BUTTERFIELD, 1977)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Samples were collected from surface soil and analyzed for general chemistry, nutrients, metals, and percent sand, silt, and clay. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.11 LEVIATHAN MINE POLLUTION ABATEMENT PROJECT, DESIGN REPORT AND DRAFT ENVIRONMENTAL IMPACT REPORT, APRIL 1983 (BROWN AND CALDWELL, 1983)

This is a planning document prepared by Brown and Caldwell for the RWQCB to be used in order to design a project that would restore the water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity, and within the limitations of available funding. It included a comprehensive assessment of Leviathan Mine and recommendations to abate the pollution from the site. Substantial details from previous investigations were summarized. The document included a compilation of the known geologic, hydrogeologic, surface water, climate, slope stability, and available geochemical data. The recommendations made by Brown and Caldwell are presented in Section B1.37.1.

This report also presented one of the earliest meteorological investigations and included estimates of precipitation from nearby locations. A copy of this document is provided in Attachment A.

B1.12 SHALLOW GROUNDWATER FLOW IN THE VICINITY OF THE OPEN PIT AT THE LEVIATHAN MINE (PRUDIC AND HAMMERMEISTER, 1984)

The USGS conducted a preliminary analysis of the shallow groundwater and the surface flow system in the vicinity of the open pit (32 acres of the area upgradient from the open pit and the 48 acres of the open pit). This information was intended to be used by the RWQCB to estimate the effect of shallow groundwater on the water quality of Leviathan Creek before and after abatement measures were carried out. For this analysis, six assumptions were employed and shallow groundwater flow calculations were made for the open pit area. Two

summary tables were produced using these assumptions. These summary tables are presented in Attachment A.

B1.13 HYDROLOGIC DATA FOR LEVIATHAN MINE AND VICINITY ALPINE COUNTY, CALIFORNIA, 1981-83 (HAMMERMEISTER AND WAIMSLEY, 1985)

This hydrologic investigation included the installation of piezometers, observations of subsurface lithology, and the analysis of surface water samples, stream sediment samples, and groundwater samples. Activities were performed by the USGS from 1981 through 1983.

Surface water field data included one or more measurements of pH, flow, water temperature, and specific conductance at 45 locations in and adjacent to the mine area. Some surface water locations were selected for identifying and counting benthic invertebrates during high- and low-flow periods.

Stream sediment samples were collected at three surface water stations in May 1983. These sediment samples were analyzed for metals, total carbon, and moisture content.

Subsurface lithology was recorded in 71 vertical borings. The borings were converted to piezometers, many of which were clustered and screened at different depths. Geotechnical properties were recorded during the drilling activities.

Groundwater data were collected from the 71 piezometers between August 1982 and April 1983 (clustered piezometers PZ-1 through PZ-33). Field measurements included the depth to water, hydraulic conductivity, and temperature. Groundwater samples were analyzed for metals and general chemistry.

Geotechnical properties of the subsurface were recorded during the installation of the 71 borings at the site by the USGS between 1981 through 1983. Selected boring logs included estimates of the original land surface or the location of potential landslide surfaces. Borehole geophysical data was collected and provided subsurface information on moisture content, porosity, density, natural gamma, and temperature logs. Selected soil samples from the borings were analyzed for mineralogy and clay type. No conclusions were cited in the report.

Maps of the sampling locations and data tables containing soil, groundwater, and borehole data presented in this report are provided in Attachment A.

B1.14 FINAL REVISED ANALYSES OF MAJOR AND TRACE ELEMENTS FROM ACID MINE WATERS IN THE LEVIATHAN MINE DRAINAGE BASIN, CALIFORNIA AND NEVADA, OCTOBER 1981 TO OCTOBER 1982 (BALL AND NORDSTROM, 1989)

Revised surface water analytical results of the 1981-1983 USGS investigation were presented in this document. This dataset was re-analyzed using a more precise method for quantifying trace metals in surface water. Sixty-seven surface water samples from 45 locations were re-analyzed. A complete copy of this document is provided in Attachment A.

B1.15 PARTIAL SOIL REMEDIATION AND RE-VEGETATION OF THE LEVIATHAN MINE (CLAASSEN, 1977)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Surface soil samples were collected from 31 sampling locations and analyzed for metals, nutrients, conductivity, pH, and percent of organic material. Samples were collected sometime between 1985 and 1986. The exact locations of the samples are not known. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.16 TRACE-ELEMENT ENRICHMENT IN STREAMBED SEDIMENT AND CRAYFISH, CARSON AND TRUCKEE RIVERS, NEVADA AND CALIFORNIA, SEPTEMBER 1992 (LAWRENCE, 1998)

Streambed sediment and crayfish samples were collected from 11 locations (5 along the Carson River and 6 along the Truckee River). The samples were analyzed for metals. Statistically-significant relations were measured between arsenic, mercury, and silver concentrations in bed-sediment and crayfish samples in each of the rivers. These relations indicated that arsenic, mercury, and silver were bio-available and were bio-accumulated in crayfish, especially in the Carson River. A map of sampling locations and the data tables present in this report are presented in Attachment A.

B1.17 LEVIATHAN MINE, SPRING 1998 SPRING MONITORING PROGRAM (SRK, 1998)

Surface water samples were collected at 9 stream locations during 6 sampling events conducted between June and July of 1998. Sampling was designed to characterize spring runoff water quality upstream of the site, immediately downstream of the site, and at several locations further downstream of the site. Stream locations included 2 station locations along the East Fork of the Carson River a short distance upstream of Bryant Creek (EFC1) and a short distance below Bryant Creek (EFC2), and from the present day surface water sampling Stations 1, 15, 16, 23, 24, and 25. Field measurements of flow, temperature, and pH were collected at each stream location. Water samples were analyzed for nutrients, hardness, total dissolved solids (TDS), total alkalinity, and metals. Data tables and a map of sample locations presented in this report are provided in Attachment A.

B1.18 DATA ON STREAM-WATER AND BED-SEDIMENT QUALITY IN THE VICINITY OF LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA, AND DOUGLAS COUNTY, NEVADA; SEPTEMBER 1998 (THOMAS AND LICO, 1998)

A chemical assessment of streams in the area of Leviathan Mine was conducted in September 1998. Measurements of stream flow, pH, dissolved oxygen, temperature, specific conductance, alkalinity, bicarbonate, and carbonate were collected at 14 locations. Surface water samples were analyzed for nutrients, major ions, trace elements, and organic carbon. Streambed sediments were collected at the same locations and analyzed for major and trace elements, total carbon, inorganic carbon, and organic carbon.

There were no conclusions drawn from the data collected and presented within this report. Data tables and a map of the sample locations presented in this report are provided in Attachment A.

B1.19 1998-1999 SUMMARY REPORT, ADMINISTRATIVE ORDER ON CONSENT, LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA (SRK, 1999)

This report presents data collected during 1998 and 1999 including a geologic reconnaissance of the property and field investigation of groundwater and surface water chemistry and the collection of climate and geotechnical data. Activities were performed from August 1998 through December 1998 and additional data collection activities occurred during 1999.

As part of the geological investigation, approximately 200 surface soil samples were collected and analyzed for pH and conductivity.

Surface water samples were collected at 19 stream locations during three sampling events between September and November of 1998. The sampling locations included discharge points from the site (e.g., Adit, AS, DS, CUD, PUD, runoff from Pond 4, and Pond 2), unnamed tributaries, and along selected USGS surface water sampling locations. Field measurements of flow, temperature, and pH were collected at each sampling location. Water samples were analyzed for nutrients, hardness, TDS, and metals.

A total of 15 new groundwater monitoring wells (MWs) were installed in the Leviathan Creek drainage area between August and October 1998. Groundwater samples from 17 wells which included the 15 newly installed MWs and two of the remaining piezometers installed by the USGS between 1981 and 1983 (PZ-25 and PZ-33) were collected in October and November 1998. Water level measurements were collected from existing wells during September and December 1998 and again in June, August, and September 1999. All other piezometers installed by the USGS had been reported to be destroyed by landslide activity or construction activity during the RWQCB Pollution Abatement Project (Brown and Caldwell, 1983). Groundwater samples were collected on 2 separate events between August 1998 and

September 1999. Groundwater parameters (pH, temperature, conductivity, TDS) were measured in the field and samples were analyzed for metals. No soil samples were collected from within the vertical borings drilled during the installation of the 15 monitoring wells. Several tables presented in this document also present tabulations of the laboratory results for the groundwater sampling events and the water level data collected from the wells.

Climate data was recorded from a light duty weather station in operation from June 1998 through September 1999. Temperature, precipitation, and wind speed were recorded from June 1998 through January 7, 1999. The weather station was re-started on July 28 1999, and continued until September 10, 1999.

A geotechnical investigation was performed at the site which included the collection of soil samples from six test pits (LTP-1 through LTP-6) and evaluation of landslide movements by installing nine landslide monuments which consisted of steel posts with a base plate anchored below the surface (LS1 through LS9). Three test pits were placed in the area of Leviathan Creek (LTP-1 through LTP-3), one test pit was placed south of the open pit (LPT-4), and one test pit was placed in the center of the open pit (LPT-5). The test pits were excavated to a maximum of 10 ft. below ground surface (bgs). Soil samples collected from the test pits were analyzed for flexible wall permeability by ASTM D5084-90, compaction characteristics by ASTM D698-91, and particle size distribution. The test pit logs were presented in Appendix F of the SRK (1999) document. The movement of the landslide monuments has not been evaluated since their installation.

A complete copy of this document is provided in Attachment A.

B1.20 DATA REPORT FOR THE LEVIATHAN MINE STUDY AREA WATER AND SEDIMENT TOXICITY TESTING AND BENTHIC COMMUNITY DATA, SEPTEMBER 1998 ASSESSMENT (ENSR, 1999)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Surface water samples were collected from 18 locations between September 1998 and October 1999. Locations included selected USGS stations and from discharge points from the site. The analyses performed on the surface water samples included measuring the pH, total dissolved solids, dissolved oxygen, dissolved organic carbon, and metals.

Stream sediment samples were collected from 18 locations with the surface water samples and analyzed for total organic carbon, grain size, and metals. A bioassessment was performed at 14 locations which included selected USGS stations and from discharge points at the site. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.21 ASSESSMENTS OF INJURIES TO AQUATIC NATURAL RESOURCES NEAR THE LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA. PHASE 1 DATA REPORT: CONCENTRATIONS OF METALS AND TRACE ELEMENTS IN AQUATIC INSECTS AND FISH (THOMPSON AND WELSH, 1999)

In September 1998, aquatic insect samples were collected in 11 stream locations in the vicinity of the site to obtain tissue for laboratory analysis. The samples were collected in locations which received contaminated surface waters from the site as well as in reaches that receive no surface water wastes from the Leviathan Mine. No samples were obtained from the reaches of Leviathan or Aspen Creeks directly downstream of the site due to the absence of aquatic insects in these locations. These samples were analyzed for metals. The data was collected to possibly determine if aquatic insects were accumulating metals and trace elements discharged from the site. Results were presented in the document but no conclusions were made.

In October 1998, mountain whitefish were collected in three East Fork Carson River locations to obtain muscle and liver tissues of fish for determination of metal and trace element concentrations. The locations were upstream of Bryant Creek, downstream of Bryant Creek, and downstream of the Ruhenstroth Dam near Dresslerville. These locations are also known as Stations 11, 12, and 13, respectively. Tissue samples were analyzed for metal concentrations. Results were presented in the document but no conclusions were made.

A complete copy of this document is provided in Attachment A.

B1.22 METHYL-MERCURY IN WATER AND BOTTOM SEDIMENT ALONG THE CARSON RIVER SYSTEM, NEVADA AND CALIFORNIA, SEPTEMBER 1998 (HOFFMAN AND THOMAS, 2000)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Surface water samples were collected from two locations (EFC-Ruhen and EFC-upstr) in September 1998. Surface water samples were analyzed for flow, pH, temperature, mercury, methyl-mercury, and total organic carbon. Stream sediments were collected from the same two locations and analyzed for mercury and methyl-mercury. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.23 LEVIATHAN MINE NATURAL RESOURCES DAMAGE ASSESSMENT PHASE I FISHERIES ASSESSMENT (LEHR, 2000)

This report documents the status of fish populations in the Leviathan-Bryant Creek watershed in October 1998. The project database indicated that samples were collected at 11 locations and included fish counts along sections of the watershed. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.24 OPERATION AND MONITORING OF BIOREACTORS AT THE LEVIATHAN MINE (MILLER, 2001)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

The University of Nevada, Reno (UNR) performed system modifications to the Aspen Seep bioreactor (ASB) to improve the efficiency of the existing treatment system. Water samples were collected through various parts of the system to evaluate the effectiveness of the modifications. Samples were collected during 15 different sampling events between January and July of 2001. Water samples were analyzed for pH, TDS, total alkalinity, and metals. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.25 PRELIMINARY ASSESSMENT OF FISH COMMUNITY DYNAMICS AND TRACE-ELEMENT EXPOSURES TO AQUATIC INVERTEBRATES AND SALMONIDS, LOWER BRYANT CREEK AND EAST FORK CARSON RIVER, DOUGLAS COUNTY, NEVADA, 2001 (HIGGINS, 2001)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Metal concentrations were analyzed in 38 fish tissue samples collected at four locations in October of 2001. These samples were named Bryant Creek (BRY), East Fork Carson River 1 (EFC 1), East Fork Carson River 2 (EFC2), and East Fork Carson River downstream of Ruhenstroth Dam (EFC-Ruhen). Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.26 GEOTECHNICAL INVESTIGATION REPORT, PHASE I PRELIMINARY SLOPE STABILITY EVALUATION, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA (KLEINFELDER, 2001A)

A geotechnical investigation was performed in the Delta Area to evaluate the slope stability of the waste pile. The scope of the investigation included a literature search, a field reconnaissance, limited laboratory testing, a preliminary slope stability analysis, and the installation of slope monitors. The following conclusions were drawn from the results of the investigation:

1. Mine waste was deposited into the Leviathan Creek valley to depths ranging up to 65 ft. Leviathan Creek was rerouted around the waste pile.

2. Field and aerial photo reconnaissance indicated that a landslide occurred on the northwest limits of the Delta Area waste pile.

3. Evidence of failure could not be detected on the waste pile south of the Delta Area slope, in the area of Pond 4, or in the channelized area of Leviathan Creek.

4. Surface soils in the Delta Area waste pile consist of clayey or silty sands with moderate to low strength parameters based on testing performed by Kleinfelder. The permeability of the waste material is low (10^{-6} cm/sec) based on testing by SRK (1998). Native soils below the waste material consist of organic-rich silty clay.

5. Groundwater is present in the slope as evidenced by springs near the base of the slope and water levels in the MW at the top of the slope (MW-12) (SRK, 1998). The groundwater level appears to be within the lower 10 ft. of the waste material and may be one of the primary causes of landslide movement.

6. There is evidence of past slope instability in waste material on the high slope east and south of the Delta Area. Signs of recent movement within the Delta Area landslide could not be detected.

7. A slope monitoring system consisting of 12 points were installed on the Delta Area slope and is monitored (weather permitting) on a monthly basis.

8. The results of the preliminary slope stability analysis indicate that the Delta Area slope is marginally stable.

9. Additional field investigations including field exploration drilling was recommended.

A complete copy of this document is provided in Attachment A.

B1.27 LEVIATHAN MINE 2001 EARLY RESPONSE ACTION, CHANNEL UNDERDRAIN TREATMENT COMPLETION REPORT (BROWN AND CALDWELL, 2002)

A treatability study was performed to achieve short-term water quality improvements in Leviathan Creek, to demonstrate continuous lime treatment, and to assist in managing solids generated by channel underdrain (CUD) treatment. The technology tested included the use of a continuous treatment lagoon system using calcium hydroxide (lime) designed for metal hydroxide and metal oxy-hydroxide precipitation.

Seven surface water sampling events were conducted between August and September of 2001 to monitor the effectiveness of the treatment technology. Additionally, prior to discharge of treated water, field parameters such as pH and temperature, were recorded and water samples were collected from the influent, effluent, and surface of Pond 4 for laboratory analysis. Water samples were analyzed for total alkalinity, acidity, TDS, sulfate, hardness, and metals. A copy of this document is provided in Attachment A.

B1.28 GEOTECHNICAL INVESTIGATION REPORT: PHASE II PRELIMINARY SLOPE STABILITY EVALUATION, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA. REPORT (KLEINFELDER, 2001B)

This geotechnical investigation included drilling 9 soil borings (B-1 through B-9) to depths of 26 to 58.5 ft. bgs in September and October of 2001. These borings were advanced in the Delta

Area of the Leviathan Creek Study Area (LCSA) to evaluate the slope stability of the waste pile. Continuous logs of all of the borings were recorded. Slope inclinometer casing was installed in 4 of the borings (B-1, B-3, B-5, and B-6) and groundwater MWs were installed in the remaining five borings (B-2, B-4, B-7, B-8, and B-9).

A geotechnical investigation was performed in the Delta Area to evaluate the slope stability of the waste pile. Groundwater elevations were collected from borings B-1 through B-9, MW-8, and MW-12 during five events between September and November 2001. Soil samples were laboratory tested for direct shear, density, and moisture content of the mine tailings. Information about this document was excerpted from Kleinfelder (2003) and is provided in Attachment A.

B1.29 Influence of Natural Sources on Mercury in Water, Sediment, and Aquatic Biota in Seven Tributary Streams of the East Fork of the Upper Carson River, California (Fischer and Gustin, 2002)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Seven tributaries were sampled between June and September 1999 to measure the concentration of mercury and methyl-mercury in stream sediments and aquatic biota. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.30 Geotechnical Slope Stability Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California (Kleinfelder, 2003)

A supplemental geotechnical investigation was performed in addition to those performed by Kleinfelder in 2001. Ten test pits (TP-1 through TP-10) ranging in depths from 8.5 to 17.5 ft. were excavated in the Delta Area of the LCSA in May 2003.

Results of the geotechnical investigations by Kleinfelder in 2001 and 2003 included a description of the landslide in the Delta Area of the LCSA, a description of subsurface conditions, and a slope stability analysis.

The Delta Slope is roughly 250 ft. in length by about 150 in maximum width and is about 80 ft. in height. It is located on the steep, northwest limit of the waste pile, east of and adjacent to Leviathan Creek.

The landslide appears to consist of an upper rotational slide and a lower debris flow or planar slide. A well defined but erosion-modified scarp, several feet in height, has formed near the top of the slope with evidence of toe bulging and movement at the toe of the slope. This

primary scarp extends for over 200 ft. along the top of the slope. A second smaller scarp is present below the primary scarp. Evidence of previous slope movement has been reported with areas near the crest of the slope exhibiting several feet of subsidence.

A lower less-defined scarp is present at the base of the rotational portion of the landslide. The lower debris flow or planar portion of the landslide is below this lower scarp and exhibits evidence of saturation, springs, and more moisture than the upper rotational portion of the slide. Small trees on the lower slope face also show signs of creep-type movement in their curved trunks.

The mine tailings consist primarily of clayey sand with gravel, sandy clay, gravelly clay, and sandy silt to depths ranging from 28.5 ft. in boring B-4 to 58 ft. in boring B-2. Varying amounts of cobbles and boulders were encountered in most of the explorations. Andesite bedrock was encountered in borings B-1 through B-6 immediately below the fill material. Bedrock was encountered at a depth of 12.5 ft. below grade in TP-3 below native soils. Borings B-7 through B-9 located above the slide area and all other test pits did not penetrate to bedrock.

Groundwater was encountered in all soil borings and all but two of the test pits (located above the head scarp). Various potential slide planes were encountered in both the soil borings as well as the test pits that consisted of saturated, very soft, sandy clay or clayey sand zones. The interface between the bedrock and mine tailings was selected as the location of the slide plane for the stability analyses.

The landslide was modeled in a computer program and tested with combinations of grading activities to determine an acceptable design for stabilizing the landslide. Results of the computer simulations indicated the slopes that terminate in the uphill portions of the pre-existing landslide will need to be flatter.

A copy of this letter report is provided in Attachment A.

B1.31 BIOASSESSMENT MONITORING OF ACID MINE DRAINAGE IMPACTS IN STREAMS OF THE LEVIATHAN MINE WATERSHED: AN UPDATE FOR 2003 SURVEYS (HERBST, 2004B)

Bioassessment monitoring was performed in 2003 as part of a long-term monitoring program that began in 1995. This monitoring continues today by U.S. Environmental Protection Agency (U.S. EPA). The purpose of the monitoring program was to document seasonal and year-to-year changes and natural variability in the ecological health surrounding the Leviathan Mine Watershed. Benthic macro-invertebrates (bottom feeding fauna and insects) were collected from riffle habitats at six stations in June of 2003 and 3 central stations in September of 2003. These stations included Stations 2, 4, 5, 6, 7, and 8 which coincide with the surface water sampling locations. The species of benthic macro-invertebrates were identified and counted.

Data were analyzed using descriptive statistics and graphical contrasts among sites by season and time. The primary metrics used for interpreting community structure and biological integrity was based on measures of diversity, tolerance, density, and dominance.

Results of the continued bioassessment monitoring since 1995 continued to show "clear and consistent signals of progressive improvement in biological integrity on Aspen and Leviathan Creek below the mine". The sample locations on Bryant Creek downstream of Mountaineer Creek were noted to be "approaching the reference stream condition in several indicators including diversity and tolerance measures".

A copy of this document is provided in Attachment A.

B1.32 WATER QUALITY STUDY REPORT FOR THE NATURAL RESOURCE DAMAGE ASSESSMENT OF SURFACE WATER BELOW THE LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA AND DOUGLAS COUNTY, NEVADA (MARKIN AND YEE, 2006)

The report was not available for review. The following information was obtained from the project database which is described in Section B1.36.

Seven surface water stations (BRY, LEV, and Stations 1, 15, 23, 25, and 26) were monitored on June 13, 2002, and analyzed for pH, alkalinity, organic carbon, nutrients, and metals. No conclusions were provided in this report. Tabulated results from this investigation were obtained from the project database and are provided in Attachment A.

B1.33 SUMMARY OF MATERIAL TESTING AND OBSERVATION SERVICES, GEOTECHNICAL SLOPE STABILITY, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA (KLEINFELDER, 2006)

This letter report represents a completion report for the landslide stabilization activities that were performed in the Delta Area of the LCSA between June and August of 2005. The activities included grading the slope from a horizontal to vertical inclination of 2½:1 to 3½:1, constructing benches at regular intervals along the slope, installing trench drains to a depth of 10.5 ft. on the benches, and constructing a toe-buttress. The width of the benches were approximately 20 ft., with the exception of the first bench which was approximately 30 ft. wide. Trench drains for subsurface were constructed along the centerline of the benches, and connected to a main subsurface drain pipe placed along the northern side of the landslide.

A "highly competent dark gray andesite rock outcropping" at the site was mined, crushed, and processed for use as Type II aggregate base material. This material was placed around the storm drain pipes and as cover for the new section of roadway. It was recommended that regular inspection and maintenance should be performed to monitor the long-term global stability of the Delta Area.

A copy of this document is provided in Attachment A.

B1.34 PRECIPITATION DATA CONTAINED IN THE DATA QUALITY OBJECTIVE REPORT: REMEDIAL INVESTIGATION AND FEASIBILITY STUDY, LEVIATHAN MINE, ALPINE COUNTY (ATLANTIC RICHFIELD, 2008C)

The Data Quality Objectives (DQO) report included a review of precipitation data from the RWQCB weather station and concluded that this data collection was not complete in terms of daily precipitation totals with data missing during 22 of 42 months. Because of the short period of record for on-site data (2003-2006), other regional data sources were used to estimate rates of precipitation at the site. Using precipitation measurements from July 1948 through August 1990 at Markleeville, California, the estimates of precipitation at the site was modeled approximately 59 percent higher than the on-site measurements (2003-2006). The DQO report also estimated short-term (or extreme) precipitation events. Three tables presented in Attachment A summarize estimated precipitation using the PRISM model compared to other sources.

B1.35 ELECTRONIC SURFACE WATER DATA OBTAINED FROM OTHER SOURCES

In addition to the above documents, surface water data was collected during specific sample collection activities between 1998 and 2005. This data has been included in the document review and uploaded to the project database.

1. U.S. EPA continues to collect biota data each year from Aspen Creek, Leviathan Creek, and Bryant Creek.

2. The USGS collected flow data from Stations 16 and 24 during 40 sampling events from October 1998 through August 2002.

3. The USGS collected flow data from Station 26 during 5 events between February 1999 and June 2000.

4. The RWQCB collected surface water samples to evaluate the water quality from the Pond 4 Lime Treatment System (LTS). Data provided from June 2002 through September 2005.

5. Atlantic Richfield Early Response Action (ERA) influent and effluent water quality data from the Aspen Seep Bioreactor (ASB) from April 2003 through February 2005.

Electronic data from ongoing surface water investigations has also been included in the document review and is uploaded to the project database:

1. Ongoing data from the RWQCB. Data includes (1) comprehensive surface water quality monitoring data (monthly and semi-annual), (2) influent and effluent water quality and sludge data from the Biphasic Treatment System of Adit and pit underdrain (PUD) flows. Data provided since August 1984.

2. Ongoing data from Atlantic Richfield. Data includes (1) influent and effluent water quality and sludge data from the Pond 4 CUD/Delta Seep (DS) Treatment System and (2) influent and effluent water quality and sludge data from the ASB's Treatment System. Data provided since September 13, 2001.

3. Ongoing data from the Nevada Department of Environmental Protection which includes surface water sampling along the East Fork Carson River and Station 26. Data provided since January 1977.

4. Ongoing data from the Army Core of Engineers which includes measurements of pH, specific conductance, and temperature of surface water from 17 surface water stations. Data provided since June 2007.

In addition to the above documents, stream sediment data was collected by the RWQCB between 2002 and 2005. The RWQCB collected sediment samples to evaluate the efficiency of the Pond 4 LTS. Ongoing sediment data is currently being collected in the Pond 4 LTS. Both sources of electronic stream sediment data are periodically uploaded into the project database.

In addition to the above documents, ongoing groundwater quality data is being collected from MW-3 by the RWQCB. This information is periodically uploaded to the project database.

In February of 2003, the RWQCB began operating a weather station at the site at Pond 1. Measurements were collected on an hourly basis and included: time, temperature, humidity, wind speed, wind direction, wind run, wind chill factor, heat index, barometer readings, precipitation, and evapotranspiration. This information is periodically uploaded to the project database (at the time of this document, the database includes information through December 31, 2008).

B1.36 PROJECT DATABASE

The project database was first created by Burt Kilbourne of Atlantic Richfield on May 5, 1999. The database was initially managed by Montgomery Watson Harza (MWH) in 2002. MWH updated the database into Microsoft Access and added additional historical data at the site. The database was then transferred to EMC^2 in the fall of 2002 who managed new incoming data until 2007. Since 2007, the database has been managed by AMEC Geomatrix (AMEC).

The database includes data collected at the site between 1957 through the present. Detailed information from 36 sources has been incorporated into the database (32 previous investigations and 4 ongoing investigations). The number of data points from each of these sources has been organized by type and is presented on Table 40 of the Program Work Plan (PWP). Based on information obtained in October 2008, most of the information in the project database is surface water data (103,506), followed by stream sediment data (3,978), bioassessment data (2,910), groundwater data (2,786), soil data (1,776), and climate data (456). Additional data submitted to Atlantic Richfield has been updated in the database as appropriate.

B1.37 OTHER ENVIRONMENTAL DOCUMENTS

Other environmental documents have contributed to the understanding of impacts at the site but did not include the collection of new data. The following documents have been reviewed in the development of the PWP:

1. *Leviathan Mine Pollution Abatement Project, Design Report and Draft Environmental Impact Report, April 1983* (Brown and Caldwell, 1983);
2. *A History of the Leviathan Mine Pollution Abatement Project, Alpine County, California* (Taxer, et. al, 1991);
3. *Leviathan Mine 5-Year Workplan, Lahonton Regional Water Quality Control Board* (RWQCB, 1995a); and
4. *Leviathan Mine Site, Phase I Remedial Investigation/Feasibility Study Work Plan Draft, April 2002* (MWH, 2002).

These documents are summarized in the following subsections.

B1.37.1 Leviathan Mine Pollution Abatement Project, Design Report and Draft Environmental Impact Report, April 1983 (Brown and Caldwell, 1983)

Four alternatives were developed that fell into two categories: pollution source control and pollution discharge control. The pollution source control alternatives included up-gradient interception of the groundwater, interception of adit flow before contamination, clay or soil-cement seals and synthetic liners to prevent infiltration of contaminated or uncontaminated groundwater into the ground, and biochemical or chemical de-oxygenation of groundwater up-gradient of the site to inhibit the formation of sulfuric acid during water contact with sulfur-rich materials. Pollution discharge control alternatives included sealing the Adit, on-site chemical treatment of acid rock drainage (ARD), and exportation of ARD off site to evaporation/holding ponds in Nevada.

The "Recommended Project" was a pollution discharge control alternative which fit within the constraint limits of the available funds (at the time was 3.76 million). The Recommended Project included the following main activities:

1. Leviathan Creek Channelization;
2. Filling and Regrading the Pit;
3. Excavation and Regrading the Waste Dump;
4. Constructing On-Site Evaporation Ponds; and
5. Regrading and improving the drainage of Spoil Area A.

The Recommended Project was expected to reduce the annual mean TDS load concentration from the site by an estimated 79 percent. A copy of this document is provided within Attachment A. Also refer to Section B1.11.

B1.37.2 A History of the Leviathan Mine Pollution Abatement Project, Alpine County, California (Taxer, et. al, 1991)

This report documents the activities that were performed during the Pollution Abatement Plan from 1983 through 1985. In August 1983, construction began with the plan of implementing the recommended project as described in Brown and Caldwell (1983), however, additional activities were performed.

"Site conditions were much worse than anticipated. Acidic seeps and springs were found in many locations throughout the construction area. The channelization of Leviathan Creek had to be redesigned and elevated due to the seeps. The seeps below the channel were collected in a gravel underdrain and discharged directly to the creek (now referred to as the CUD). Site constraints made it impossible to allow discharge to an evaporation pond. Rainfall made the site unworkable due to the heavy mud produced from the tailings. The construction season had to end by November 15th for the two years of construction."

The settlement with Atlantic Richfield allowed for many improvements to the original design. Approximately 17,000 ft. of drainage ditches were changed to concrete from soil cement. A fifth evaporation pond was added (but only a total of 11.4 acres of ponds could be built due to limited stable areas at the site). Additional ARD seeps were captured and routed to the evaporation ponds. Additional funds were available so an intensive re-vegetation project was initiated.

Post-project water quality samples were collected to evaluate the effectiveness of the abatement activities. Based on graphs within the document, the downstream median

concentration of TDS decreased approximately 30%, substantially less than the anticipated post-project reduction of 79 percent. Based on the post-project water quality monitoring results, Leviathan Creek remained degraded after the implementation of the abatement activities. The sources of ongoing water quality problems were identified from three areas (1) uncontrolled springs and seeps, (2) evaporation pond overflows, and (3) erosion of tailings into the creek channel.

A copy of this document is provided in Attachment A.

B1.37.3 Leviathan Mine 5-Year Work Plan, Lahontan Regional Water Quality Control Board (RWQCB, 1995a)

This document outlines a five-year plan developed by the RWQCB for addressing the water quality issues that have remained at Leviathan Mine since the Leviathan Mine Pollution Abatement Project (PAP). It included additional details of the work completed for the PAP, described maintenance needs, and included a plan for monitoring the post-project water quality.

This document indicated that improvements were still needed to improve the water quality of Leviathan, Aspen, and Bryant Creeks. The RWQCB indicated that treating flows from the CUD and pond overflows in addition to controlling erosion would mitigate the impacts to the creeks.

A copy of this document is provided in Attachment A.

B1.37.4 Leviathan Mine Site, Phase I Remedial Investigation/Feasibility Study Work Plan Draft, April 2002 (MWH, 2002)

A work plan was prepared by MWH on behalf of Atlantic Richfield to implement a phased RI/FS including ERAs at the site in 2002. To avoid confusion with the PWP, the document will be referred to as the 2002 MWH work plan. While the 2002 MWH work plan outlined for the entire RI/FS process, the main objective of the document was to update the project database (which was completed and presented in Section 3.1.36). Once those tasks were completed, subsequent work plans were supposed to be prepared that would better characterize the site, fulfill data gaps, and evaluate appropriate long-term treatment technologies.

ATTACHMENT A

Excerpted Data from Previous Investigations (on CD-ROM)

LETTER TO THE RWQCB: REGARDING WATER SAMPLES COLLECTED FROM ASPEN AND LEVIATHAN CREEKS, PRE-OPEN PIT MINING

(White, 1952)

76148

N2

SFUND RECORDS CTR
76148

COPY

July 9, 1952

Mr. A. E. Millar
General Manager
Anaconda Copper Mining Co.,
P. O. Box 632
Yerington, Nevada

Dear Mr. Millar:

On June 25, 1952, samples of water for chemical testing were taken of two surface creek supplies in the area to the west of and adjacent to the Nevada-California line about 12 miles south of Gardnerville on U.S. #395.

One sample was from Aspen Creek above the proposed Anaconda site, water was clear, and colorless, tasteless, odorless, temperature was 52° F. The past winter was one of heavy snowfall, there was no direct flow from the surface to the stream, the ground surface was still damp, no snow, and only a small volume of sub-surface drainage to the stream. The creek appeared to be an excellent source for development as a domestic supply. pH by Helige comparator was 7.6 to 7.8.

Leviathin Creek was sampled. This water had no odor, it did have a yellowish color, and cloudy opaqueness, pH by Helige was 7.0 to 7.2. This sample was from a point directly below the bridge. There were trickles of surface water and bank seepage along this creek.

A second sample was taken downstream of the preceding sample. This sample had a Helige comparator pH of 7.0 to 7.2. At this point the creek volume was estimated at 10 to 12 c.f.s.

This sampling should be repeated at the time of lowest approximate flow in Leviathin Creek, probably in mid-September, again in November or December.

Yours very truly,

W. W. White, Director
Division of Public Health Engineering

www/h

CODE WHI-001

NEVADA DIVISION OF WILDLIFE STREAM SURVEY – BRYANT CREEK

(NDCNR, 1955)

NDW Stream Survey

76132

M1

SFUND RECORDS CTR
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BRYANT CREEK (Barney Riley Cr.)

Douglas County
September 19, 1955

INTRODUCTION

This stream has its source in California in Alpine County at an approximate elevation of 6,300 feet. Leviathan and Mountaineer Creeks join to form the initial flow of Bryant Creek. The entire length of stream lies in the Sierra Nevada Mountains. From the California line the stream flows over private property belonging to Brooks Park of Gardnerville, Indian Land, Taylor Grazing land, and part of the Toiyabe National Forest. At 5,100 feet that small flow of water which had not previously been diverted enters the East Fork of the Carson River. From two and one-half miles above the mouth of the creek, two miles of the stream bank have been burned over from a previous fire with intermittent bank erosion along this section.

The creek has a total length of 6.5 miles--3.9 miles in Nevada and 2.6 miles in California (see map). At the present time this stream has no fishable length. The average width of the creek was 4'8" and had an average depth of 3.0 inches.

Bryant Creek is located approximately eighteen road miles southeast of Gardnerville. An unimproved dirt road follows along most of the length of the stream and would be accessible to trucks. According to Brooks Park when trout were present in the creek there had never been any objection to fishermen fishing on the Park property which extends from the state line to one mile downstream.

WATER TYPE

Flow (Velocity and Volume)

The average velocity was 1.3 feet per second or slow. No velocity exceeded 1.6 or less than 1.1 feet per second.

The approximate volume of flow was 1.3 cubic feet per second. Minimum flow was recorded at 1.1 at sample area (c) with the maximum flow occurring at sample area (a) of 1.5 c.f.s. It was estimated that the incoming flows from Mountaineer and Leviathan Creeks were 0.80 c.f.s. and 0.70 c.f.s., respectively. Other than a

CODE NCR-002

few small seepage areas and springs no additional water was noted as flowing into the stream except from Dowd Creek which had an inflow to Bryant Creek of approximately 0.30 c.f.s. Directly below the Dowd Creek confluence most of the water was diverted into an irrigation ditch. Additional seepage areas below the diversion, probably escape water from the ditch, caused an influx in flow.

Mr. Park stated that 1934 was an exceptionally dry year with 1955 considered as a fairly dry year for volume flow.

Temperatures --

The following air and water temperatures were recorded at the shocking section on July 12, 1955 and at the sample areas on September 19, 1955.

July 12th			
S.S. I	11:00 a.m.	air 72.0°F	water 53.0°F
S.S. II	11:30 a.m.	73.0	61.5
S.S. III	12:00 noon	75.0	62.5
S.S. IV	12:45 p.m.	78.0	72.5
S.S. V	1:15 p.m.	80.5	74.0
September 19th			
S.A. (a)	12:00 noon	50.0	46.5
S.A. (b)	2:30 p.m.	56.0	61.0
S.A. (c)	4:30 p.m.	56.0	61.0

Turbidity --

At sample areas (a) and (b) the water was slightly cloudy. According to Mr. Park when the stream has an increased flow he has noticed that the water tends to increase in cloudiness to the point of becoming milky at times. This is probably the result of the flow from Leviathan Creek percolating through the mine dumps. These dumps are a direct result of Anaconda's open pit sulphur mine above, which has used the canyon as a convenient dumping ground without taking the necessary precautions to keep the water clean. Mr. Park added that the cloudy condition of the creek as it exists today was not present prior to the mining in Leviathan Canyon by Anaconda. Only occasionally did water from the old Leviathan mine tunnel flow into the creek.

Pools and Riffles --

Pools varied from fair to poor in number. Pools at the upper elevation were

4

fair to poor in quality; those at the central elevation from fair to good; and those at the lower elevation generally fair with pools up to twenty inches deep.

Much of the creek can be considered as being made up of riffle areas.

Chemical Analyses --

The pH values for sample area (a), (b), and (c), were 7.6, 7.7, and 7.3, respectively. At sample area (b) the water was tested for carbonates and bicarbonates. No carbonates were present but bicarbonates tested at 48.0 parts per million. Also a water sample was collected on Leviathan Creek directly above its confluence with Mountaineer Creek. This water sample was taken into the office of the State Food and Drug Laboratory at Reno for analysis. Chlorides were represented in the sample at 12 parts per million and sulphates at 691 p.p.m. A deposition of what appears to be an iron compound was prevalent over the entire bottom of the stream bed.

BOTTOM TYPES

The bottom was dominantly rocks and rubble with rocks comprising from 30 to 40% of the bottom and similar for rubble. It was estimated that gravel made up 10% of the stream bed with sand making up 5 to 20% and mud 5 to 10%. As mentioned in the preceding paragraph, an orange or rust deposition covered the entire stream bed which appeared to be an iron compound. At the upper elevation a very dense covering persisted with a much lighter deposition below.

VEGETATION TYPES AND ABUNDANCE

Aquatic Vegetation

Algae were present on some rocks but not abundant. Some of those present as determined by Francis Druet were Stigeoclonium tenue, Ulothrix zonata, Prasiola spp. Oedogonium spp., and diatoms. Water crowfoot was dense along some sections at the lower elevation with horsetail present.

Bank Vegetation.

The dominant type of vegetation at the upper elevation was choke-cherry with numerous rosebrush and willows present. Choke-cherry, willows and rosebrush were

were the dominant types of vegetation at the central elevation, and sagebrush and rabbit brush dominant along the burned over area. Willows, alders, and cottonwoods were frequent along some sections at the lower elevation. Other plants present along the creek were pinions, mountain mahogany, juniper, jeffrey pines, service berry, desert peach, snow bush, bitterbrush, grasses, mullen and other herbaceous plants.

COVER

At the upper elevation some sections were open or partially open with about an even number of sections with dense cover from bank vegetation. Choke-cherry offered the greatest amount of cover. Rocks offered fair cover along potholes or small pools. Much of the stream was open at the central and lower elevations with alders and cottonwoods occasionally offering overhead cover. Willows and rosebrush intermittently afforded close cover over the water. Along the open areas rocks and a few boulders afforded the only major type of cover.

SPAWNING CONDITIONS

Spawning sites were considered as poor primarily due to the deposition of the iron compound and the adherence of the bottom material. Gravel did not appear abundant at any one location in the stream bed.

ANIMAL TYPES AND ABUNDANCE

Food abundance along the stream varied from poor to good. Along most sections available food was considered as poor. The following small aquatic animals were found to be present: Insects--blackfly larvae, fair to poor; mayfly nymphs, poor; elmid larvae, poor; adult dytiscid and elmid beetles, poor; water striders, fair to poor; caddisfly larvae (5 species), poor to excellent; water pennies, poor; damselfly nymphs, poor. Gastropods--snails, fair to poor.

Fish — On July 12th five shocking sections were set up along the creek which varied in length from 100 to 190 feet. Shocking efficiency was considered as good for all sections. No fish were shocked at any of the sections.

Mr. Park said that he wasn't aware of any plantings made in the creek during

the past years; however, he does recall fishing the creek thirty-five years ago with his parents. At that time he had good success catching trout at the old Barney Riley place. No recent records are available indicating planting of trout on this stream.

DIVERSIONS AND WATER USES

There are two diversions on Bryant Creek. One located approximately 1.4 miles above the river and the other one-tenth mile above the river. Both are used for irrigating pastures and fields. Both diversion points have dirt and rock-fills across the stream, but the upper diversion also has a forty-two inch cement diversion box. Water rights to this creek belong to Mr. Park with the exception of domestic water use for the Anaconda Copper Mining Company.

POLLUTION

Chemical pollution of the stream was present resulting from water percolating through and over the Anaconda mine dumps. According to Thomas Trelease, Brooks Parks and others, serious pollution resulted not only to the creek but to the East Fork of the Carson River several years ago which caused trout mortality and possibly the death of livestock.

RATING TO KEY STREAM

The key stream is Clear Creek with a rating of Three. This creek has been given a temporary rating of Five.

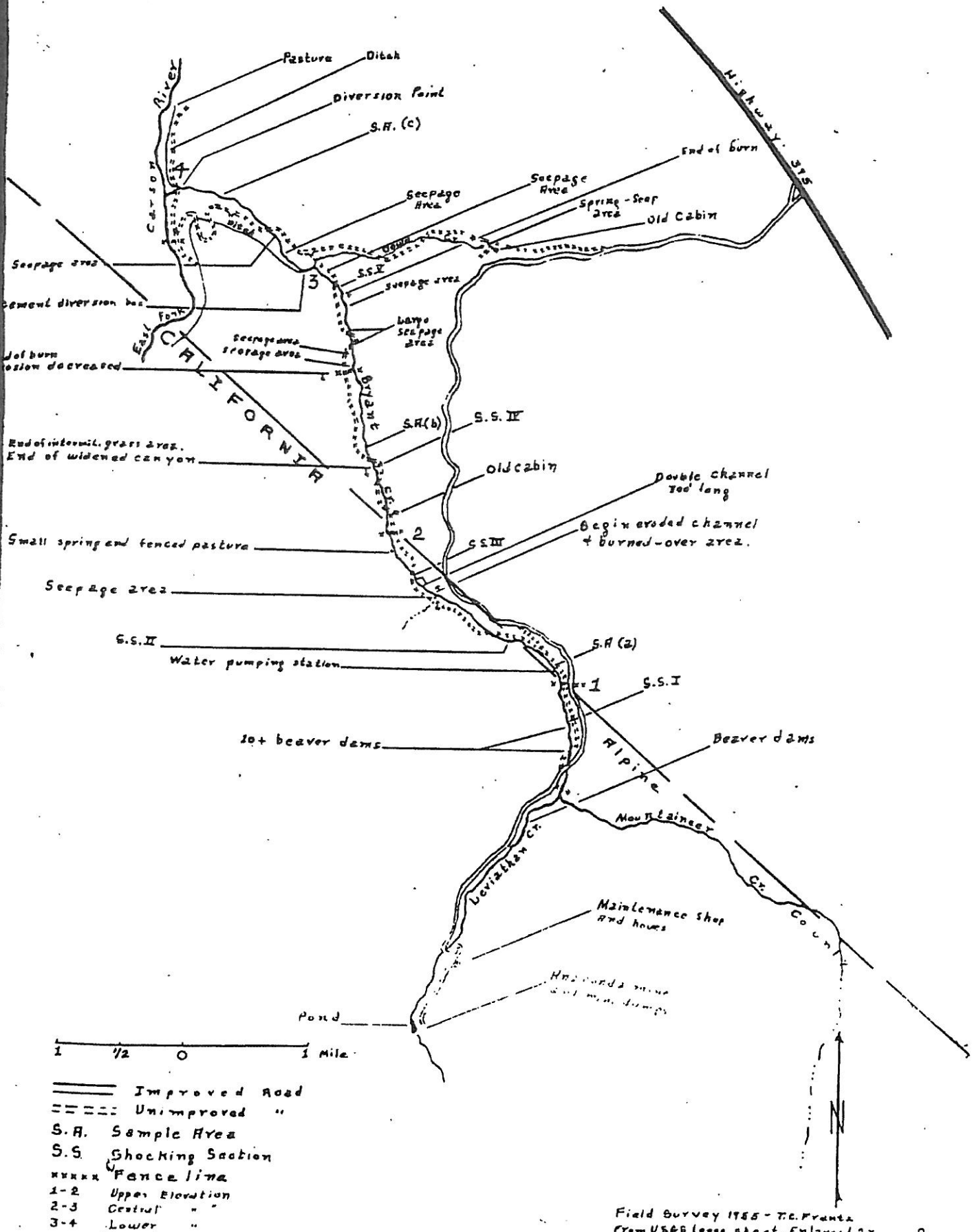
RECOMMENDATIONS

1. That Anaconda Copper Mining Company install a culvert under the mine dumps in Leviathan Canyon to reduce chemical pollution of Bryant Creek.

s/TCFrantz

Text . . . . . 5 sheets
Survey Sheets. . . 3 sheets
Map . . . . . 1 sheet
Photographs. . . . 2 sheets
Photo. addendum. . 1 sheet

BRYANT CREEK
Douglas County



Field Survey 1955 - T.C. Frantz
From USGS topog sheet. Enlarged 2x

Bryant Cr.--Douglas Co.

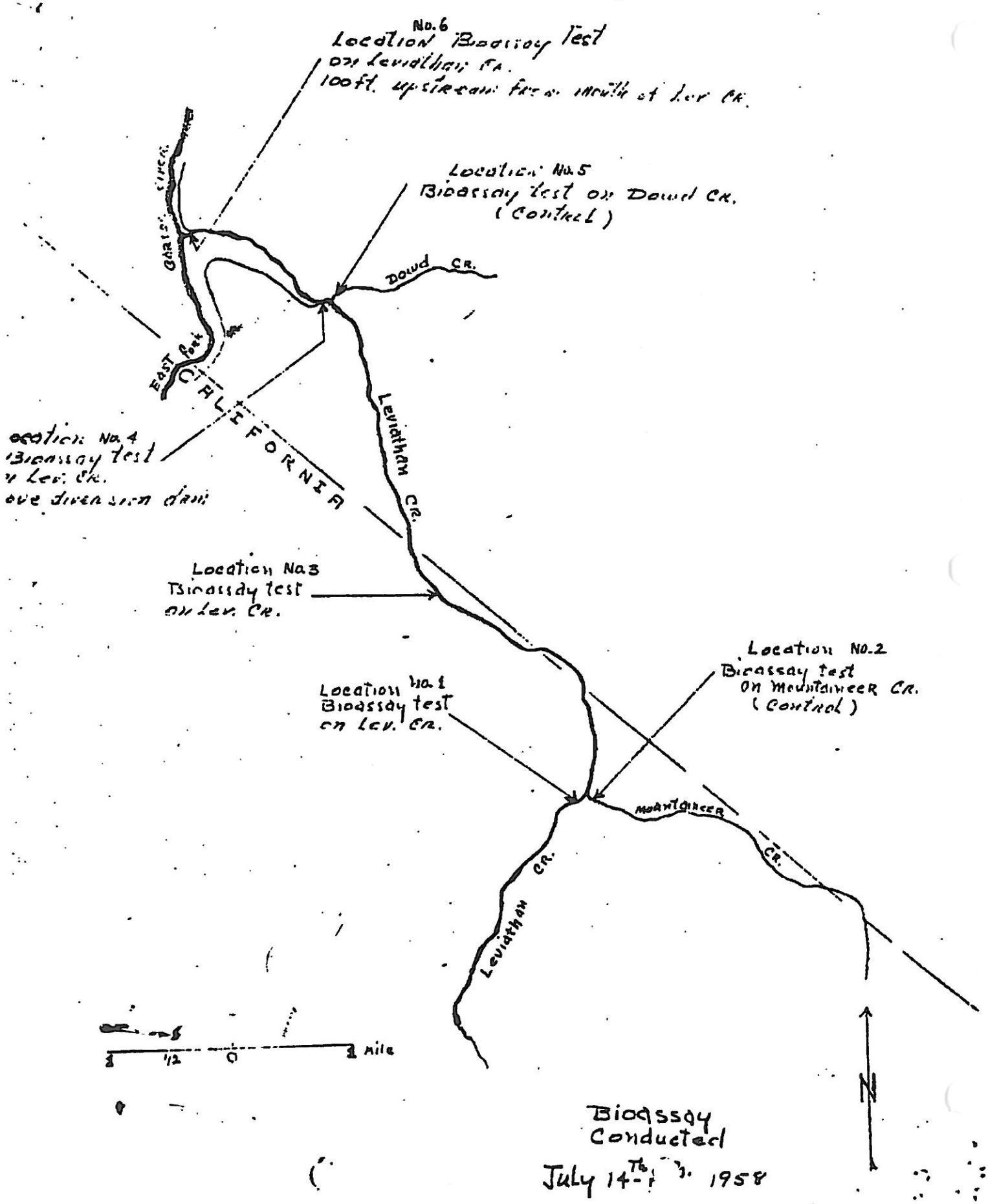
ADDENDUM

The following past planting record has been located in one of the files.

Date	Species	Average Size	No. Planted
1951	Brook	1" - 1½"	1,000

(Coli, 1958)

LEVIATHAN CR.
BIOASSAY



Bioassay
Conducted
July 14-[illegible] 1958

LEVIATHAN CRK. TEST FISH ---- 3" RAINBOW TROUT

Refer to map Location of bioassay	Test no.	No. of test fish	Crk. water temp. start of test	Crk. water temp. end of test	Time of death half of fish	Time of death all of fish	% Survival 24 hrs.	% Survival 48 hrs.	1958 Date test started
Leviathan creek	1	8	62°F.	64°F.	20 min.	25 min.	0	0	7/14
Leviathan creek	3	8	64°F.	67°F.	——	135 min.	0	0	7/14
Leviathan creek	4	8	64°F.	74°F.	135 min.	160 min.	0	0	7/14
Leviathan creek	6	8	60°F.	73°F.	145 min.	170 min.	0	0	7/16
Control tests									
Mountaineer creek	2	8	60°F.	62°F.	——	——	100 %	100 %	7/14
Dowd creek	5	8	67°F.	76°F.	——	——	100 %	100 %	7/14

LEVIATHAN CREEK WATER QUALITY SAMPLE RESULTS

(Reinke, 1958)

CHEMICAL ANALYSES

Leviathan Creek Samples
Collected September 27, 1957
Bureau of Sanitary Engineering

	Sampling Points				
	Road Crossing Above Mine	Weir at Pond Outlet	Pond Outlet Above Confl. Mountainsor Creek	Irrigation Diversion Brooks Ranch	Road Crossing Above Confl. Carson River
pH	7.5	2.9	3.1	7.6	5.1
Total Solids (mg/l)	147	5123	1616	381	686
Specific Conductance (micromhos/cm at 25°C)	148	10,800	2950	518	1040
Color (True APHA units)	10	75?	20	5	4
(Apparent APHA units)	20	>100	>100	>100	15
Turbidity (mg/l as SiO_2)	9	115	260	75	24
Acidity (Mineral mg/l $CaCO_3$)	---	466	114	---	---
(Total mg/l $CaCO_3$)	4.0	1360	235	2.3	8.9
Alkalinity (mg/l $CaCO_3$)	64.3	---	---	56.6	---
Hardness (mg/l $CaCO_3$)	50.5	1621	745	189	306
(All anions and cations reported in mg/l)					
Chloride	1.8	2.4	2.2	2.8	4.5
Sulfate	6.2	3170	994	155	389
Aluminum	0.0	0.87	0.16	0.03	0.03
Boron	0.023	0.27	0.060	0.023	0.045
Calcium	13.9	470	210	48.4	83.4
Magnesium	3.8	109	53.5	16.5	23.7
Copper	0.18	0.0	0.66	0.40	0.10
Iron	0.40	445	53	5.0	0.58
Manganese	<0.05	22.8	8.0	0.92	<0.05
Sodium	8.8	29.0	10.2	11.0	35.9
Potassium	4.3	20	7.9	5.6	8.8
Zinc	0.45	1.5	0.6	0.0	0.45
Fluoride	0.14	5.6	1.36	0.3	0.5
% Sodium	25.3	3.69	2.84	10.9	19.8

REPORT ON POLLUTION OF LEVIATHAN CREEK CAUSED BY LEVIATHAN MINE

(RWQCB, 1968)

76163

N9

SFUND RECORDS CTR
76163

State of California

The Resources Agency
State Water Resource Control Board

LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

Report on Pollution

of

LEVIATHAN CREEK

Caused By

LEVIATHAN MINE

November 25, 1968

C O N T E N T S

LEVIATHAN CREEK DESCRIPTION AND USES - - - - - - 1

LEVIATHAN MINE HISTORY - - - - - - - - - - - - - - 1

VIOLATION OF WASTE DISCHARGE REQUIREMENTS- - - - 4

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LEVIATHAN CREEK DESCRIPTION AND USES

Leviathan Creek, located in Alpine County, is a small mountain stream tributary to Bryant Creek which is a California-Nevada interstate water. Leviathan Creek enters Bryant Creek in California. Bryant Creek then flows approximately one mile prior to entering the State of Nevada. It then flows into the East Fork Carson River.

At present there are no fish or aquatic life in Bryant Creek below the entrance of Leviathan Creek or in Leviathan Creek below Leviathan Mine. Evidence indicates that fish were present in Leviathan Creek and Bryant Creek prior to the re-opening of the mine by Anaconda Company in 1952. Although no concrete evidence is available of the fish life in the stream, there are many persons who are willing to testify that they did catch fish from the streams prior to 1952.

There is reason to believe that Leviathan Creek historically has been acidic in nature because of the mineral deposits in the watershed and because of stories told of using the creek water to shine pennies. It appears, however, that the creek did at that time support fish life.

For many years Mr. Brooks Park has diverted Bryant Creek to irrigate his River Ranch property. At times during the summer months the entire flow of the stream is diverted to irrigate Mr. Park's summer pasture. The diversion is within the State of Nevada and the irrigated lands are located both in California and Nevada.

Two sources of water are available to Mr. Park for irrigation of the River Ranch property. The area irrigated with spring water shows a much more luxurious growth than that irrigated with water diverted from Bryant Creek. It can be proven that the Leviathan Mine drainage does have a definite adverse affect upon the soil and vegitation of the River Ranch property.

LEVIATHAN MINE HISTORY

The Leviathan Sulphur Mine was originally opened in the early 1900's, operated during WWI, and closed sometime shortly afterwards. It was activated again from 1935 to about 1939 and then was inactive until 1951.

The entire area is dotted with small springs which flow through the ore body, picking up high concentrations of sulphates. When these waters are exposed to the atmosphere, sulphuric acid is formed. The waters then flow into Leviathan Creek and have for many years created a condition detrimental to fish life and adverse to irrigation uses.

In 1952 a fish kill occurred on the Carson River. This was caused by the opening of an old mine shaft which had accumulated a large quantity of acid water from seepage.

In 1953 the Anaconda Company began removing high grade sulphur ore by stripping off the overlying deposits for open pit mining rather than by underground mining as had been done earlier. Much of the overburden removed was deposited into Leviathan Canyon causing the waters of Leviathan Creek to seep through this tailing dump and thus become polluted with sulphates, iron, and other minerals. The stripping of the overburden coupled with the seepage from springs flowing from the ore body increased the amount of sulphuric acid in the stream and eliminated all life in the creek bed. The high iron and sulphate concentrations became detrimental to crops irrigated with this water downstream.

In May of 1956 arrangements were made to begin a monitoring program on Leviathan Creek. Monthly samples were taken at from two to seven stations by the Anaconda Company through November 1962.

The Anaconda Company attempted to decrease the pollution of Leviathan Creek in various ways. One method was to divert the waters of Leviathan Creek around the overburden dump in an impervious ditch to eliminate the leaching of creek waters through the tailings. This never proved entirely satisfactory because high flows during the spring months would wash out the diversion ditch. The company also experimented with disposing of the mine seepage in injection wells but was not successful.

A partial treatment was affected by trapping the mine seepage in a large pond below the tailing pile and diverting the flow to a smaller pond where lime was added to raise the pH and precipitate some of the iron before it was released to the creek. Under normal conditions the company impounded this water during the summer and released it a little at a time at the end of the mining season. In November 1959 the pond dike broke releasing the entire contents to Leviathan Creek and thence to the Carson River. Approximately 10,000 fish were killed on about 10 miles of the Carson River in Nevada. The Anaconda Company paid the Nevada Department of Fish and Game $4,000 for damages.

On November 19, 1962 the Anaconda Company sold the Leviathan Mine property to Mr. Chris Mann and Associates. Before selling the mine, the company installed an 8" plastic pipe in place of the ditch to carry Leviathan Creek water around the tailing dump.

They also tried unsuccessfully to seal a mine shaft, and they converted some of the exposed ore with waste material.

On November 28, 1962 Mr Mann submitted a report on waste discharge to the Lahontan Regional Board, and on December 20 discharge requirements by Resolution 62-12 were adopted by the Board. By May of 1963 it was found that the 8" pipe headworks were washed out and the discharge was violating the requirements of Resolution 62-12. In July it was noted that the diversion structure was replaced and seepage from the mine shafts was being diverted for land disposal. In August, samples taken showed a violation still occurring, and Mr. Mann stated he couldn't afford to meet the requirements.

The Lahontan Regional Board held a Cease and Desist Hearing on December 5, 1963 which was continued to the meeting of March 20, 1964. On that date a Cease and Desist Order was issued to Mr. William Chris Mann and Associates by Board Resolution 64-3. The mine owner was given 180 days to correct the situation and was to report on his compliance at the Board's meeting in September. At the September meeting Mr. Mann requested a one year extension to complete the work and was granted a 6 month extension. At the end of the 6 month period another 6 month extension was granted.

At a meeting of the Lahontan Regional Board held on September 21, 1965 the staff reported to the Board on the progress of the work by Mr. Mann to reduce the pollution of Leviathan Creek. A concrete dam had been built above the tailings and the 8" pipe had been relocated to divert the creek around the tailings. An attempt had also been made to divert the shaft drainage away from the creek. However, monthly samples taken during the spring and summer showed that the waters in the creek below the mine had a pH ranging from 3 to 5. The staff recommended to the Board that the matter be referred to the District Attorney of Alpine County for prosecution, and the Board passed a motion to such effect.

Shortly thereafter it was found that a company was interested in purchasing the mine from Mr. Mann and placing the mine back into operation. So as not co complicate the sale of the property the Regional Board staff did not refer the matter to the District Attorney at that time. The sale was not consummated, and the Regional Board then began preparing to present the matter to the District Attorney of Alpine County for prosecution.

It was then learned that the U.S. Borax and Chemical Company was considering purchase of the mine. The Regional Board staff contacted U.S. Borax and explained to them the water pollution problems involved. The Borax Corporation conducted extensive exploratory work over a period of approximately one year. On November 18, 1968 the Regional Board learned that U.S. Borax would probably not purchase the mine, and it appears at this time that Mr. Chris Mann and Associates will continue as the mine owner.

VIOLATION OF WASTE DISCHARGE REQUIREMENTS

Waste discharge requirements were established for the Leviathan Mine by the Lahontan Regional Board in Resolution 62-12 on December 20, 1962. The resolution requires that: (1) the waters of Leviathan Creek shall not have a pH of less than 6.5 or more than 8.5 by reason of any waste water resulting from the mining operation, past or present; (2) the sulphate (SO_4) content in the waters of Leviathan Creek, as measured at the 10x10 culvert just below the mine, shall not exceed 250 ppm by reason of any waste water resulting from the mining operation, past or present; and (3) waste water resulting from the mine shall not contain materials of such nature or in such concentrations as to render the receiving waters deleterious to present beneficial uses.

Analysis of samples taken in Leviathan Creek just below the mine at the 10x10 culvert from 1963 through 1965 gave the following results:

Indicator	Range	Number of Samples
pH	2.8-7.4	24
SO_4 (ppm)	8.4-500	25
Fe (ppm)	4.92-61	5

Of the 24 samples tested for pH, the results showed that 18 or 75% had a pH below 6.5. The sulphate test results showed that 16 of the 25 samples or 65% had SO_4 concentrations greater than 250 ppm. Investigation has shown that a crop of hay and wild oats irrigated with the waters of Leviathan Creek is stunted in growth when compared with a similar crop grown under equal conditions but irrigated with water from another source. All three requirements were being violated during this period. The conditions now existing are worse than that found during the sampling period.

WATER QUALITY UPSTREAM FROM MINE

Analysis of samples taken in Leviathan Creek just above the mine from 1955 through 1965 gave the following range of results:

Indicator	Range	Number of Samples
pH	6.9-8.4	14
SO_4 (ppm)	3.3-29	14
Fe (ppm)	0.08-2.0	5

These results show that the water above the mine is not polluted and is of excellent quality for irrigation and for fish life propogation. These results also conclusively show that degredation of the waters of Leviathan Creek occurs in the vicinity of the mine and is a direct result of the mine.

PROBLEM AS IT EXISTS TODAY

The pollution problem that now exists is definitely in violation of the Waste Discharge Requirements established by the Regional Board. The Cease and Desist Order issued by the Regional Board is not being met. The pollution problem will not alleviate itself for possibly hundreds of years. The pollution can be greatly reduced by water diversions and by covering exposed acidic materials. The pollution could be completely corrected by proper treatment of the acid drainage water in conjunction with water diversion and covering. The cost of water treatment is likely prohibitive, however it is felt that Leviathan Creek could be made acceptable as a source of irrigation water without treatment and likely within economic reason.

RECENT DEVELOPMENTS

On November 22, 1968 a meeting was held at South Lake Tahoe at the request of Mr. Park and the Nevada State Health Department. The following persons were present:

Ernest Gregory - Chief, Bureau of Environmental Health, Nevada State Division of Health

Robert Grayson - Attorney, Nevada Attorney General's Office

Brooks Park - Rancher, user of Leviathan Creek water

Paul Lamboley - Attorney for Mr. Park, Woodburn, Forman, Blakey, Folsom, and Hug

Mr. Armstrong - C.P.A. for Mr. Park

Paul Bonderson - Chief, Division of Water Quality, California Water Resources Control Board

Gavin Craig - Chief, Legal Division, California Water Resources Control Board

John Leggett - Executive Officer, Lahontan Regional Water Quality Control Board

Fred McLaren - Engineer, Lahontan Regional Water Quality Control Board

The legal council for Mr. Park has written letters to nearly all agencies involved with the Leviathan Mine pollution problem, including the Federal Water Pollution Control Administration. The letters ask that steps be taken immediately to alleviate the problem. The State of California must act now to seek a solution since a California-Nevada interstate water is involved and is being polluted from a source in California.

The meeting was called to decide what the next steps should be and the following decisions were reached:

1. The Lahontan Regional Water Quality Control Board will immediately refer the matter to the District Attorney of Alpine County for legal action.

2. The State of California will attempt to get the Assistance of an expert in the field of acid mine drainage to review the problem and make recommendations for a solution.

3. The State of California will investigate the possibility of Federal or State funds being available to assist in correcting the problem. (Mr. Bonderson stated that to his best knowledge no such funds were available from any source.)

4. A letter will be sent from the Lahontan Regional Board to Anaconda Corp. asking for any information they may have that could be of assistance and asking that they directly assist in solving the problem.

5. The Lahontan Regional Board will keep the Nevada Division of Health and Mr. Park informed of all developments by submitting status reports.

It was generally agreed that further delays in finding a solution to the problem could not be tolerated.

RESOLUTION 62-12

Waste Discharge Requirements
LEVIATHAN SULPHUR MINE
Alpine County

WHEREAS on December 3, 1962 Mr. William Chris Mann, owner of the property on which the Leviathan Sulphur Mine is located, did file, in compliance with Section 13054 of the Water Code of the State of California, a report on waste discharge for any waste waters which might occur as a result of this mining operation, and

WHEREAS said Leviathan Sulphur Mine is located on Leviathan Creek in the County of Alpine, and

WHEREAS the Board has caused the staff of the Board, the Alpine County Health Department, the State Department of Public Health, the State Department of Water Resources, and the State Department of Fish and Game to investigate the aforesaid waste discharge, and

WHEREAS these agencies have completed their studies and made recommendations, and

WHEREAS the staff of the Board in the course of investigation has submitted the following findings to the Board:

(a) The Leviathan Sulphur Mine, located in the South 1/2 of Section 15, R21E, T10N, MDB&M, is no longer in operation.

(b) The Anaconda Company previously owned and operated this mine as an open pit mine, placing a tremendous amount of overburden in the stream channel. Prior to their purchase of the mine two shafts were sunk horizontally into the hillside.

(c) Considerable mine drainage occurred from the two shafts and water trapped by the overburden percolated through the overburden. Both the mine drainage and the seepage from the overburden had extremely low pH values.

(d) While operating the mine the Anaconda Company treated both these waste discharges prior to their entering Leviathan Creek.

(e) Prior to selling, the Anaconda Company sealed both mine shafts and constructed an 8" inside diameter pipeline to carry any waters in the upper Leviathan Creek around the overburden so as to eliminate seepage through the overburden.

(f) The new owner, Mr. Chris Mann, is well aware of the potential pollution problems and has agreed to adequately maintain the pipeline.

(g) The waters of Leviathan Creek are diverted just above Dowd for irrigation of Meadow Hay by a rancher in the State of Nevada. Said diversion takes all the water in Leviathan Creek during the summer months, June through October.

(h) Leviathan Creek has not been a fisheries resource for years, however the East Fork of the Carson River, of which Leviathan Creek is a tributary, does provide good trout fishing and a good habitat for fish; now therefore be it

RESOLVED that after review of the findings of its staff, the Alpine County Health Department, the State Department, the State Department of Public Health, the State Department of Water Resources, and the State Department of Fish and Game, the Board does hereby establish the following requirements:

1. The sulphate (SO_4) content in the waters of Leviathan Creek, as measured at the 10 x 10 culvert, shall not exceed 250 ppm by reason of any waste waters resulting from this mining operation, past or present.

2. The waters of Leviathan Creek shall not have a pH reading less than 6.5 nor more than 8.5 by reason of any waste water resulting from this mining operation, past or present.

3. Waste water resulting from this mine shall not contain materials of such nature, or in such concentrations as to render the receiving waters deleterious to present beneficial uses.

4. A monitoring program having the approval of this Board shall be established by the discharger, and be it

FURTHER RESOLVED that the above requirements may be revised from time to time as changes in conditions make it necessary, and be it

FURTHER RESOLVED that a certified copy of this resolution shall be forwarded by mail to Mr. William Chris Mann and to such other agencies or persons who may have need thereof or who may request same.

Passed and adopted by the Lahontan Regional Water Pollution Control Board No. 6 at a regular meeting of said Board held on December 20, 1962, by the following votes:

AYES:

C. A. Scholl, Chairman
Cecil Edmunds
Victor H. Hough, M.D.
Gale O. Kenyon
Wm. A. Alpers

ABSENT:

Richard S. Armstrong
John M. Bernard

ATTEST:

J. T. Leggett
Executive Officer

RESOLUTION 64-3

Cease and Desist Order

LEVIATHAN SULPHUR MINE
Alpine County

WHEREAS the Lahontan Regional Water Pollution Control Board on December 20, 1962 approved Resolution 62-12 establishing discharge requirements for waste waters draining from the Leviathan Sulphur Mine in Alpine County, and

WHEREAS a copy of Resolution 62-12 was mailed to Mr. William Chris Mann, owner of the Leviathan Sulphur Mine, on January 4, 1963, and

WHEREAS on July 22, 1963 a letter was received by this office filing a complaint on behalf of Mr. Brooks Park, a resident of the State of Nevada, who uses the Leviathan Creek waters for irrigation of meadow hay, and

WHEREAS investigations by the staff of this Board and the Bureau of Sanitary Engineering, did establish the following facts:

1. Water samples taken from Leviathan Creek at the 10 x 10 box culvert, and analyzed for pH, Sulphate (SO_4), and total iron (Fe), had the following results:

	5/9/63	8/14/63	9/13/63	9/19/63	10/9/63
pH	5.9	3.6	3.9	4.0	4.1
SO_4	132 ppm	374 ppm	325 ppm	312 ppm	302 ppm
Fe	--	4.92 ppm	33 ppm	61 ppm	28 ppm

2. Analyses of water samples from seepage waters of the Leviathan Mine established pH values as low as 1.9, concentrations of Sulphates (SO_4) as high as 7,835 ppm, and concentrations of Total Iron (Fe), as high as 3,352 ppm.

3. No other water draining into Leviathan Creek was found to have a pH value below 6.5 or a Sulphate content greater than 250 ppm, and

WHEREAS the results of these investigations show that the Sulphate concentration in Leviathan Creek at the 10 x 10 box culvert has been in excess of the 250 ppm limitation established in Requirement #1; the pH of Leviathan Creek waters were lower than the 6.5 established in Requirement #2; and under this condition the use of Leviathan Creek waters for the irrigation of meadow hay is of questionable value, and

WHEREAS it is the opinion of the staff of this Board that these investigations have clearly shown that the change in quality of Leviathan Creek water, as measured at the 10 x 10 culvert, is in fact a result of the drainage from the Leviathan Mine, and therefore in direct violation of the requirements established in Resolution 62-12, and

WHEREAS it is the recommendation of the staff of this Board that a cease and desist order be issued, and

WHEREAS Mr. Wm. Chris Mann & Associates, owners of the Leviathan Sulphur Mine, were notified by mail on November 18, 1963 that a cease and disist action would be considered at a meeting to be held on December 5, 1963, and

WHEREAS on December 5, 1963 consideration of the issuance of the cease and desist order was continued until March 20, 1964; now therefore be it

RESOLVED that the Lahontan Regional Water Pollution Control Board, after reviewing the findings of its staff, and the comments of the various interested agencies, and having heard all interested parties present and desiring to be heard, finds that Mr. Wm. Chris Mann & Associates, owners of the Leviathan Sulphur Mine, have permitted waste water from the Leviathan Sulphur Mine to drain into Leviathan Creek in violation of discharge requirements #1-2-3 of Resolution 62-12, and be it

FURTHER RESOLVED that Mr. Wm. Chris Mann & Associates are hereby ordered to cease and desist such violation of discharge requirements and are hereby ordered to comply forthwith with said requirements established in Resolution 62-12 as approved on December 20, 1962, and be it

FURTHER RESOLVED that forthwith mentioned above means to comply within 180 days of the adoption of this resolution, and be it

FURTHER RESOLVED that in the event of failure of Mr. Wm. Chris Mann & Associates to comply with the requirements of this cease and desist order, the facts showing non-compliance shall be certified to the District Attorney of Alpine County pursuant to Section 13063 of the Water Code of the State of California, and be it

FURTHER RESOLVED that the Executive Officer of this Board is hereby authorized and directed to certify and transmit a copy of this resolution by certified mail, with receipt requested, to Mr. Wm. Chris Mann & Associates.

Passed and adopted by the Lahontan Regional Water Pollution Control Board No. 6 on March 20, 1964, st a regular meeting of said Board, by the following votes:

AYES:

C. A. Scholl, Chairman
Victor H. Hough, M.D.
Wm. A. Alpers
John M. Bernard

ABSENT:

Gale O. Kenyon
Richard S. Armstrong

ATTEST:

J. T. Leggett
Executive Officer

EXCERPT OF MINUTES OF 62ND REGULAR MEETING
OF
LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

September 21, 1965

Leviathan Mine - Alpine County

The Executive Officer presented a memorandum to the Board outlining the history of the sulphur drainage problem from the Leviathan Mine into Leviathan Creek, the resulting cease and desist order that was issued by the Board on March 20, 1964, and the progress made to date by Wm. Chris Mann & Associates, owners of the mine, on correction of the problem since the issuance of the order. The Board was informed that although considerable progress has been made towards correction the requirements established by the Board are still not being met, and that Mr. Brooks Park, a rancher who uses the Leviathan Creek water for irrigation of pasture land, is insisting that the owners of the mine be directed to comply with the requirements of the Board. The Executive Officer stated it was his opinion that since it has been eighteen months since the issuance of the cease and desist order, several extensions of time having been granted, and the terms of the order have not as yet been met, the matter should be placed in the hands of the District Attorney for further action.

Mr. Neel, Co-owner of the Leviathan Mine, stated that although the problem may not be resolved, a considerable amount of money and time has been spent in attempting to do so, and that it was felt a considerable amount of progress towards correction has been made. He also stated that everything possible has been done with the amount of money available, and that it was felt the only possible means now of solving the problem to the satisfaction of Mr. Park would be to treat the water, which would be too costly unless the assets of the mine could be liquidated. He informed the Board that his company has three proposals pending to accomplish this, but that placing the matter in the hands of the District Attorney would nullify these possibilities. He therefore requested a further extension of time to allow his company to consummate a transaction for the extraction of sulphur from the mine in order that a revenue would be forthcoming to allow them to continue in their attempt to resolve the problem, by possibly treating the water.

It was the consensus of opinion of the Board that in view of Mr. Park's insistence that compliance with the requirements of the Board be accomplished immediately, no further extension of time should be granted to Wm. Chris Mann & Associates on the cease and desist order now in effect.

A motion was made by Mr. Longo, and seconded by Mr. Kenyon, to certify to the District Attorney of Alpine County the facts showing non-compliance with the cease and desist order outlined in the Board's Resolution 64-3 issued to Wm. Chris Mann & Associates on March 20, 1964, pursuant to Section 13063 of the Water Code of the State of California. MOTION CARRIED.

LETTER: TRANSMIT RWQCB MEETING MINUTES; FISH AND GAME REPORT [STERLING P. DAVIS, 1969]

(Leggett, 1969)

TABLE 1

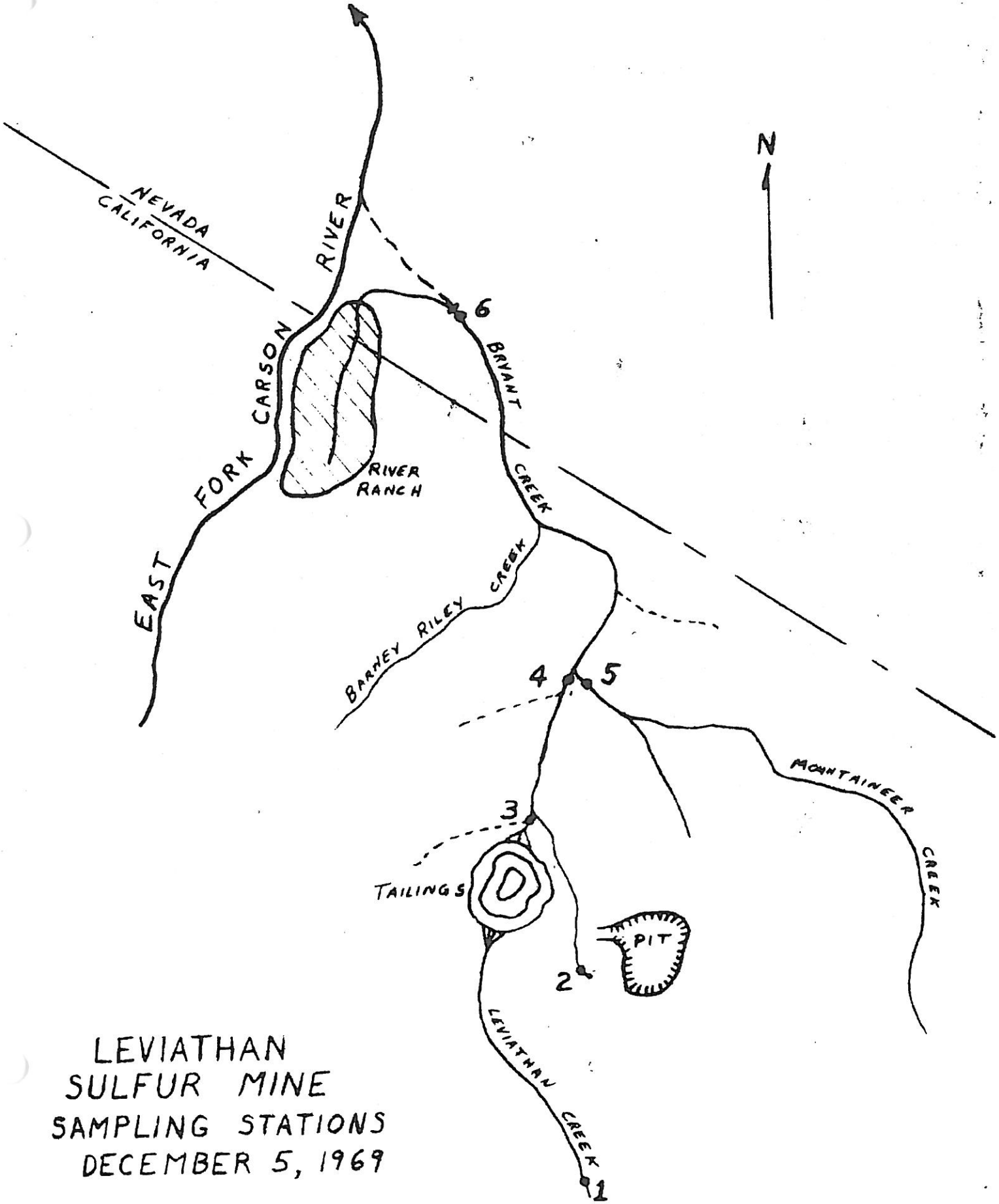
Sampling Data Collected on December 5, 1968
to Measure Effects of Leviathan Mine Wastes

Station	Bottom Organisms Number*	Bottom Organisms Types	pH	Water Temp (°F)	Bioassay Toxicity
1. Leviathan Cr. above mine (control station)	15	caddisfly, stonefly, hellgrammite, cranefly	7.7	32	nontoxic to fish
2. Abandoned mine shaft spring	none	none	2.7	58	96 hr. TLm= 0.225%
3. Below mine tailings at combination of three springs; above confluence with abandoned mine shaft spring	Station 3 was not sampled by Fish and Game				
4. Mountaineer Cr. above confluence with Leviathan Cr. (control station)	83	caddisfly, stonefly beetle, annelid worms	7.1	32	nontoxic to fish
5. Leviathan Cr. (below mine) above entrance of Mountaineer Cr.	none	none	3.4	35	96 hr. TLm= 4.4%
6. Bryant Cr. at Ponds diversion (below mine)	none	none	6.8, 6.9	36	threshold toxicity to fish

* Three square feet of stream bottom plus 5 rocks (4-6" long) were sampled at each station.

LEVIATHAN SULFUR MINE - WATER QUALITY DATA
December 5, 1968

CONSTITUENTS Concentrations are in mg/l unless otherwise stated	STATION NO. 1 LEVIATHAN CREEK ABOVE MINE	STATION NO. 2 MINE DRAINAGE - SPRING FROM MINE SHAFT	STATION NO. 3 MINE DRAINAGE -COMBINED SPRINGS BELOW TAILING DUMPS	STATION NO. 4 LEVIATHAN CREEK JUST ABOVE MOUNTAINEER CREEK	STATION NO. 5 MOUNTAINEER CREEK AT ENTRANCE TO LEVIATHAN CREEK	STATION NO. 6 BRYANT CREEK AT DIVERSION TO PARK RANCH
DISSOLVED OXYGEN	10.0	0.0		5.5	10.1	9.9
TEMPERATURE - °F	32	58		35	32	36
FIELD pH - units	7.7	2.7		3.4	7.2	6.8
LABORATORY pH - units	7.7	2.6	3.3	3.8	8.0	7.0
TURBIDITY - units	1.3	48	68	160	3.2	70
APPARENT COLOR - units	5	15	60	90	10	50
TRUE COLOR - units	< 5	< 5	15	20	< 5	5
ALKALINITY AS $CaCO_3$	60	0	0	0	64.0	16
METHYL ORANGE ACIDITY AS $CaCO_3$	0.0	1,720	216	240	0.0	0.0
PHENOLPHTHALEIN ACIDITY AS $CaCO_3$	5	17,000	1,104	410	2.0	10
TOTAL DISSOLVED SOLIDS	125	1,525	4,235	1,778	117	404
HARDNESS AS $CaCO_3$ (calc.)	3.2	3.2	97	55	3.2	8.2
CALCIUM	< 0.5	< 0.5	25.1	15.3	0.5	2.7
MAGNESIUM	< 0.5	< 0.5	8.2	4.0	< 0.5	< 0.5
SODIUM	9.2	24.2	22.6	17.3	7.2	11.3
POTASSIUM	3.1	15.8	13.6	5.8	2.3	4.4
SULFATE	8.8	2,610	2,900	1,010	2.6	8.1
CHLORIDE	< 1	< 1	< 1	1	< 1	1
FLUORIDE	< 0.1	7.0	4.8	1.6	0.1	0.8
BORON	0.2	73	8.9	2.8	0.5	2.4
IRON	0.20	159	286	112	0.42	92
NICKEL	0.03	2.8	0.20			0.04
CADMIUM	< 0.01	< 0.1	0.02			< 0.01
ARSENIC	< 0.01	70.0	< 0.02			0.09
SELENIUM	< 0.01	0.23	< 0.01			
COPPER	0.04	64	0.58	2.0	0.11	0.11
ZINC	< 0.01	0.1	0.28	< 0.01	0.03	0.05
ALUMINUM	< 0.01	48	14.7	6.6	0.14	0.38
MANGANESE	< 0.01	4.8	7.9	4.0	< 0.01	0.10



LEVIATHAN
SULFUR MINE
SAMPLING STATIONS
DECEMBER 5, 1969

INVESTIGATION OF SOIL AND IRRIGATION WATER CONDITIONS ON THE BROOKS PARK-RIVER RANCH

(Nelson Laboratories, 1969)

Soil Quality Results from the Project Database
Nelson Laboratories (1969)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
A	11/11/1969	B	0.14	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	B	0.16	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Ca, Available	2140	pounds		NEL-002
A	11/11/1969	Ca, Available	2440	pounds		NEL-002
A	11/11/1969	Ca, Available	2820	pounds		NEL-002
A	11/11/1969	Cl	10	ppm		NEL-002
A	11/11/1969	Cl	20	ppm		NEL-002
A	11/11/1969	Cl	30	ppm		NEL-002
A	11/11/1969	Clay	21.7	%		NEL-002
A	11/11/1969	Clay	25.2	%		NEL-002
A	11/11/1969	Clay	27.2	%		NEL-002
A	11/11/1969	Cu	0.01	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Cu	0.02	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Cu	2.04	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Cu	3.63	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Cu	5.2	ppm	DTPA Extractable	NEL-002
A	11/11/1969	EC	0.47	mmhos/c		NEL-002
A	11/11/1969	EC	0.53	mmhos/c		NEL-002
A	11/11/1969	EC	0.73	mmhos/c		NEL-002
A	11/11/1969	Fe	0.08	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Fe	0.11	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Fe	0.19	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Fe	81.2	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Fe	128.2	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Fe	136.6	ppm	DTPA Extractable	NEL-002
A	11/11/1969	K, Available	196	pounds		NEL-002
A	11/11/1969	K, Available	229	pounds		NEL-002
A	11/11/1969	K, Available	244	pounds		NEL-002
A	11/11/1969	Mg, Available	634	pounds		NEL-002
A	11/11/1969	Mg, Available	636	pounds		NEL-002
A	11/11/1969	Mg, Available	660	pounds		NEL-002
A	11/11/1969	Mn	0.13	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Mn	0.19	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Mn	1.35	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Mn	15	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Mn	15.3	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Mn	21.1	ppm	DTPA Extractable	NEL-002
A	11/11/1969	NH3	10	pounds		NEL-002
A	11/11/1969	NH3	15	pounds		NEL-002
A	11/11/1969	NH3	25	pounds		NEL-002
A	11/11/1969	NO3	10	pounds		NEL-002
A	11/11/1969	NO3	15	pounds		NEL-002
A	11/11/1969	NO3	20	pounds		NEL-002
A	11/11/1969	OM%	2.22	%		NEL-002
A	11/11/1969	OM%	5.44	%		NEL-002
A	11/11/1969	OM%	8.66	%		NEL-002
A	11/11/1969	P, Available	26	pounds		NEL-002
A	11/11/1969	P, Available	36	pounds		NEL-002
A	11/11/1969	P, Available	55	pounds		NEL-002
A	11/11/1969	pH	5.1	su		NEL-002
A	11/11/1969	pH	5.65	su		NEL-002
A	11/11/1969	pH	5.9	su		NEL-002
A	11/11/1969	Sand	37.2	%		NEL-002
A	11/11/1969	Sand	50.2	%		NEL-002
A	11/11/1969	Sand	55.2	%		NEL-002
A	11/11/1969	Zn	0.06	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Zn	0.08	ppm	in Saturated Soil Extract	NEL-002
A	11/11/1969	Zn	0.93	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Zn	1.28	ppm	DTPA Extractable	NEL-002
A	11/11/1969	Zn	3.18	ppm	DTPA Extractable	NEL-002
B	11/11/1969	B	0.27	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	B	0.29	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	B	0.32	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Ca, Available	2285	pounds		NEL-002

B	11/11/1969	Ca, Available	2610	pounds		NEL-002
B	11/11/1969	Ca, Available	3120	pounds		NEL-002
B	11/11/1969	Cl	10	ppm		NEL-002
B	11/11/1969	Cl	20	ppm		NEL-002
B	11/11/1969	Clay	15.2	%		NEL-002
B	11/11/1969	Clay	17.2	%		NEL-002
B	11/11/1969	Clay	19.4	%		NEL-002
B	11/11/1969	Cu	0.025	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Cu	0.05	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Cu	0.08	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Cu	0.68	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Cu	0.87	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Cu	0.89	ppm	DTPA Extractable	NEL-002
B	11/11/1969	EC	0.32	mmhos/c		NEL-002
B	11/11/1969	EC	0.4	mmhos/c		NEL-002
B	11/11/1969	EC	0.44	mmhos/c		NEL-002
B	11/11/1969	Fe	0.05	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Fe	0.06	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Fe	0.11	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Fe	15.3	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Fe	21.6	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Fe	24.8	ppm	DTPA Extractable	NEL-002
B	11/11/1969	K, Available	784	pounds		NEL-002
B	11/11/1969	K, Available	836	pounds		NEL-002
B	11/11/1969	K, Available	849	pounds		NEL-002
B	11/11/1969	Mg, Available	460	pounds		NEL-002
B	11/11/1969	Mg, Available	477	pounds		NEL-002
B	11/11/1969	Mg, Available	500	pounds		NEL-002
B	11/11/1969	Mn	0.05	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Mn	0.06	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Mn	0.09	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Mn	6.6	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Mn	9	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Mn	10.7	ppm	DTPA Extractable	NEL-002
B	11/11/1969	NH3	10	pounds		NEL-002
B	11/11/1969	NH3	15	pounds		NEL-002
B	11/11/1969	NO3	15	pounds		NEL-002
B	11/11/1969	NO3	20	pounds		NEL-002
B	11/11/1969	NO3	25	pounds		NEL-002
B	11/11/1969	OM%	2.22	%		NEL-002
B	11/11/1969	OM%	2.45	%		NEL-002
B	11/11/1969	OM%	3.03	%		NEL-002
B	11/11/1969	P, Available	108	pounds		NEL-002
B	11/11/1969	P, Available	116	pounds		NEL-002
B	11/11/1969	P, Available	133	pounds		NEL-002
B	11/11/1969	pH	6.35	su		NEL-002
B	11/11/1969	pH	6.4	su		NEL-002
B	11/11/1969	Sand	58.8	%		NEL-002
B	11/11/1969	Sand	60.8	%		NEL-002
B	11/11/1969	Sand	64.2	%		NEL-002
B	11/11/1969	Zn	0.06	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Zn	0.085	ppm	in Saturated Soil Extract	NEL-002
B	11/11/1969	Zn	1.02	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Zn	1.64	ppm	DTPA Extractable	NEL-002
B	11/11/1969	Zn	2.5	ppm	DTPA Extractable	NEL-002
C	11/11/1969	B	0.14	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	B	0.17	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	B	0.39	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Ca, Available	2080	pounds		NEL-002
C	11/11/1969	Ca, Available	2220	pounds		NEL-002
C	11/11/1969	Ca, Available	2610	pounds		NEL-002
C	11/11/1969	Cl	20	ppm		NEL-002
C	11/11/1969	Clay	22.6	%		NEL-002
C	11/11/1969	Clay	26.6	%		NEL-002
C	11/11/1969	Clay	27.4	%		NEL-002

C	11/11/1969	Cu	0.01	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Cu	0.02	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Cu	0.05	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Cu	2.17	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Cu	3.41	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Cu	3.89	ppm	DTPA Extractable	NEL-002
C	11/11/1969	EC	0.48	mmhos/c		NEL-002
C	11/11/1969	EC	0.55	mmhos/c		NEL-002
C	11/11/1969	EC	0.72	mmhos/c		NEL-002
C	11/11/1969	Fe	0.14	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Fe	0.21	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Fe	90	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Fe	119.7	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Fe	130.2	ppm	DTPA Extractable	NEL-002
C	11/11/1969	K, Available	202	pounds		NEL-002
C	11/11/1969	K, Available	229	pounds		NEL-002
C	11/11/1969	K, Available	237	pounds		NEL-002
C	11/11/1969	Mg, Available	504	pounds		NEL-002
C	11/11/1969	Mg, Available	547	pounds		NEL-002
C	11/11/1969	Mg, Available	669	pounds		NEL-002
C	11/11/1969	Mn	0.19	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Mn	0.27	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Mn	2.67	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Mn	20.4	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Mn	24.1	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Mn	28.6	ppm	DTPA Extractable	NEL-002
C	11/11/1969	NH3	10	pounds		NEL-002
C	11/11/1969	NH3	23	pounds		NEL-002
C	11/11/1969	NO3	10	pounds		NEL-002
C	11/11/1969	OM%	2.6	%		NEL-002
C	11/11/1969	OM%	3.94	%		NEL-002
C	11/11/1969	OM%	9.89	%		NEL-002
C	11/11/1969	P, Available	30	pounds		NEL-002
C	11/11/1969	P, Available	43	pounds		NEL-002
C	11/11/1969	P, Available	73	pounds		NEL-002
C	11/11/1969	pH	4.9	su		NEL-002
C	11/11/1969	pH	5.4	su		NEL-002
C	11/11/1969	pH	5.6	su		NEL-002
C	11/11/1969	Sand	41.4	%		NEL-002
C	11/11/1969	Sand	48.2	%		NEL-002
C	11/11/1969	Sand	54	%		NEL-002
C	11/11/1969	Zn	0.1	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Zn	0.12	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Zn	0.18	ppm	in Saturated Soil Extract	NEL-002
C	11/11/1969	Zn	1.39	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Zn	1.69	ppm	DTPA Extractable	NEL-002
C	11/11/1969	Zn	3.13	ppm	DTPA Extractable	NEL-002
D	11/11/1969	B	0.4	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	B	0.43	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	B	0.57	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Ca, Available	2440	pounds		NEL-002
D	11/11/1969	Ca, Available	2520	pounds		NEL-002
D	11/11/1969	Cl	20	ppm		NEL-002
D	11/11/1969	Cl	30	ppm		NEL-002
D	11/11/1969	Clay	27.6	%		NEL-002
D	11/11/1969	Clay	28.8	%		NEL-002
D	11/11/1969	Clay	29.6	%		NEL-002
D	11/11/1969	Cu	0.01	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Cu	0.025	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Cu	0.05	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Cu	0.77	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Cu	0.82	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Cu	1.39	ppm	DTPA Extractable	NEL-002
D	11/11/1969	EC	0.33	mmhos/c		NEL-002
D	11/11/1969	EC	0.42	mmhos/c		NEL-002

D	11/11/1969	EC	0.47	mmhos/c		NEL-002
D	11/11/1969	Fe	0.11	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Fe	0.27	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Fe	0.32	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Fe	28.9	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Fe	31	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Fe	49	ppm	DTPA Extractable	NEL-002
D	11/11/1969	K, Available	455	pounds		NEL-002
D	11/11/1969	K, Available	517	pounds		NEL-002
D	11/11/1969	K, Available	562	pounds		NEL-002
D	11/11/1969	Mg, Available	745	pounds		NEL-002
D	11/11/1969	Mg, Available	885	pounds		NEL-002
D	11/11/1969	Mg, Available	995	pounds		NEL-002
D	11/11/1969	Mn	0.02	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Mn	0.03	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Mn	0.15	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Mn	10.7	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Mn	14.6	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Mn	29.6	ppm	DTPA Extractable	NEL-002
D	11/11/1969	NH3	10	pounds		NEL-002
D	11/11/1969	NH3	12	pounds		NEL-002
D	11/11/1969	NO3	10	pounds		NEL-002
D	11/11/1969	NO3	15	pounds		NEL-002
D	11/11/1969	OM%	1.3	%		NEL-002
D	11/11/1969	OM%	1.66	%		NEL-002
D	11/11/1969	OM%	3.01	%		NEL-002
D	11/11/1969	P, Available	204	pounds		NEL-002
D	11/11/1969	P, Available	225	pounds		NEL-002
D	11/11/1969	P, Available	229	pounds		NEL-002
D	11/11/1969	pH	6	su		NEL-002
D	11/11/1969	pH	6.25	su		NEL-002
D	11/11/1969	Sand	43	%		NEL-002
D	11/11/1969	Sand	43.2	%		NEL-002
D	11/11/1969	Sand	46	%		NEL-002
D	11/11/1969	Zn	0.11	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Zn	0.15	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Zn	0.23	ppm	in Saturated Soil Extract	NEL-002
D	11/11/1969	Zn	0.32	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Zn	0.53	ppm	DTPA Extractable	NEL-002
D	11/11/1969	Zn	0.97	ppm	DTPA Extractable	NEL-002
E	11/11/1969	B	0.44	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	B	0.49	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	B	0.56	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Ca, Available	2140	pounds		NEL-002
E	11/11/1969	Ca, Available	2610	pounds		NEL-002
E	11/11/1969	Ca, Available	2925	pounds		NEL-002
E	11/11/1969	Cl	30	ppm		NEL-002
E	11/11/1969	Cl	40	ppm		NEL-002
E	11/11/1969	Clay	25.2	%		NEL-002
E	11/11/1969	Clay	27.6	%		NEL-002
E	11/11/1969	Cu	0.03	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Cu	0.06	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Cu	1.82	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Cu	2.17	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Cu	2.6	ppm	DTPA Extractable	NEL-002
E	11/11/1969	EC	0.37	mmhos/c		NEL-002
E	11/11/1969	EC	0.44	mmhos/c		NEL-002
E	11/11/1969	EC	0.56	mmhos/c		NEL-002
E	11/11/1969	Fe	0.54	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Fe	0.72	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Fe	0.84	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Fe	123	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Fe	171	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Fe	179.4	ppm	DTPA Extractable	NEL-002
E	11/11/1969	K, Available	98	pounds		NEL-002

E	11/11/1969	K, Available	215	pounds		NEL-002
E	11/11/1969	K, Available	455	pounds		NEL-002
E	11/11/1969	Mg, Available	665	pounds		NEL-002
E	11/11/1969	Mg, Available	892	pounds		NEL-002
E	11/11/1969	Mg, Available	943	pounds		NEL-002
E	11/11/1969	Mn	0.04	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Mn	0.13	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Mn	13	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Mn	13.5	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Mn	18.8	ppm	DTPA Extractable	NEL-002
E	11/11/1969	NH3	10	pounds		NEL-002
E	11/11/1969	NH3	12	pounds		NEL-002
E	11/11/1969	NO3	15	pounds		NEL-002
E	11/11/1969	NO3	20	pounds		NEL-002
E	11/11/1969	NO3	25	pounds		NEL-002
E	11/11/1969	OM%	1.74	%		NEL-002
E	11/11/1969	OM%	4.74	%		NEL-002
E	11/11/1969	OM%	7.17	%		NEL-002
E	11/11/1969	P, Available	4	pounds		NEL-002
E	11/11/1969	P, Available	9	pounds		NEL-002
E	11/11/1969	P, Available	10	pounds		NEL-002
E	11/11/1969	pH	6.2	su		NEL-002
E	11/11/1969	pH	6.3	su		NEL-002
E	11/11/1969	Sand	41.2	%		NEL-002
E	11/11/1969	Sand	45.2	%		NEL-002
E	11/11/1969	Sand	47	%		NEL-002
E	11/11/1969	Zn	0.07	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Zn	0.11	ppm	in Saturated Soil Extract	NEL-002
E	11/11/1969	Zn	0.44	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Zn	1.18	ppm	DTPA Extractable	NEL-002
E	11/11/1969	Zn	1.78	ppm	DTPA Extractable	NEL-002
F	11/11/1969	B	0.36	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	B	0.39	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	B	0.5	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Ca, Available	2350	pounds		NEL-002
F	11/11/1969	Ca, Available	2440	pounds		NEL-002
F	11/11/1969	Ca, Available	2695	pounds		NEL-002
F	11/11/1969	Cl	20	ppm		NEL-002
F	11/11/1969	Cl	30	ppm		NEL-002
F	11/11/1969	Clay	26.6	%		NEL-002
F	11/11/1969	Clay	27.6	%		NEL-002
F	11/11/1969	Clay	31.6	%		NEL-002
F	11/11/1969	Cu	0.02	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Cu	0.04	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Cu	0.07	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Cu	1.76	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Cu	2.26	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Cu	2.45	ppm	DTPA Extractable	NEL-002
F	11/11/1969	EC	0.37	mmhos/c		NEL-002
F	11/11/1969	EC	0.4	mmhos/c		NEL-002
F	11/11/1969	EC	0.44	mmhos/c		NEL-002
F	11/11/1969	Fe	0.25	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Fe	0.38	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Fe	0.95	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Fe	94.8	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Fe	129.3	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Fe	172.2	ppm	DTPA Extractable	NEL-002
F	11/11/1969	K, Available	188	pounds		NEL-002
F	11/11/1969	K, Available	208	pounds		NEL-002
F	11/11/1969	K, Available	260	pounds		NEL-002
F	11/11/1969	Mg, Available	782	pounds		NEL-002
F	11/11/1969	Mg, Available	787	pounds		NEL-002
F	11/11/1969	Mg, Available	800	pounds		NEL-002
F	11/11/1969	Mn	0.05	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Mn	0.06	ppm	in Saturated Soil Extract	NEL-002

F	11/11/1969	Mn	0.09	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Mn	10.9	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Mn	12.8	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Mn	13.1	ppm	DTPA Extractable	NEL-002
F	11/11/1969	NH3	10	pounds		NEL-002
F	11/11/1969	NO3	10	pounds		NEL-002
F	11/11/1969	NO3	15	pounds		NEL-002
F	11/11/1969	NO3	20	pounds		NEL-002
F	11/11/1969	OM%	2.11	%		NEL-002
F	11/11/1969	OM%	3.36	%		NEL-002
F	11/11/1969	OM%	6.67	%		NEL-002
F	11/11/1969	P, Available	13	pounds		NEL-002
F	11/11/1969	P, Available	15	pounds		NEL-002
F	11/11/1969	P, Available	18	pounds		NEL-002
F	11/11/1969	pH	6.2	su		NEL-002
F	11/11/1969	pH	6.4	su		NEL-002
F	11/11/1969	pH	6.45	su		NEL-002
F	11/11/1969	Sand	40	%		NEL-002
F	11/11/1969	Sand	44	%		NEL-002
F	11/11/1969	Sand	46	%		NEL-002
F	11/11/1969	Zn	0.03	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Zn	0.04	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Zn	0.07	ppm	in Saturated Soil Extract	NEL-002
F	11/11/1969	Zn	0.5	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Zn	0.54	ppm	DTPA Extractable	NEL-002
F	11/11/1969	Zn	0.99	ppm	DTPA Extractable	NEL-002

Notes:

Informaton obtained from database source code YOU-001 within the project database. The original source was from *Investigation of Soil and Irrigation Water Condiditons of the Brooks Park* by Nelson Laboratories for RWQCB (1970).

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, K = Potassium, Mg = Magnesium, Mn = Manganese, Na = Sodium, , P = Phosphorous, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, Dis = dissolved, SpC = s, uS/cm = microseimens per centimeter, ppm = parts per million, OM = organic matter

Surface Water Results from the Project Database
Nelson Laboratories (1969)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
BCDD	11/11/1969	Alkalinity (Bicarbonate)	24	mg/l as HCO3	Total	NEL-002
BCDD	11/11/1969	Alkalinity (Carbonate)	0	ppm	Dis	NEL-002
BCDD	11/11/1969	As	0.01	ppm	Dis	NEL-002
BCDD	11/11/1969	B	0.04	ppm	Dis	NEL-002
BCDD	11/11/1969	Ca	43	ppm	Dis	NEL-002
BCDD	11/11/1969	Cl	6	ppm	Dis	NEL-002
BCDD	11/11/1969	Cu	0.01	ppm	Dis	NEL-002
BCDD	11/11/1969	Fe	0.03	ppm	Dis	NEL-002
BCDD	11/11/1969	Fe	0.25	ppm	Dis	NEL-002
BCDD	11/11/1969	Hardness	153	ppm	Dis	NEL-002
BCDD	11/11/1969	Mg	11	ppm	Dis	NEL-002
BCDD	11/11/1969	Mn	1.09	ppm	Dis	NEL-002
BCDD	11/11/1969	Na	13	ppm	Dis	NEL-002
BCDD	11/11/1969	Na	15.7	%	Dis	NEL-002
BCDD	11/11/1969	NO3	0.1	ppm	Dis	NEL-002
BCDD	11/11/1969	pH	6.7	su		NEL-002
BCDD	11/11/1969	PO4	0.01	ppm	Dis	NEL-002
BCDD	11/11/1969	SO4	142	ppm	Dis	NEL-002
BCDD	11/11/1969	Specific Conductance	0.38	uS/cm	Dis	NEL-002
BCDD	11/11/1969	TDS	239	ppm	Dis	NEL-002
BCDD	11/11/1969	Zn	0.02	ppm	Dis	NEL-002
CCDD	11/11/1969	Alkalinity (Bicarbonate)	98	mg/l as HCO3	Total	NEL-002
CCDD	11/11/1969	Alkalinity (Carbonate)	0	ppm	Dis	NEL-002
CCDD	11/11/1969	As	0.01	ppm	Dis	NEL-002
CCDD	11/11/1969	B	0.04	ppm	Dis	NEL-002
CCDD	11/11/1969	Ca	18	ppm	Dis	NEL-002
CCDD	11/11/1969	Cl	6	ppm	Dis	NEL-002
CCDD	11/11/1969	Cu	0.02	ppm	Dis	NEL-002
CCDD	11/11/1969	Fe	0.04	ppm	Dis	NEL-002
CCDD	11/11/1969	Fe	0.11	ppm	Dis	NEL-002
CCDD	11/11/1969	Hardness	74	ppm	Dis	NEL-002
CCDD	11/11/1969	Mg	7	ppm	Dis	NEL-002
CCDD	11/11/1969	Mn	0.02	ppm	Dis	NEL-002
CCDD	11/11/1969	Na	14	ppm	Dis	NEL-002
CCDD	11/11/1969	Na	28.9	%	Dis	NEL-002
CCDD	11/11/1969	NO3	0.1	ppm	Dis	NEL-002
CCDD	11/11/1969	pH	8.2	su		NEL-002
CCDD	11/11/1969	PO4	0.07	ppm	Dis	NEL-002
CCDD	11/11/1969	SO4	22	ppm	Dis	NEL-002
CCDD	11/11/1969	SpC	0.19	uS/cm	Dis	NEL-002
CCDD	11/11/1969	TDS	165	ppm	Dis	NEL-002
CCDD	11/11/1969	Zn	0.01	ppm	Dis	NEL-002

Notes:

Informaton obtained from database source code NEL-002 within the project database. The original source was from *Investigation of Soil and Irrigation Water Conditions on the Brooks Park - River Ranch.* By Nelson Laboroatories (1969)

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, Dis = dissolved, SpC = specific conductivity, uS/cm = microseimens per centimeter, ppm = parts per million, su = standard units, mg/l = milligrams per liter

AN APPRAISAL OF THE EFFECTS OF CONTAMINANTS IN IRRIGATION WATER DERIVED FROM BRYANT CREEK ON THE AGRICULTURAL POTENTIAL OF RIVER RANCH

(Young, 1970)

Soil Quality Results from the Project Database
Young (1970)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
1C	9/7/1970	As	0.1	ppm	Agricultural Consultants Lab	YOU-001
1C	9/7/1970	Co	4.2	ppm	Agricultural Consultants Lab	YOU-001
1C	9/7/1970	Cu	0.8	ppm	Agricultural Consultants Lab	YOU-001
1C	9/7/1970	Cu	3.1	ppm	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Cu	3.8	ppm	Colorado State Univ Soil Lab	YOU-001
1C	9/7/1970	Fe	11	ppm	Data questionable. Agricultural	YOU-001
1C	9/7/1970	Fe	74	ppm	Colorado State Univ Soil Lab	YOU-001
1C	9/7/1970	Fe	75	ppm	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Fe	282	ppm	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Fe	605	ppm	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Mn	10.2	ppm	Colorado State Univ Soil Lab	YOU-001
1C	9/7/1970	Mn	100	ppm	Agricultural Consultants Lab	YOU-001
1C	9/7/1970	Ni	2.2	ppm	Agricultural Consultants Lab	YOU-001
1C	9/7/1970	pH	6.32	su	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Zn	1.2	ppm	Colorado State Univ Soil Lab	YOU-001
1C	9/7/1970	Zn	1.6	ppm	Nevada Soil and Water Testing	YOU-001
1C	9/7/1970	Zn	2.4	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	As	0.1	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	Co	3.8	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	Cu	0.2	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	Cu	3.2	ppm	Nevada Soil and Water Testing	YOU-001
2C	9/7/1970	Cu	3.5	ppm	Colorado State Univ Soil Lab	YOU-001
2C	9/7/1970	Fe	7	ppm	Data questionable. Agricultural	YOU-001
2C	9/7/1970	Fe	118	ppm	Colorado State Univ Soil Lab	YOU-001
2C	9/7/1970	Fe	137	ppm	Nevada Soil and Water Testing	YOU-001
2C	9/7/1970	Fe	363	ppm	Nevada Soil and Water Testing	YOU-001
2C	9/7/1970	Fe	814	ppm	Nevada Soil and Water Testing	YOU-001
2C	9/7/1970	Mn	13.4	ppm	Colorado State Univ Soil Lab	YOU-001
2C	9/7/1970	Mn	90	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	Ni	1.2	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	pH	6.6	su	Nevada Soil and Water Testing	YOU-001
2C	9/7/1970	Zn	0.34	ppm	Agricultural Consultants Lab	YOU-001
2C	9/7/1970	Zn	2.7	ppm	Colorado State Univ Soil Lab	YOU-001
2C	9/7/1970	Zn	2.8	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	As	0.1	ppm	Agricultural Consultants Lab	YOU-001
2L	9/7/1970	Co	15	ppm	Agricultural Consultants Lab	YOU-001
2L	9/7/1970	Cu	2	ppm	Agricultural Consultants Lab	YOU-001
2L	9/7/1970	Cu	7.8	ppm	Colorado State Univ Soil Lab	YOU-001
2L	9/7/1970	Cu	12.5	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Fe	2	ppm	Data questionable. Agricultural	YOU-001
2L	9/7/1970	Fe	140	ppm	Colorado State Univ Soil Lab	YOU-001
2L	9/7/1970	Fe	182	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Fe	370	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Fe	855	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Mn	16.2	ppm	Colorado State Univ Soil Lab	YOU-001
2L	9/7/1970	Mn	180	ppm	Agricultural Consultants Lab	YOU-001
2L	9/7/1970	Ni	28	ppm	Agricultural Consultants Lab	YOU-001
2L	9/7/1970	pH	5.6	su	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Zn	3.2	ppm	Colorado State Univ Soil Lab	YOU-001
2L	9/7/1970	Zn	3.5	ppm	Nevada Soil and Water Testing	YOU-001
2L	9/7/1970	Zn	7	ppm	Agricultural Consultants Lab	YOU-001
IL	9/7/1970	As	0.1	ppm	Agricultural Consultants Lab	YOU-001
IL	9/7/1970	Co	14	ppm	Agricultural Consultants Lab	YOU-001
IL	9/7/1970	Cu	3.6	ppm	Agricultural Consultants Lab	YOU-001
IL	9/7/1970	Cu	7.9	ppm	Colorado State Univ Soil Lab	YOU-001
IL	9/7/1970	Cu	10.7	ppm	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Fe	5	ppm	Data questionable. Agricultural	YOU-001
IL	9/7/1970	Fe	150	ppm	Colorado State Univ Soil Lab	YOU-001
IL	9/7/1970	Fe	171	ppm	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Fe	349	ppm	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Fe	835	ppm	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Mn	26	ppm	Colorado State Univ Soil Lab	YOU-001
IL	9/7/1970	Mn	140	ppm	Agricultural Consultants Lab	YOU-001
IL	9/7/1970	Ni	20	ppm	Agricultural Consultants Lab	YOU-001

Soil Quality Results from the Project Database
Young (1970)
Leviathan Mine Site
Alpine County, California

IL	9/7/1970	pH	5.65	su	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Zn	3.3	ppm	Colorado State Univ Soil Lab	YOU-001
IL	9/7/1970	Zn	3.4	ppm	Nevada Soil and Water Testing	YOU-001
IL	9/7/1970	Zn	6.2	ppm	Agricultural Consultants Lab	YOU-001

Notes:

Informaton obtained from database source code YOU-001 within the project database. The original source was from *An Appraisal of the Effects of Contaminants in Irrigation Water Derived from Bryant Creek on the Agricultural Potential of River Branch,* Ralph Young, Agricultural Consultant

As = Arsenic, B = Boron, Co = Cobalt, Cu = Copper, Fe = Iron, Mn = Manganese, Ni = Nickel, Zn = Zinc, ppm = parts per million, su= standard units

Surface Water Results from the Project Database
Young (1970)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
BCDD	9/7/1970	Alkalinity (Bicarbonate)	0.9	ppm	Total	YOU-001
BCDD	9/7/1970	Alkalinity (Carbonate)	0	ppm		YOU-001
BCDD	9/7/1970	Ca	3.2	ppm		YOU-001
BCDD	9/7/1970	Cl	0.03	ppm		YOU-001
BCDD	9/7/1970	Co	0.1	ppm		YOU-001
BCDD	9/7/1970	Cu	0.1	ppm		YOU-001
BCDD	9/7/1970	Fe	2.5	ppm		YOU-001
BCDD	9/7/1970	Mg	3.2	ppm		YOU-001
BCDD	9/7/1970	Mn	1	ppm		YOU-001
BCDD	9/7/1970	Na	0.45	ppm		YOU-001
BCDD	9/7/1970	pH	7.6	su		YOU-001
BCDD	9/7/1970	SO4	2.78	ppm		YOU-001
BCDD	9/7/1970	SpC	396	uS/cm		YOU-001
BCDD	9/7/1970	Zn	0	ppm		YOU-001

Notes:

Informaton obtained from database source code YOU-001 within the project database. The original source was from *An Appraisal of the Effects of Contaminats in Irrigation Water Derived From Bryant Creek on the Agricultural Potential of River Ranch* . By Young (1970).

Ca = Calcium, Cl = Chlorine, Co = cobalt, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, SO4 = Sulfate Zn = Zinc, HCO3 = bicarbonate, Dis = dissolved, SpC = specific conductivity, uS/cm = microseimens per centimeter, ppm = parts per million

REPORT ON POLLUTION OF LEVIATHAN CREEK, BRYANT CREEK, AND THE EAST FORK CARSON RIVER CAUSED BY THE LEVIATHAN SULFUR MINE

(RWQCB, 1975)

D. PRESENT CONDITIONS

The conditions in Leviathan Creek have not improved during the period since the 1963 and 1969 intensive studies. The abandoned Anaconda Leviathan Sulphur Mine continues to discharge highly mineralized acid mine drainage to the creek.

Board staff collected two series of samples for chemical analysis in 1975. The results of those samples are compared with past results in the table below.

pH:

Location	12-19-74	7-2-74	1963-1969*
Upstream of discharge	7.6	8.3	7.2
Discharges	2.7	2.8	1.3
Creek below discharge	2.7	---	2.8

* minimum values from page IV-3

SULFATES

Concentration - mg/l

Location	12-19-74	7-2-74	1968-1969*
Upstream of discharge	6.8	134	13
Discharges	4243	2790	2935
Creek below discharge	3119	---	1425

* maximum values from page IV-5

TOTAL DISSOLVED SOLIDS

Concentration - mg/l

Location	12-19-74	7-2-74	1963-1969*
Upstream of discharge	130	362	125
Discharges	4900	4345	26,400
Creek below discharges	4650	---	5130

* maximum values from page IV-6

COPPER

Concentration - mg/l

Location	12-19-74	7-2-74	1963-1969*
Upstream of discharge	---	[illegible]	0.04
Discharges	---	0.93	11.5
Creek below discharges	---	---	2.0

* maximum values from page IV-7

IRON

Location	Concentration - mg/l 12-19-74	7-2-74	1968-1969*
Upstream of discharge	0.35	0.4	0.26
Discharges	390	400	4170
Creek below discharges	375	---	342

* maximum values from page IV-8

MANGANESE

Location	Concentration - mg/l 12-19-74	7-2-74	1968-1969*
Upstream of discharge	---	1.2	<0.05
Discharges	---	23	8.2
Creek below discharges	---	---	13

* maximum values from page IV-8

ARSENIC

Location	Concentration - mg/l 12-19-74	7-2-74	1968-1969*
Upstream of discharge	0.00	0.00	0.01
Discharges	1.2	---	110
Creek below discharges	1.2	---	1.2

* maximum values from page IV-9

When the Board staff collected samples and made a visual inspection of the abandoned Anaconda Leviathan Sulphur Mine on June 2, 1974, the following conditions were noted:

1. Leviathan Creek above the mine has a flow of approximately 0.5 cubic feet per second (cfs) while the flow of the creek immediately below the spoil materials, but above the mine discharge, was approximately 0.3 cfs. The combined flow from the acid mine leachate prior to entering Leviathan Creek was approximately 0.7 cfs.

2. There was no surface discharge from the pit area at the time of the inspection.

3. The major discharge from Leviathan Mine to Leviathan Creek was apparently comprised of two principal sources:

   a) The drainage from the collapsed mine tunnel, and
   b) Several outcroppings located at the toe of the overburden placed in the original drainage channel of Leviathan Creek.

4. The mine drainage was clear as it discharged from the tunnel and outcroppings, but became progressively more turbid (reddish-brown color) as it flowed downstream.

5. The creek bottom of Leviathan Creek above the Leviathan Mine appeared natural while the creek bottom of Leviathan Creek below the Leviathan Mine was blanketed with a reddish-brown precipitate.

6. A thin, dark green periphyton growth was apparent in the mine drainage flow.

7. There was no snow on the ground or evidence of recent precipitation. Climatic conditions were clear and sunny.

When Board staff collected samples and made a visual inspection of the abandoned Anaconda Leviathan Sulphur Mine on December 19, 1974, the following conditions were noted:

1. Leviathan Creek above the mine had a flow of approximately 0.5 cfs, while the flow of the creek immediately below the spoil materials, but above the mine discharge, was estimated to be less than 0.025 cfs. Virtually the entire flow in Leviathan Creek below the discharge location was the mine discharge itself.

2. There was no discharge from the pit area at the time of the inspection .

3. The major discharge from Leviathan Mine to Leviathan Creek was apparently comprised of two principle sources; the drainage from the collapsed mine tunnel and a large spring located at the bottom of the slope just below the crusher. There were several smaller springs located at the toe of the overburden which contributed to the flow to Leviathan Creek.

4. The mine drainage was clear, but there were sediments of various colors along the edge of the flow and the creek bed below the mine. Some of the colors included in the sediments coating the rocks were blue-green, yellow and reddish-brown.

5. It had snowed in the vicinity of the mine a few days prior to the inspection and the ground was saturated in many locations. There was still snow cover on the ground in most areas outside of the cleared areas of the mine.

Table VI-1
Flow Measurements
Bryant Creek Leviathan Creek Stream System

In Cubic Feet Per Second

Station 1/	May 14	May 28	May 29	June 12,13 2/4/	June 24	June 26	July 8,9 2/	July 14	July 23,24 2/	August 7,8 2/	August 21	September 4,5 2/	September 22,23 2/4/
(1)	22 3/	9.8		3.2		1.27	0.86		0.43	0.54	0.19	0.15	0.14
(2)					1.72		0.91		0.39	0.22	0.16	0.13	0.135
T_1					0.18								
(3)					2.26		0.93		0.49	0.12	0.012	0.005	0.010
(4)					2.41							0.040	0.047
(5)					3.08		1.49		0.84	0.45	0.35	0.33	0.289
T_2					0.54						0.036		
(6)			16.1	5.9	3.26		1.96	1.80	0.83	0.46	0.46	0.40	0.427
Aspen Creek	5.5 3/		1.73	1.50	1.10	1.15	0.8	0.61	0.61	0.40	0.58	0.48	0.55
Aspen Tributary	0.5 3/		0.19	0.19			0.060	0.0742	0.0993	0.06	0.060	0.047	0.037
T_3					0.14								
(7)	65 3/		22.2	10.5	4.82		3.65		1.84	1.33	0.857	0.90	0.95
Mountaineer Cr.	25 3/		14.5	8.8	5.26		4.45		2.98	2.82	2.29	2.06	2.87
Bryant Creek at Gage	160		59	23		13.5	13.3		8.5	7.1	6.6	5.8	5.8
Doud Springs Creek						0.21							0.47
River Ranch Upper Ditch	0		0	7.1		5.09	6.46		4.3	4.3	4.3	0	0
River Ranch Lower Ditch						4.02							0
Bryant Creek at Mouth						5.52							

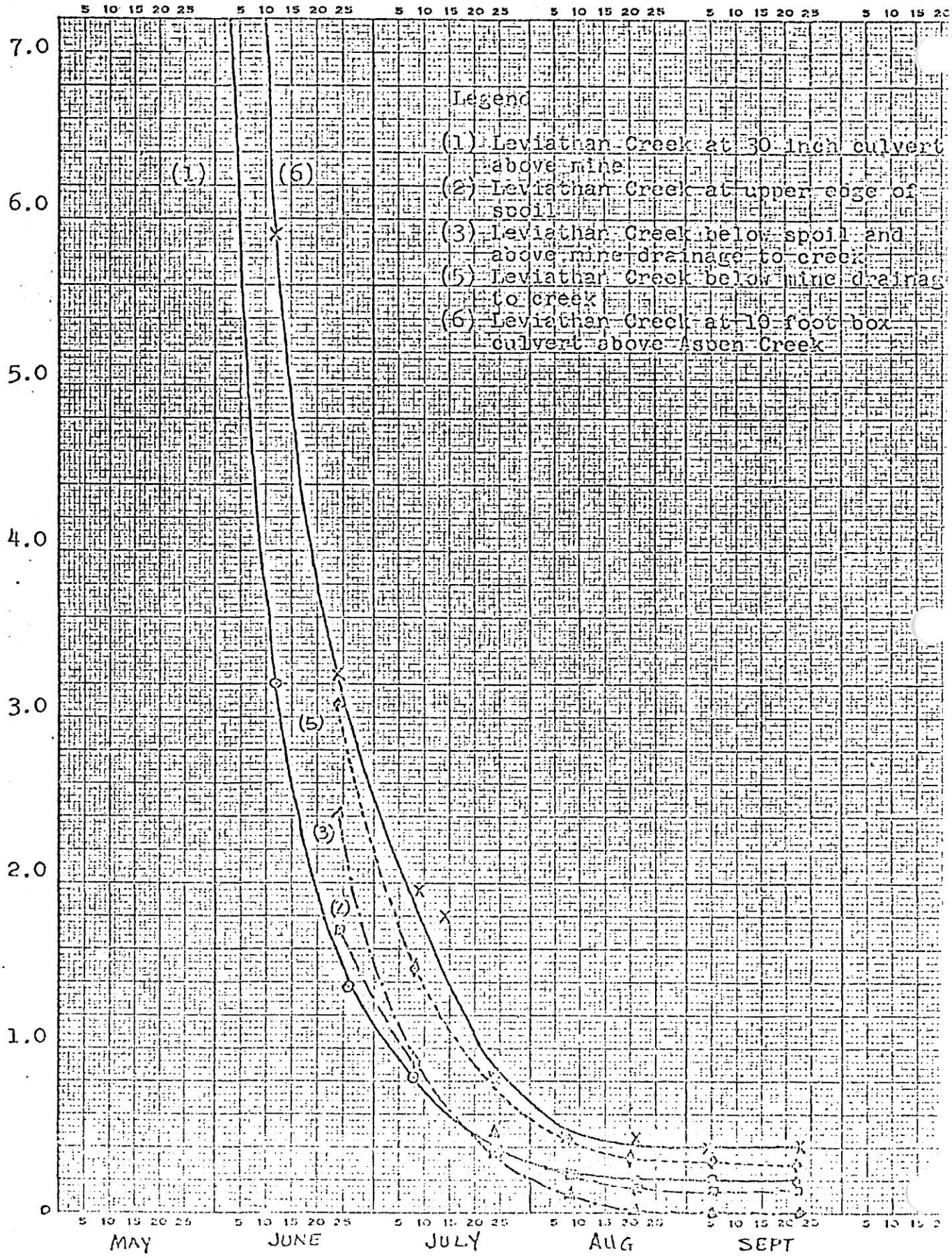
1/ See Plate 9 and tabulation on page 4 for location and description
2/ Measurement made on one of two dates
3/ Estimated
4/ Water quality samples taken on these dates

Table VI-2
Flow Measurements
Leviathan Mine Drainage

In Cubic Feet Per Second

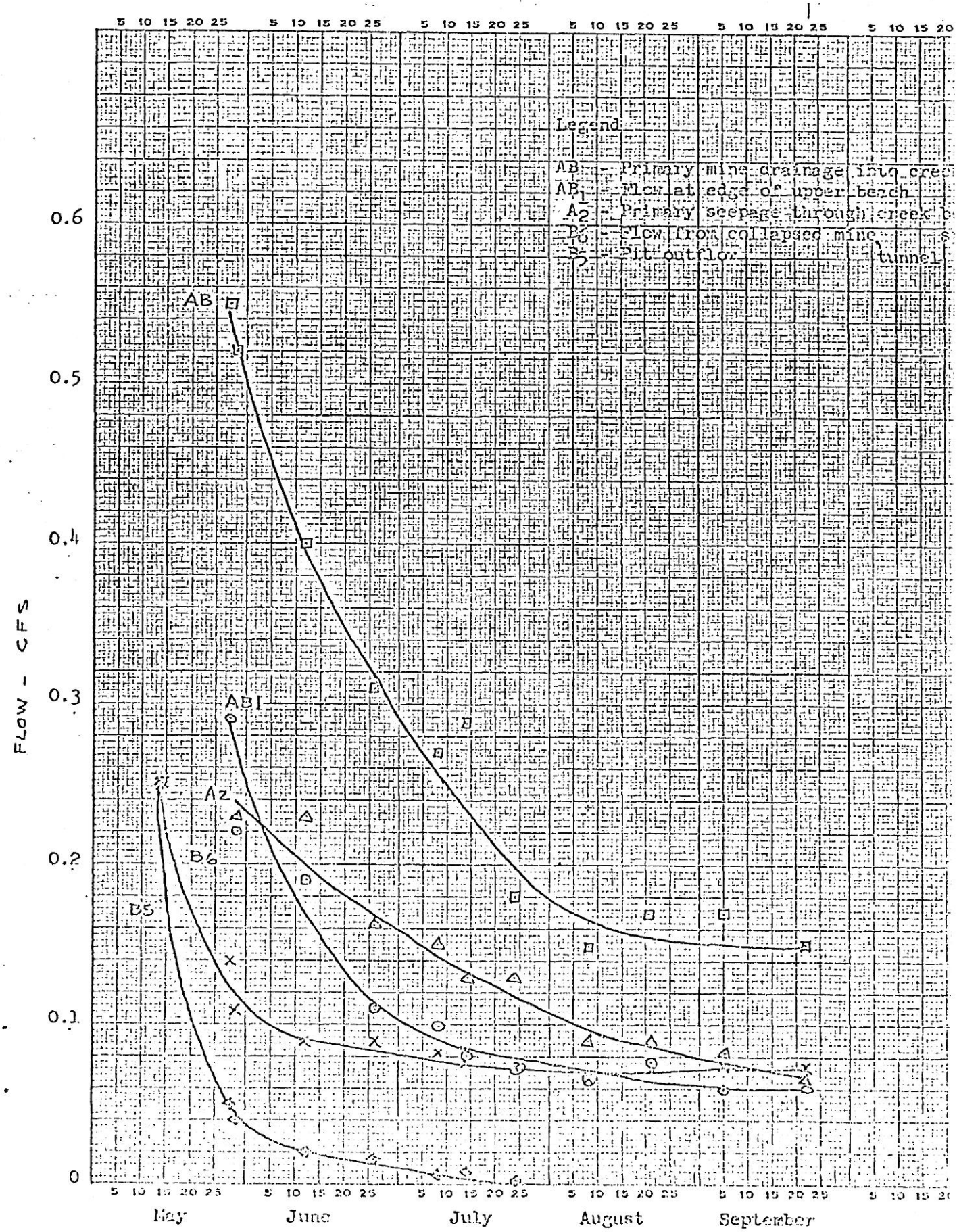
	May			June			July			August		September	
STATION/1	14	28	29	12&13/2/4	24	26	8&9/2	14	23&24/2	7&8/2	21	4&5/2	22&23/2/4
A_3					0.033				0.05		0.036	0.020	0.029
AB		0.55	0.50	0.40	0.297	0.31	0.27	0.29	0.19	0.15	0.17	0.17	0.15
A_2			0.23	0.23	0.191	0.163	0.151	0.13	0.129	0.090	0.090	0.082	0.067
AB_1		0.29	0.22	0.19	0.113	0.11	0.10	0.08	0.0742	0.067	0.078	0.060	0.060
A_1					0.0033		0.0033		0	0	0	0	0
B_6	0.25/3	0.14	0.11	0.09	0.110	0.090	0.082	0.0781	0.0742	0.067	0.074	0.074	0.074
B_5	0.25/3	0.05	0.04	0.02	0.024	0.008	0.003	0.0085	0.0013	0	0	0	0
B_4				0.0009		0.0005	0 (wet)		0.0002		Pools	Pools	Pools
B_3				0.0005		0 (wet)	0 (wet)		0 (wet)	0		0	0
B_2				0.0014		0.0005/3	Trickle		Trickle	0		Trickle	Trickle
B_1				0.0022		0.0005/3	0.0004/3		0.0004/3	Trickle	Trickle	Trickle	Trickle
C_1			0.13	0.15	0.123	0.109	0.099		0.0904	0.110	0.10	0.082	0.082
C_2								0.1185	0.1185			0.090	0.090
C_3					0.018							Trickle	Trickle

/1 See Plate 10 and Tabulation on Page 4 for location and description.
/2 Measurements made on one of the two dates.
/3 Estimated.
/4 Water quality samples taken on these dates.

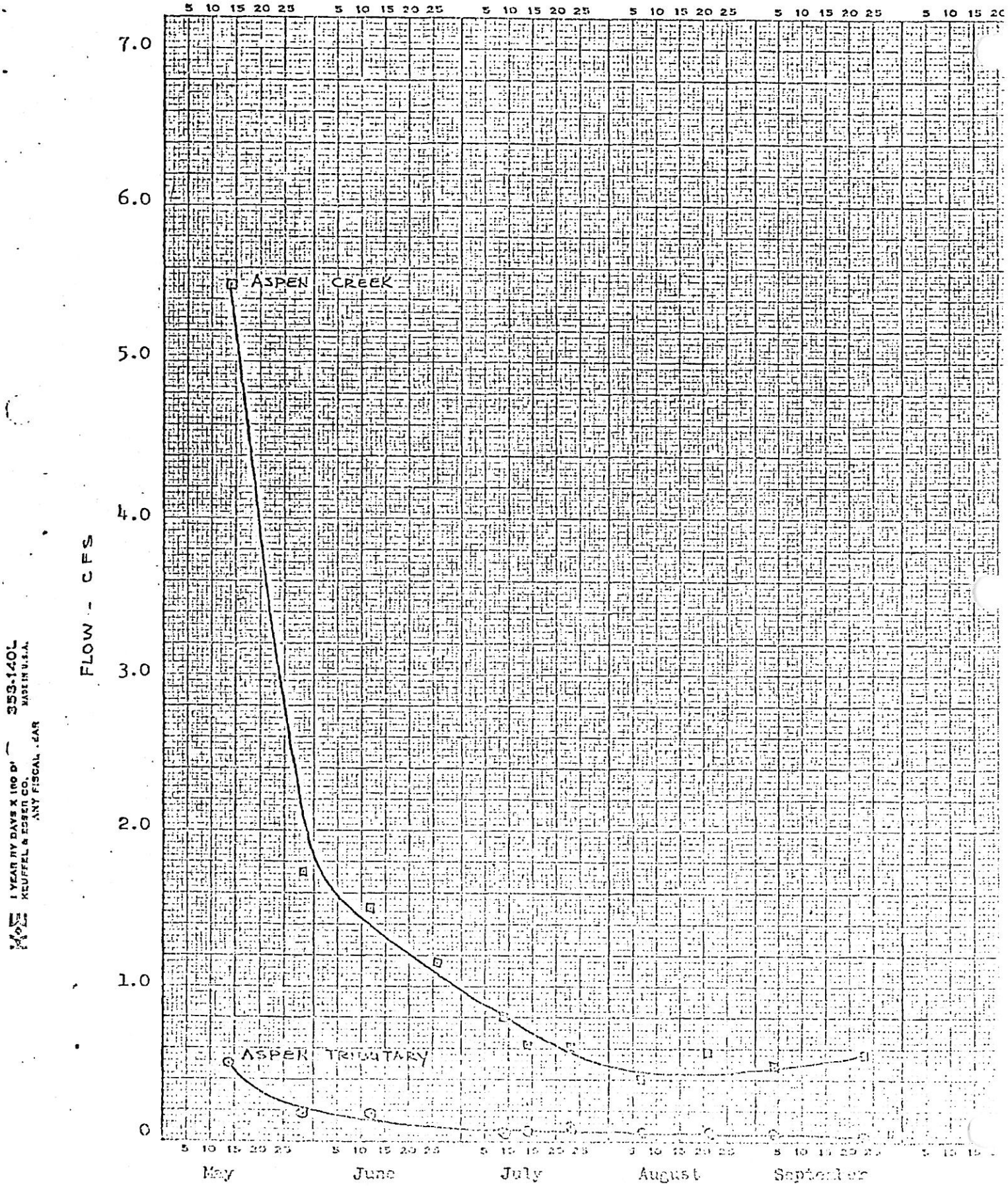


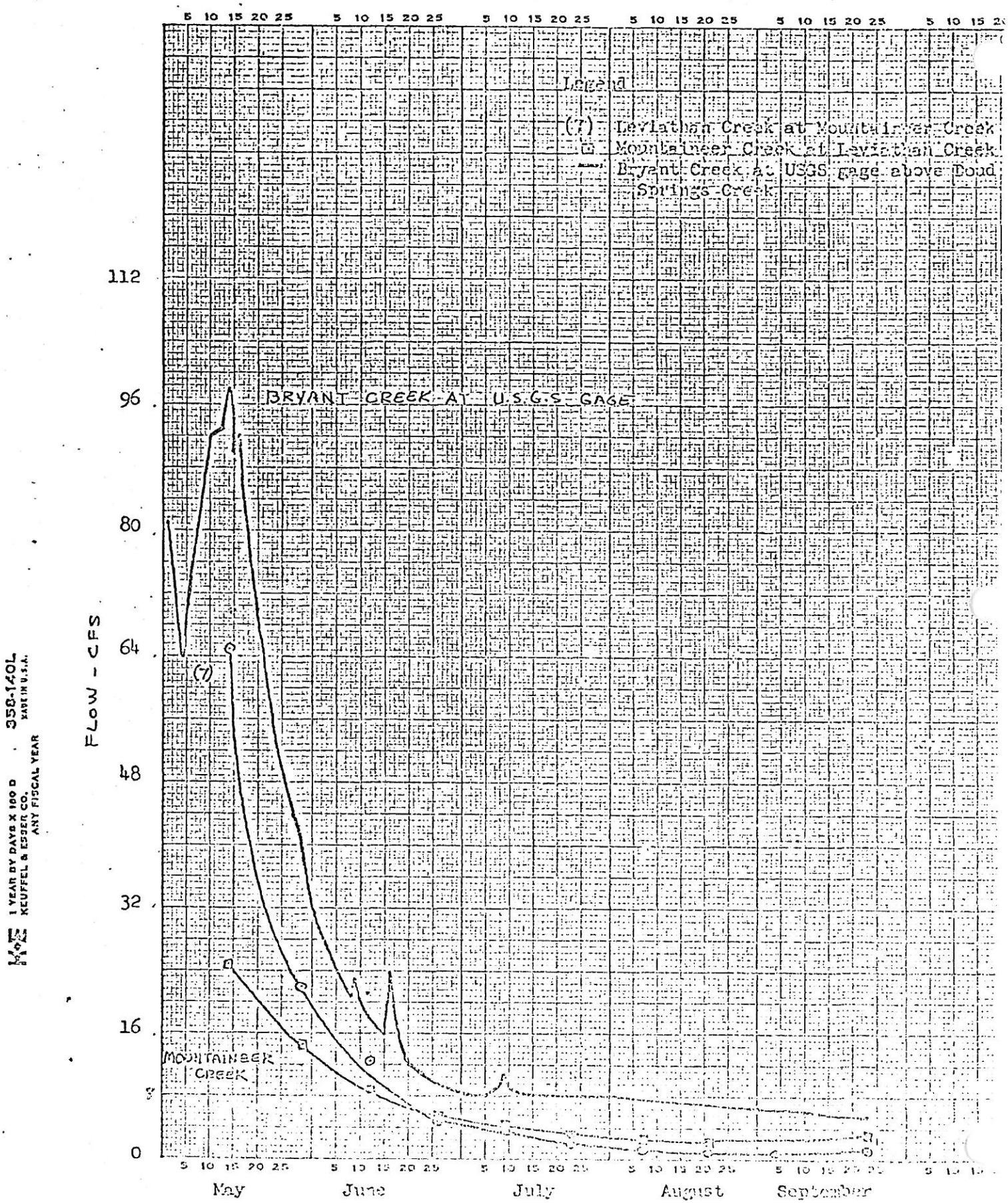
359-140L
1 YEAR BY DAYS X 100 DI
KEUFFEL & ESSER CO.
ANY FISCAL YEAR
MADE IN U.S.A.

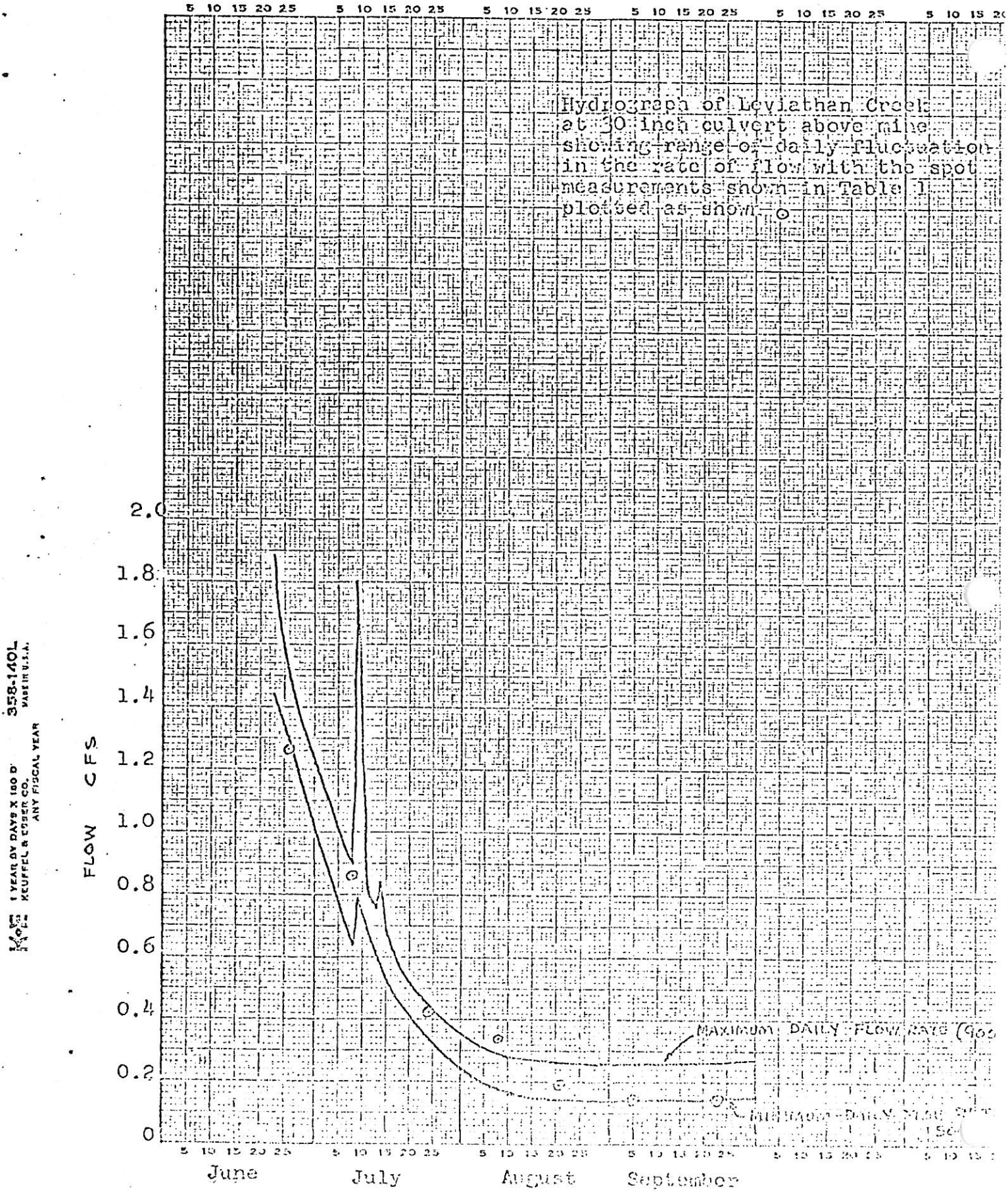
1969

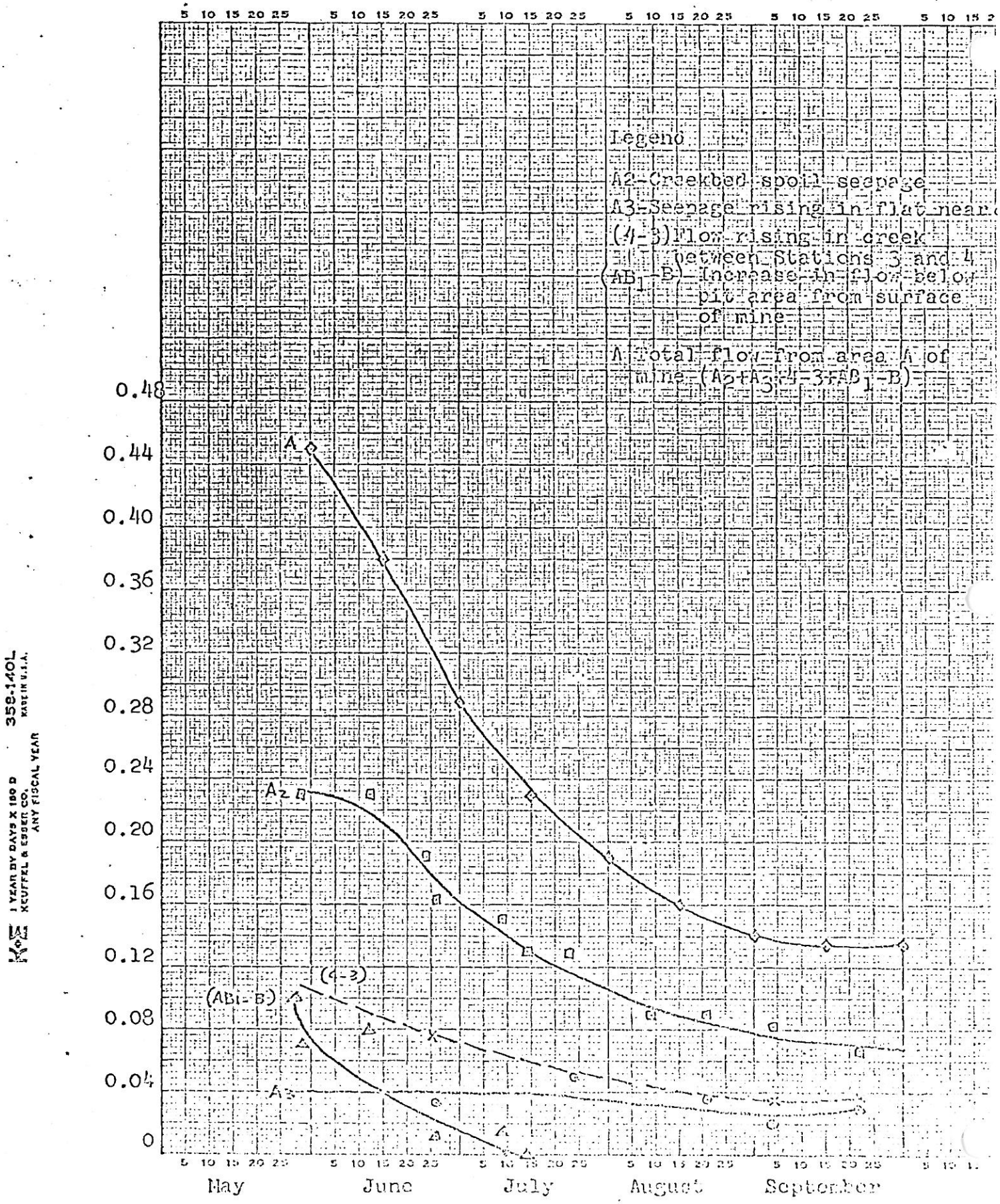

Legend
AB - Primary mine drainage into cree
AB1 - Flow at edge of upper beach
A2 - Primary seepage through creek b
B6 - Flow from collapsed mine s
B5 - Pit outflow tunnel
AB
AB1
A2
B6
B5
FLOW - CFS
0.6
0.5
0.4
0.3
0.2
0.1
0
5 10 15 20 25
May
June
July
August
September

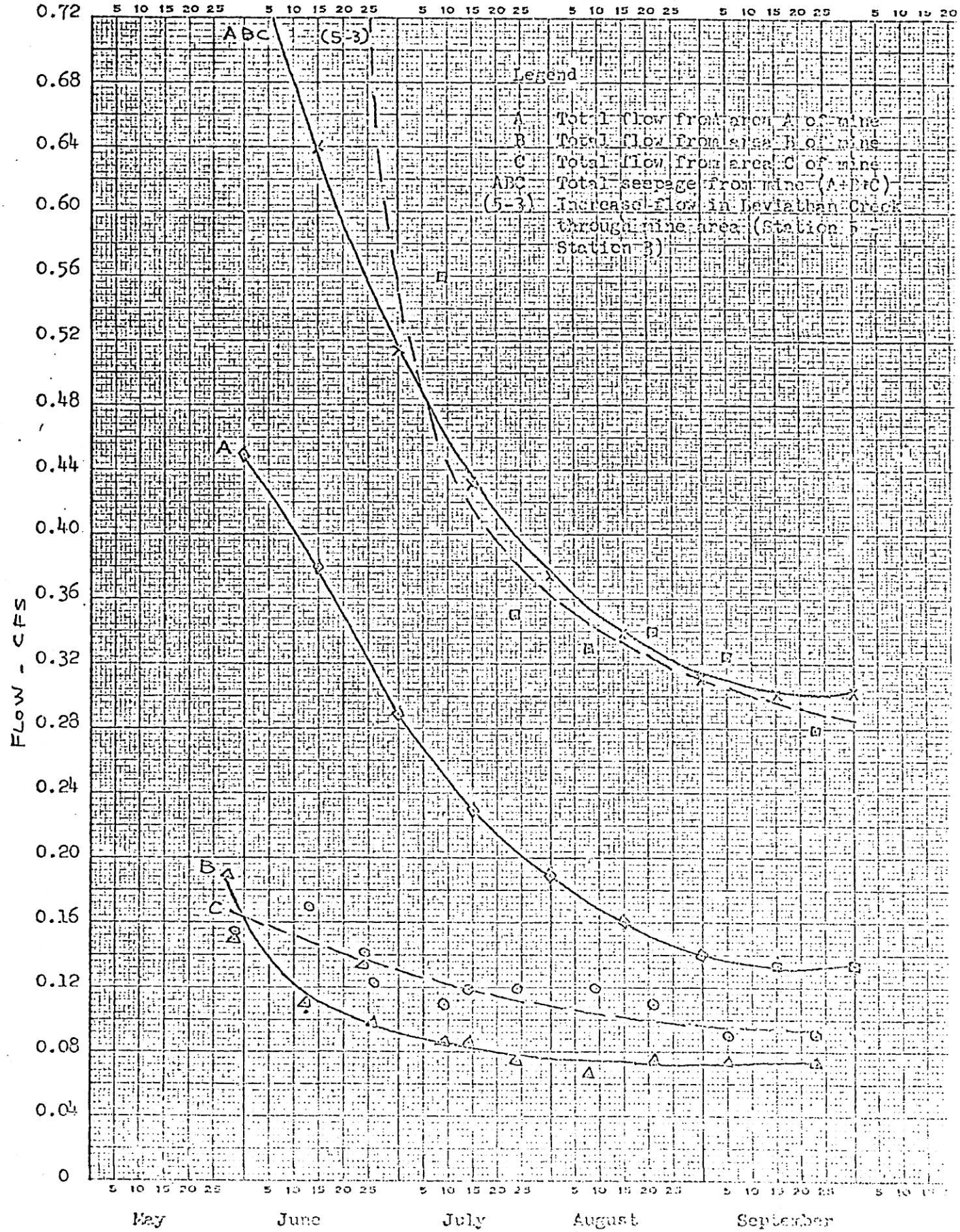
1969


FLOW - CFS
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
ASPEN CREEK
ASPEN TRIBUTARY
May
June
July
August
September
1 YEAR BY DAYS X 100 DIV
KEUFFEL & ESSER CO.
ANY FISCAL YEAR
353-140L
MADE IN U.S.A.

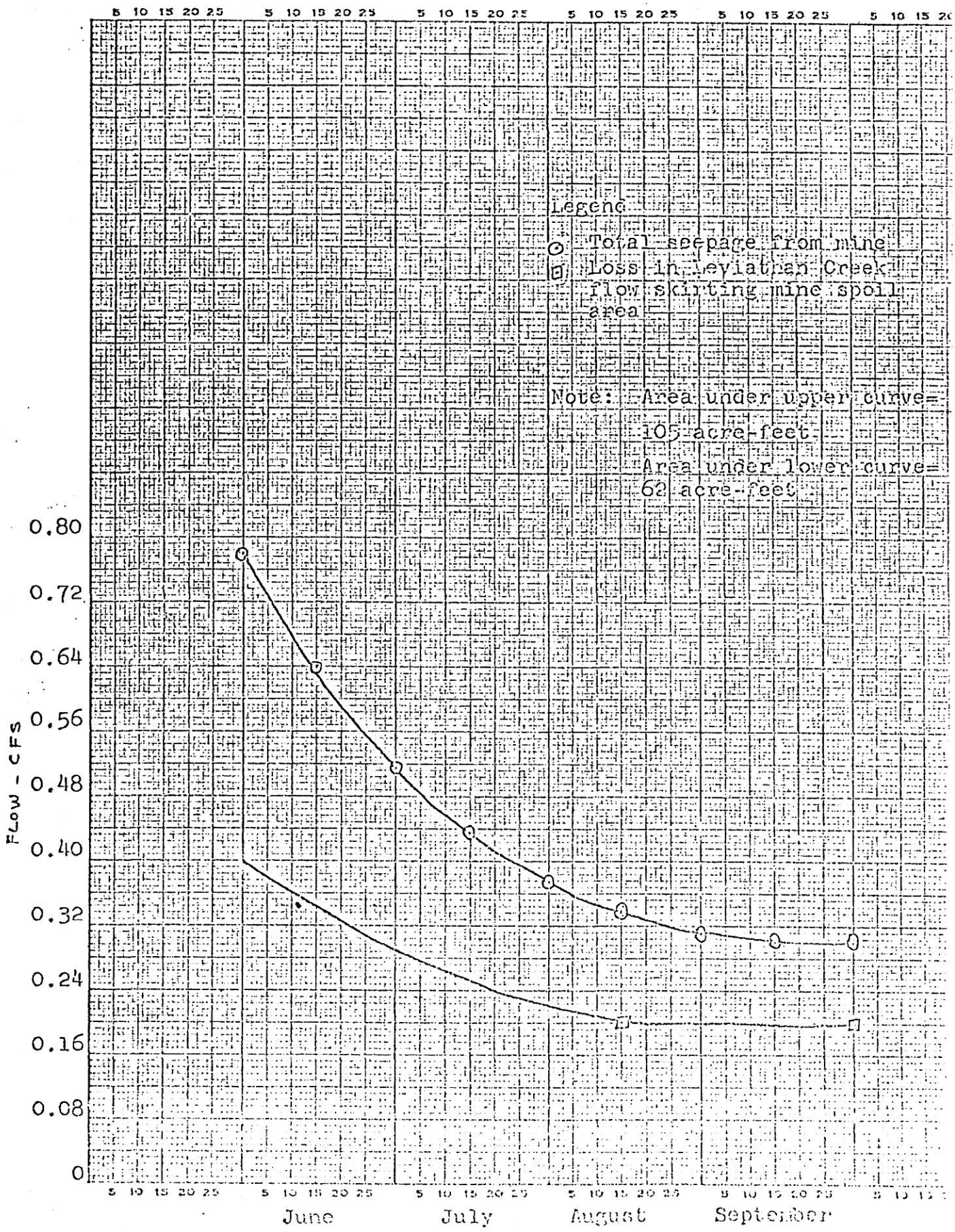

Legend
(7) Leviathan Creek at Mountaineer Creek
Mountaineer Creek at Leviathan Creek
Bryant Creek at USGS gage above Doud Springs Creek
BRYANT CREEK AT U.S.G.S. GAGE
MOUNTAINEER CREEK
(7)
FLOW - CFS
112
96
80
64
48
32
16
0
May
June
July
August
September
1 YEAR BY DAYS X 100 D
KEUFFEL & ESSER CO.
ANY FISCAL YEAR
358-140L
MADE IN U.S.A.


Hydrograph of Leviathan Creek
at 30 inch culvert above mine
showing range of daily fluctuation
in the rate of flow with the spot
measurements shown in Table 1
plotted as shown ⊙
FLOW CFS
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
MAXIMUM DAILY FLOW RATE
June
July
August
September
358-140L
MADE IN U.S.A.
1 YEAR BY DAYS X 100 D
KEUFFEL & ESSER CO.
ANY FISCAL YEAR


Legend
A2-Creekbed spoil seepage
A3-Seepage rising in flat near
(4-3)Flow rising in creek between Stations 3 and 4
(AB1-B) Increase in flow below pit area from surface of mine
A Total flow from area A of mine (A2+A3+4-3+AB1-B)
0.48
0.44
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0
A
A2
(4-3)
(AB1-B)
A3
5 10 15 20 25
May
June
July
August
September
358-140L
1 YEAR BY DAYS X 180 D
KEUFFEL & ESSER CO.
ANY FISCAL YEAR
MADE IN U.S.A.



1 YEAR BY DAYS X 180 D'
KEUFFEL & ESSER CO.
ANY FISCAL YEAR
358-140L
MADE IN U.S.A.


Legend
Total seepage from mine
Loss in Leviathan Creek flow skirting mine spoil area
Note: Area under upper curve= 105 acre-feet
Area under lower curve= 62 acre-feet
FLOW - CFS
0.80
0.72
0.64
0.56
0.48
0.40
0.32
0.24
0.16
0.08
0
5 10 15 20 25
June
July
August
September

(Butterfield, 1977)

Soil Quality Results from the Project Database
Butterfield (1977)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Soil 1		Ca, Exchangeable	2.9	meq/100g	strongly altered material	BUT-001
Soil 1		clay	22	percent	strongly altered material	BUT-001
Soil 1		Cu, Available	10	ppm	strongly altered material	BUT-001
Soil 1		Fe, Available	39	ppm	strongly altered material	BUT-001
Soil 1		K, Available	40	ppm	strongly altered material	BUT-001
Soil 1		Mg, Exchangeable	1	meq/100g	strongly altered material	BUT-001
Soil 1		Mn, Available	15	ppm	strongly altered material	BUT-001
Soil 1		NO3, Available	0.6	ppm	strongly altered material	BUT-001
Soil 1		pH	4.3	su	strongly altered material	BUT-001
Soil 1		sand	63	percent	strongly altered material	BUT-001
Soil 1		silt	15	percent	strongly altered material	BUT-001
Soil 1		Zn, Available	0.7	ppm	strongly altered material	BUT-001
Soil 10		Ca, Exchangeable	11.8	meq/100g	weakly altered material	BUT-001
Soil 10		clay	52	percent	weakly altered material	BUT-001
Soil 10		Cu, Available	0.7	ppm	weakly altered material	BUT-001
Soil 10		Fe, Available	37	ppm	weakly altered material	BUT-001
Soil 10		K, Available	310	ppm	weakly altered material	BUT-001
Soil 10		Mg, Exchangeable	3.9	meq/100g	weakly altered material	BUT-001
Soil 10		Mn, Available	28	ppm	weakly altered material	BUT-001
Soil 10		NO3, Available	0.5	ppm	weakly altered material	BUT-001
Soil 10		pH	4.2	su	weakly altered material	BUT-001
Soil 10		sand	36	percent	weakly altered material	BUT-001
Soil 10		silt	12	percent	weakly altered material	BUT-001
Soil 10		Zn, Available	1	ppm	weakly altered material	BUT-001
Soil 11		Ca, Exchangeable	6	meq/100g	weakly altered material	BUT-001
Soil 11		clay	63	percent	weakly altered material	BUT-001
Soil 11		Cu, Available	1	ppm	weakly altered material	BUT-001
Soil 11		Fe, Available	50	ppm	weakly altered material	BUT-001
Soil 11		K, Available	205	ppm	weakly altered material	BUT-001
Soil 11		Mg, Exchangeable	1.6	meq/100g	weakly altered material	BUT-001
Soil 11		Mn, Available	7	ppm	weakly altered material	BUT-001
Soil 11		NO3, Available	1	ppm	weakly altered material	BUT-001
Soil 11		pH	2.9	su	weakly altered material	BUT-001
Soil 11		sand	24	percent	weakly altered material	BUT-001
Soil 11		silt	13	percent	weakly altered material	BUT-001
Soil 11		Zn, Available	1.6	ppm	weakly altered material	BUT-001
Soil 12		Ca, Exchangeable	32	meq/100g	weakly altered material	BUT-001
Soil 12		clay	48	percent	weakly altered material	BUT-001
Soil 12		Cu, Available	1.8	ppm	weakly altered material	BUT-001
Soil 12		Fe, Available	33	ppm	weakly altered material	BUT-001
Soil 12		K, Available	470	ppm	weakly altered material	BUT-001
Soil 12		Mg, Exchangeable	10	meq/100g	weakly altered material	BUT-001
Soil 12		Mn, Available	6.3	ppm	weakly altered material	BUT-001
Soil 12		NO3, Available	1.4	ppm	weakly altered material	BUT-001
Soil 12		P, Available	41	ppm	weakly altered material	BUT-001
Soil 12		pH	6.7	su	weakly altered material	BUT-001
Soil 12		sand	37	percent	weakly altered material	BUT-001
Soil 12		silt	15	percent	weakly altered material	BUT-001
Soil 12		Zn, Available	1.3	ppm	weakly altered material	BUT-001
Soil 13		Ca, Exchangeable	32	meq/100g	weakly altered material	BUT-001
Soil 13		clay	41	percent	weakly altered material	BUT-001
Soil 13		Cu, Available	3.1	ppm	weakly altered material	BUT-001
Soil 13		Fe, Available	20	ppm	weakly altered material	BUT-001
Soil 13		K, Available	480	ppm	weakly altered material	BUT-001
Soil 13		Mg, Exchangeable	10	meq/100g	weakly altered material	BUT-001
Soil 13		Mn, Available	3.3	ppm	weakly altered material	BUT-001
Soil 13		NO3, Available	0.7	ppm	weakly altered material	BUT-001
Soil 13		P, Available	6	ppm	weakly altered material	BUT-001
Soil 13		pH	7	su	weakly altered material	BUT-001
Soil 13		sand	47	percent	weakly altered material	BUT-001
Soil 13		silt	12	percent	weakly altered material	BUT-001
Soil 13		Zn, Available	1.6	ppm	weakly altered material	BUT-001
Soil 2		Ca, Exchangeable	5.9	meq/100g	strongly altered material	BUT-001
Soil 2		clay	34	percent	strongly altered material	BUT-001

Soil 2		Cu, Available	3.5	ppm	strongly altered material	BUT-001
Soil 2		Fe, Available	39	ppm	strongly altered material	BUT-001
Soil 2		K, Available	135	ppm	strongly altered material	BUT-001
Soil 2		Mg, Exchangeable	2.3	meq/100g	strongly altered material	BUT-001
Soil 2		Mn, Available	26	ppm	strongly altered material	BUT-001
Soil 2		NO3, Available	1	ppm	strongly altered material	BUT-001
Soil 2		pH	4.5	su	strongly altered material	BUT-001
Soil 2		sand	46	percent	strongly altered material	BUT-001
Soil 2		silt	20	percent	strongly altered material	BUT-001
Soil 2		Zn, Available	2	ppm	strongly altered material	BUT-001
Soil 3		Ca, Exchangeable	4.2	meq/100g	strongly altered material	BUT-001
Soil 3		clay	38	percent	strongly altered material	BUT-001
Soil 3		Cu, Available	0.6	ppm	strongly altered material	BUT-001
Soil 3		Fe, Available	18	ppm	strongly altered material	BUT-001
Soil 3		K, Available	60	ppm	strongly altered material	BUT-001
Soil 3		Mg, Exchangeable	3.2	meq/100g	strongly altered material	BUT-001
Soil 3		Mn, Available	7	ppm	strongly altered material	BUT-001
Soil 3		NO3, Available	0.8	ppm	strongly altered material	BUT-001
Soil 3		pH	4.4	su	strongly altered material	BUT-001
Soil 3		sand	47	percent	strongly altered material	BUT-001
Soil 3		silt	15	percent	strongly altered material	BUT-001
Soil 3		Zn, Available	0.6	ppm	strongly altered material	BUT-001
Soil 4		Ca, Exchangeable	6.8	meq/100g	strongly altered material	BUT-001
Soil 4		clay	16	percent	strongly altered material	BUT-001
Soil 4		Cu, Available	1.3	ppm	strongly altered material	BUT-001
Soil 4		Fe, Available	13	ppm	strongly altered material	BUT-001
Soil 4		K, Available	30	ppm	strongly altered material	BUT-001
Soil 4		Mg, Exchangeable	0.9	meq/100g	strongly altered material	BUT-001
Soil 4		Mn, Available	1.4	ppm	strongly altered material	BUT-001
Soil 4		NO3, Available	1.5	ppm	strongly altered material	BUT-001
Soil 4		P, Available	3	ppm	strongly altered material	BUT-001
Soil 4		pH	7	su	strongly altered material	BUT-001
Soil 4		sand	62	percent	strongly altered material	BUT-001
Soil 4		silt	22	percent	strongly altered material	BUT-001
Soil 4		Zn, Available	0.7	ppm	strongly altered material	BUT-001
Soil 5		Ca, Exchangeable	17.4	meq/100g	weakly altered material	BUT-001
Soil 5		clay	62	percent	weakly altered material	BUT-001
Soil 5		Cu, Available	1	ppm	weakly altered material	BUT-001
Soil 5		Fe, Available	39	ppm	weakly altered material	BUT-001
Soil 5		K, Available	270	ppm	weakly altered material	BUT-001
Soil 5		Mg, Exchangeable	3.1	meq/100g	weakly altered material	BUT-001
Soil 5		Mn, Available	50	ppm	weakly altered material	BUT-001
Soil 5		NO3, Available	1	ppm	weakly altered material	BUT-001
Soil 5		pH	3.8	su	weakly altered material	BUT-001
Soil 5		sand	25	percent	weakly altered material	BUT-001
Soil 5		silt	13	percent	weakly altered material	BUT-001
Soil 5		Zn, Available	2	ppm	weakly altered material	BUT-001
Soil 6		Ca, Exchangeable	15.8	meq/100g	weakly altered material	BUT-001
Soil 6		clay	67	percent	weakly altered material	BUT-001
Soil 6		Cu, Available	0.6	ppm	weakly altered material	BUT-001
Soil 6		Fe, Available	33	ppm	weakly altered material	BUT-001
Soil 6		K, Available	350	ppm	weakly altered material	BUT-001
Soil 6		Mg, Exchangeable	6	meq/100g	weakly altered material	BUT-001
Soil 6		Mn, Available	50	ppm	weakly altered material	BUT-001
Soil 6		NO3, Available	0.3	ppm	weakly altered material	BUT-001
Soil 6		pH	4.2	su	weakly altered material	BUT-001
Soil 6		sand	24	percent	weakly altered material	BUT-001
Soil 6		silt	9	percent	weakly altered material	BUT-001
Soil 6		Zn, Available	3.1	ppm	weakly altered material	BUT-001
Soil 7		Ca, Exchangeable	6.1	meq/100g	weakly altered material	BUT-001
Soil 7		clay	56	percent	weakly altered material	BUT-001
Soil 7		Cu, Available	0.5	ppm	weakly altered material	BUT-001
Soil 7		Fe, Available	50	ppm	weakly altered material	BUT-001
Soil 7		K, Available	200	ppm	weakly altered material	BUT-001
Soil 7		Mg, Exchangeable	1.8	meq/100g	weakly altered material	BUT-001

Soil Quality Results from the Project Database
Butterfield (1977)
Leviathan Mine Site
Alpine County, California

Soil 7		Mn, Available	29	ppm	weakly altered material	BUT-001
Soil 7		NO3, Available	0.8	ppm	weakly altered material	BUT-001
Soil 7		pH	3.5	su	weakly altered material	BUT-001
Soil 7		sand	33	percent	weakly altered material	BUT-001
Soil 7		silt	11	percent	weakly altered material	BUT-001
Soil 7		Zn, Available	1.5	ppm	weakly altered material	BUT-001
Soil 8		Ca, Exchangeable	29	meq/100g	weakly altered material	BUT-001
Soil 8		clay	65	percent	weakly altered material	BUT-001
Soil 8		Cu, Available	1	ppm	weakly altered material	BUT-001
Soil 8		Fe, Available	32	ppm	weakly altered material	BUT-001
Soil 8		K, Available	470	ppm	weakly altered material	BUT-001
Soil 8		Mg, Exchangeable	10	meq/100g	weakly altered material	BUT-001
Soil 8		Mn, Available	50	ppm	weakly altered material	BUT-001
Soil 8		NO3, Available	0.4	ppm	weakly altered material	BUT-001
Soil 8		pH	4.5	su	weakly altered material	BUT-001
Soil 8		sand	25	percent	weakly altered material	BUT-001
Soil 8		silt	10	percent	weakly altered material	BUT-001
Soil 8		Zn, Available	1.5	ppm	weakly altered material	BUT-001
Soil 9		Ca, Exchangeable	7.5	meq/100g	weakly altered material	BUT-001
Soil 9		clay	65	percent	weakly altered material	BUT-001
Soil 9		Cu, Available	0.6	ppm	weakly altered material	BUT-001
Soil 9		Fe, Available	41	ppm	weakly altered material	BUT-001
Soil 9		K, Available	190	ppm	weakly altered material	BUT-001
Soil 9		Mg, Exchangeable	3	meq/100g	weakly altered material	BUT-001
Soil 9		Mn, Available	16	ppm	weakly altered material	BUT-001
Soil 9		NO3, Available	2	ppm	weakly altered material	BUT-001
Soil 9		pH	3.7	su	weakly altered material	BUT-001
Soil 9		sand	24	percent	weakly altered material	BUT-001
Soil 9		silt	11	percent	weakly altered material	BUT-001
Soil 9		Zn, Available	1.8	ppm	weakly altered material	BUT-001

Notes:

Informaton obtained from database source code BUT-001 within the project database. The original source was from *The Revegetation Potential of the Leviathan Mine Spoils,* MS Thesis, University of Nevada, Reno, Richard Butterfield (1977)

Ca = Calcium, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, NO3 = Nitrate, SO4 = Sulfate, Zn = Zinc, ppm = parts per million, meq/100g milli-equivalents per 100 grams, su= standard units

LEVIATHAN MINE POLLUTION ABATEMENT PROJECT, DESIGN REPORT AND DRAFT ENVIRONMENTAL IMPACT REPORT, APRIL 1983

(Brown and Caldwell, 1983)

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LAHONTAN REGION

LEVIATHAN MINE POLLUTION ABATEMENT PROJECT

DESIGN REPORT AND DRAFT ENVIRONMENTAL IMPACT REPORT

APRIL 1983

BROWN AND CALDWELL
CONSULTING ENGINEERS

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

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LEVIATHAN MINE POLLUTION ABATEMENT PROJECT

DESIGN REPORT AND DRAFT ENVIRONMENTAL IMPACT REPORT

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Engineering and Environmental Studies

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Jeanne Duncan, Technical Writer
Mary Jane Dunckhorst, Word Processing Supervisor
Sylvia Prosser, Typist
Amy Matsunaga, Typist
Michael A. Doran, Graphic Arts
David R. Duncan
William P. Veile

GEOTECHNICAL CONSULTANTS, INC.

Joseph M. Gonzalez
Richard C. Slade
Joseph F. Montagna

ANDREW LEISER

Andrew Leiser, Ph.D.

UNITED STATES GEOLOGICAL SURVEY

Dale Hammermeister

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CHAPTER 1

INTRODUCTION AND EXECUTIVE SUMMARY

This design report and draft environmental impact report is the result of engineering work conducted over the past year to design a project that will correct the serious water pollution of Leviathan Creek that results from past mining activities at the Leviathan Mine. The report has been prepared to meet the objective of the California Regional Water Quality Control Board, Lahontan Region, (Regional Board) to develop a project that will restore the water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity, within the limitations of available funding.

MAGNITUDE OF THE PROBLEM

Leviathan Mine is a large, inactive and unreclaimed sulfur mine located on the eastern slope of the Sierra Nevada in Alpine County, California. The site includes a total of 245 acres of land devastated by mining operations. Much of it is covered by mining waste to a considerable depth. A large open pit lies on the southerly portion of the site, and there is a 30-acre landslide on the northern portion. A waste dump, consisting of several million cubic yards of material excavated from the lower zone of the mine pit, lies to the west of the pit.

Subsurface mining began at the site in the early 1860s and continued, with numerous periods of inactivity, through the early 1950s. From that time until cessation of mining, surface mining techniques (open pit mining) were used. Excavation of the open pit created large spoil tailings and waste dump areas that partially block Aspen and Leviathan Creeks.

Leviathan Creek flows directly through portions of the mine site and becomes contaminated as it passes through mine waste materials and receives seeps and discharges from the mine. Precipitation readily infiltrates into the porous waste materials, and leachate is developed which migrates to groundwater and feeds the numerous seeps. The active landslide on the north side of the mine tends to disrupt flow in Leviathan Creek and contributes to pollution of the stream.

The creek above Leviathan Mine is a good quality mountain stream. Below the mine, water quality degradation has eliminated fish and seriously impaired other beneficial uses downstream to the East Fork Carson River, despite dilution effects of several unpolluted tributaries. Characterizing the degradation are low pH (acidity), high concentrations of sulfates, iron, arsenic, copper, and other heavy metals, high dissolved solids, and turbidity.

The conditions that contribute to the pollution of Leviathan Creek from the mine site have developed over several decades, and extend over a wide area. Pollution enters the creek from many sources, some of which cannot easily be quantified. A project that attempts to restore Leviathan Creek to its pre-mine state of water quality is necessarily broad in scope. The choice of solutions to the problem is further limited by the need to develop abatement methods that do not require operation, and involve minimal maintenance.

OPTIONS AND THEIR FEASIBILITY

The level to which pollution abatement can attain the desired pre-mining water quality conditions and restore beneficial uses of the stream will be determined, ultimately, by available financial resources. The Regional Board has been awarded a $3.76 million grant for the Leviathan Mine Pollution Abatement Project through the 1978 California Clean Water and Water Conservation Bond Law. An earlier feasibility study for this project, which was based on much less data and developed options in less detail, estimated that a complete abatement project could be developed within the range of available funding. Considerable additional investigation was made and data developed for this study. The conclusions of this report unmistakably confirm that engineering and construction costs and subsequent maintenance required to restore pre-mining water quality conditions would far exceed the funding presently available.

This report, therefore, serves two purposes: (1) to establish a maximum feasible pollution abatement project (i.e. the maximum abatement project that the Regional Board could implement if not constrained by funding, and (2) to define a project that will improve water quality and restore beneficial uses to the greatest extent possible within the limits of available funds. To serve both these purposes, it was necessary to analyze problem sources and develop control methods in sufficient detail to permit estimation of their construction costs. It was also necessary to develop design concepts to the level needed to estimate their probable cost and their probable pollution control effectiveness (cost-effectiveness).

As a result of this analysis and conceptual design, two potential projects have been developed and are presented in Chapter 7. The project presented as the "Recommended Project" is a project which accomplishes the maximum level of pollution abatement and downstream restoration of beneficial uses that is attainable within the limits of available funding. The project presented as the "Maximum Feasible Pollution Abatement Project" would produce further improvement of downstream water quality by more intensive application of control concepts shown to be cost-effective in the Recommended Project.

Both projects were evolved through an alternative projects screening process presented in Chapter 6 which concludes with identification of an "Apparent Best (alternative) Project." The screening process considered cost, control effectiveness, and water quality benefits. Seven alternatives were examined, ranging in cost from about $2 million to $8 million. Figure 6-5 (Chapter 6) shows a cost-effectiveness comparison of the alternatives. Alternatives B and C appear at the point on the cost-effectiveness curve where the incremental effectiveness of expending more money for construction begins to taper off. Alternative B was identified as the Apparent Best Project. This optimal project concept has been used to develop a Recommended Project within available funding, and also to identify the maximum feasible project.

Recommended Project

Discussed beginning on Page 7-1, the recommended project was developed from the most cost effective features of the apparent best alternative, with modifications to reduce costs. After analysis and refinement of elements of the apparent best alternative, a project was developed within available funding that nearly achieves the control level of the most expensive alternative. Control effectiveness of the recommended project is discussed in detail in Chapter 7. With the recommended project, water quality criteria could be met to restore irrigation, stock watering, and groundwater recharge beneficial uses. The only pre-mining beneficial use that would not be restored by the recommended project is cold freshwater aquatic habitat. However, even with respect to this beneficial use, the project would provide major advancement of the stream condition toward the necessary quality.

Table 1-1 shows the major problem areas contributing to water quality degradation of Leviathan Creek, and the percent contribution of each to the total problem. The recommended project concentrates on control measures that would achieve the maximal reduction in water quality impacts from these major pollution sources for the least cost.

Table 1-1. Leviathan Mine Problem Areas and Importance

	Average percent contribution[a]	Correction priority
Waste dump, delta, and Spoil Areas B and C	39	1
Mine pit and Adit No. 5	35	2
Spoil Area A and landslide	26	3

[a]Percent of total estimated dissolved minerals load as measured by TDS.

Major elements of the recommended project are:

1. Leviathan Creek Channelization. Realignment of 1,900 linear feet of the creek channel would redirect the creek and prevent its contamination by passage through mine waste materials. The use of a sealed channel would prevent acid groundwater seepage from entering the channel through the sides and bottom.

2. Mine Pit Filling and Regrading. Construction of compacted terraced surfaces and sealed surface drainage channels would increase the quantity and improve the quality of surface drainage from the pit. Open channels would be constructed to carry runoff rapidly to the bottom of the pit. A pipeline would be installed to carry surface drainage from the pit to Leviathan Creek.

3. Waste Dump Excavation and Regrading. The waste dump would be regraded to eliminate erosion and infiltration. Excavated materials would be used for fill for earthwork planned for the mine pit and other areas.

4. On-site evaporation ponds. Surface runoff can be allowed to flow to the creek without significantly affecting water quality. Subsurface drainage, however, contains leachates which seriously degrade water quality. Evaporation ponds would be constructed on-site to receive subsurface drainage collected by a mine pit and adit underdrain system. The waste dump excavation would produce a flat surface on the reduced

dump to allow construction of seven acres of ponds. Ponds would be lined with heavy and durable plastic membranes to prevent seepage through the bottom and sides and consequent groundwater degradation. A total of 15 acres of ponds would be constructed using the waste dump and other areas on-site. The evaporation pond area would not be sufficient to dispose of all the subsurface drainage, therefore discharge of contaminated water would occur in the early- to mid-spring period of average water years.

5. Spoil Area A Regrading and Drainage Work. This involves regrading of surface depressions and constructing surface drainage channels to improve drainage. Improved surface drainage would reduce infiltration and subsurface drainage.

Chapter 7 includes a presentation of the costs and discussions of the potential improvement in pollution abatement of revegetation if the mine site is added to the recommended project. A determination as to whether or not revegetation should be added to the project must await the results of the revegetation pilot study which is to be conducted at the site over the next two years.

The recommended project would reduce the annual mean TDS load from the mine site by an estimated 79 percent. The construction bid price for the project is estimated at $2.8 million. The average annual cost for project maintenance is estimated at $10,500 for the first five years. These costs are detailed in Tables 7-1 and 7-2 (Chapter 7).

Maximum Feasible Pollution Abatement Project

A more intense application of the control methods employed in the recommended project would be used to develop the maximum feasible pollution abatement project. This project would include three options representing two separate maximum cost-effective options of excavation/regrading or revegetation added to the recommended project, and a third option that combines the recommended project with both of the maximum but still cost-effective options to develop the maximum feasible level of control. Extreme regrading and filling of the pit is used to drastically reduce subsurface flow to the level that can be completely contained by evaporative ponds on the site. Surface flows would also be reduced by vegetative uptake and transpiration from the intense revegetation of the regraded areas of the waste dump, pit, and Spoil Area A.

The most effective combination of control methods used to achieve the maximum feasible pollution abatement project would reduce the annual mean TDS load from the mine site by from 85 to

90 percent. This could be achieved at an estimated construction bid price of $5.8 million. Because the initial five-year period of maintenance would require substantial vegetative replanting, the average annual cost for project maintenance is estimated to be $92,000 for the first five years. These costs are detailed in Tables 7-16 and 7-17 (Chapter 7).

CONTENTS OF THE REPORT

This report constitutes both the Draft Environmental Impact Report and the preliminary design report for the project, and includes the construction management plan. A revegetation plan is also included as Appendix A. The report presents detailed information on the data and methods used to define and prioritize problem areas and their importance, and to develop and analyze control methods. It also describes project alternatives, and their costs. The specific organization of the report is described below.

Environmental Impact Report

Elements of the Environmental Impact Report appear throughout the report with related information. Chapter 2 contains the description of the environmental setting. Chapter 6 contains descriptions and environmental assessment of alternative projects. Chapter 7 contains the description and evaluation of the recommended project and the maximum feasible pollution abatement project. Chapter 8 is the environmental impact assessment of the apparent best project. Reviewers are encouraged to examine information presented in other chapters to gain full appreciation of the immensity of the Leviathan Mine pollution problem which must be addressed within the constraints of comparatively limited funding.

Analysis of Problems and Controls

Chapter 3 describes the impact of mine seepage and surface discharges on water quality in Leviathan Creek and downstream waters and quantifies the sources of these pollutants at the mine site. The chapter concludes with a discussion of the order of control priorities determined for problem area correction.

Chapter 4 describes the screening process used to determine the relative effectiveness of a number of potential methods for control of water pollution and control of the landslide. Chapter 5 describes the potential control methods in sufficient detail to allow development of reliable cost estimates and evaluation of their contrrol effectiveness.

Evaluation of Alternatives

Chapter 6 describes the evaluation of seven alternative projects. These alternatives were analyzed for their cost-effectiveness, both in terms of reduction of pollutant loading at the mine site and protection levels for the beneficial uses of Leviathan Creek. This chapter describes how the alternatives were selected, and the evolution of the comparative analysis that led to determination of the apparent best project, later refined to the recommended project.

Chapter 7 fully describes the recommended project and its elements. Control effectiveness and water quality benefits are discussed beginning on Page 7-9. The maximum feasible pollution abatement project is also described in Chapter 7.

Construction Management Plan

The construction management plan describes the progress and organization of construction of the recommended project. Project work is planned for completion in two construction seasons.

CHAPTER 2

PROJECT AREA DESCRIPTION/ENVIRONMENTAL SETTING

As depicted on Figure 2-1,[a] the 265-acre Leviathan Mine property lies within a remote and rugged portion of northeastern Alpine County, California, on the eastern flank of the central Sierra Nevada, near the California-Nevada border, approximately 25 miles southeast of Lake Tahoe, and 6-1/2 miles east of Markleeville, California. As identified on the Topaz Lake and Mt. Siegel U.S. Geological Survey (USGS) quadrangle sheets, the mine property is situated principally within Sections 15 and 22, Township 10 North, Range 21 East, MDB&M, although small portions of the workings extend into the southeastern and northwestern corners of the adjoining Sections 14 and 23, respectively.

Access to the mine area is dependent on the weather, but is provided by unpaved roads from State Highway 89 through Markleeville on the southeast and from U.S. Highway 395 south of Gardnerville, Nevada, on the north. The California-Nevada border lies approximately three miles northeast of the mine.

HISTORY OF SITE

A brief summary of the history and development of Leviathan Mine is considered important in understanding the present pollution problem. This summary, which emphasizes the development of the open pit due to its significant impact on the mine property, is not intended to be a detailed review of all historic mine activities. The reader is referred to the published literature described in the final section of this chapter under the heading "Review of Literature". Referenced literature is completely described in the "References" section at the end of this chapter.

Summary of Mine Development

Leviathan Mine was originally developed in 1863 by prospectors who apparently were seeking a source of blue vitriol for processing silver sulfide ore obtained at the Comstock Mines at Virginia City, Nevada. Six years later, the miners

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[a]Throughout this report, figures referenced in the text are included at the end of the chapter where first referenced. Plates referenced are included in a map pocket following the appendices.

became interested in primary copper minerals, constructed a few adits, and worked at the mine for a few years. Virtually no information exists on these early mine workings, especially on the geology and groundwater conditions encountered during construction and operation. Reportedly, however, operations were terminated in 1872 because the miners had encountered too little copper and too much sulfur.

Apparently, the mine remained idle until the early to mid-1930s at which time development of the sulfur body was initiated. Numerous adits, raises, drifts, and stopes were excavated to explore and mine the sulfur. Another period of virtual inactivity at the mine followed from 1941 to 1951.

In 1951, the property was purchased by the Anaconda Company to develop the sulfur by open-pit methods. According to Nordyke (1953, p. 175), the main sulfur ore body contained as much as 28 percent elemental sulfur and occurred in a crudely lens-shaped body with a maximum thickness of 100 feet. However, it was located beneath nearly 300 feet of overburden. Because of the high fire danger associated with continued underground mining of the concentrated sulfur, the Anaconda Company decided to use the open-pit mining method, despite the high stripping ratio of waste to ore.

Stripping of the overburden commenced in late 1952 and continued until December 1954. During this time, 22,000,000 tons of waste were reportedly removed by a combination of bulldozers, power shovels, and local drilling and blasting. Sulfur removals reportedly totaled approximately 2,500,000 tons during these operations which ended with the mine's abandonment in 1962.

According to information provided by U.S. Borax--Technical Department (correspondence to California Regional Water Quality Control Board, March 4, 1981), open-pit mining was initiated in an easterly (uphill) direction into a hillside and, as it progressed, the waste to ore ratio increased. Reportedly, this stripping ratio varied between 4:1 and 11:1, although U.S. Borax correspondence indicates the amount of waste removed resulted in a somewhat higher overall ratio.

These wastes contained several hundred thousand tons of lower grade ore as compared to the average grade of 28 percent sulfur being mined for commercial extraction. Both sulfur and sulfur-bearing minerals in unknown concentrations exist in waste and spoil areas on the site. According to a California Regional Water Quality Control Board, Lahontan Region (Regional Board) internal memo to Mr. Roy Hampson dated September 14, 1982, which reported upon a discussion with a former engineer for the construction company at the mine, stripping of the overburden and caprock was generally conducted without any

coordinated plans other than to remove the overburden/caprock "in the easiest possible manner with the shortest level haul distance." As a result, materials were not classified, and there was no separation of caprock materials from those of higher sulfur content. Moreover, no dump plans were established and the original ground surface was not prepared in any way prior to dumping of the overburden.

Past Pollution Control Efforts

Because much of the overburden and caprock were placed in and along the channels of Leviathan and Aspen Creeks, streamflow and oxygen were provided ready access to the sulfur in the materials. The open pit served as a bowl to catch and infiltrate precipitation into underlying ore deposits. Infiltration of precipitation into the spoil areas and waste dump created many unnatural seeps. This combination eventually formed acidic conditions and high concentrations of arsenic, copper, zinc, iron, and other pollutants in the creeks, particularly Leviathan Creek. The degradation of Leviathan Creek was documented as early as 1952. After the Anaconda Company began operating the mine as an open pit in 1954, W. W. White of the Nevada State Health Department, T. J. Trelease of the Nevada Department of Fish and Game, and J. T. Leggett of the Regional Board, all observed noticeable changes in the Leviathan Creek water quality during the summer of 1954. In 1956, Anaconda began monthly water quality sampling which continued until 1962 when they sold the property. Reportedly as early as 1956, the Anaconda Company had begun to monitor water quality in the mine area and to attempt to decrease the creek pollution by various methods (Regional Board, November 25, 1968, p. 2). The following pollution control attempts are discussed in the Regional Board report:

1. Anaconda diverted Leviathan Creek around the waste dump in an impervious ditch lined with bentonite clay in an attempt to eliminate leaching of creek water through the waste. Reportedly, this was ineffective because high runoff flows in the creek in the spring tended to wash out the ditch.

2. In 1955, Anaconda began collecting mine seepage in one or more large ponds near Leviathan Creek and then diverting the seepage to a smaller pond where lime was added in an attempt to neutralize the acidic water and to precipitate some of the iron before the water was released to the creek. However, in November 1959, breaching of the pond dike caused the release of a large volume of highly acidic and contaminated (heavy metals) water to Leviathan Creek and resulted in large fish kills as far downstream as the Carson River in Nevada. A Nevada State Department of Health letter to the

Anaconda Company (December 16, 1959) indicates the volume of acid water discharge to the creek from this breaching was on the order of 1 to 5 million gallons, but "probably nearer to 2 million gallons," with a pH of 2.6 to 2.8, and "containing about 500 parts per million (ppm) iron in solution plus deposited iron accumulating in the pond." Anaconda paid the Nevada Department of Fish and Game $4,000 to cover damages from this discharge. The dike was rebuilt after the accident.

3. Anaconda constructed two injection wells near Leviathan Creek in 1960, west-northwest of the open pit in an attempt to dispose of the contaminated water. Waste waters were never successfully discharged through these wells because the wells were allowed to inject by gravity flow not pressure; the wells clogged very rapidly, probably by precipitation of materials in the discharge (possibly also by bacterial plugging), and possibly because the rocks have insufficient fracture permeability and porosity to accept much water.

4. The creek was again relined in 1960 with bentonite clay and again washed out. Anaconda also tried spraying ponded water on the roads (probably as a dust abatement measure).

5. In 1961, the well injections were ceased because of continual plugging. Lime was still being added to ponded water to improve its quality.

6. In 1962, Anaconda constructed a concrete bulkhead near the portal of Adit No. 5, the lowermost adit ever excavated at the mine, in an attempt to keep the acid discharge confined underground. According to the Regional Board (internal memo, October 12, 1982), the bulkhead consisted of an 8-inch-thick gunite plug placed within the adit 40 feet from the portal. This plug has not been successful as evidenced by the highly acidic spring which presently issues from the portal outside and to the west of the mine pit.

7. In 1962, Anaconda installed an 8-inch plastic pipe to carry Leviathan Creek through the area between the crusher and the waste dump. At this time, the Anaconda Company sold the property to Mr. Chris Mann (Alpine Mining Enterprises) and removed the treatment facilities. By 1963, the headworks of the 8-inch pipe had been washed out. The Regional Board notified Mr. Mann that the discharge requirements were being violated and that a Cease and Desist Order would be recommended. No action was taken by the Regional Board until 1965.

8. In 1965, it was found that Alpine Mining Enterprises had undertaken some attempted corrective measures. A dam had been constructed on Leviathan Creek above the waste dump and an 8-inch pipe had been provided to carry creek flow around the waste dump. Adit No. 5 drainage was also being diverted away from Leviathan Creek. Regardless, waste discharge requirements were still being violated. The owners explained that they had done everything possible with the money available. The only other option was treatment and that was too expensive.

Between 1965 and 1968, two companies considered purchasing the mine for reopening. Neither acquisition materialized so the Regional Board began preparing for legal action against Alpine Mining Enterprises. As a result of the litigation, Alpine Mining Enterprises was required to notify the Regional Board of any plans to sell the Leviathan property.

In 1971, the Regional Board requested that the State Water Resources Control Board (State Board) investigate possible federal funding for cleanup with a demonstration grant. This was attempted, but was unsuccessful.

In 1975, the Regional Board worked together with Anaconda to reroute Leviathan Creek generally back to its original channel alignment. This effort consisted of cutting a ditch along an alignment running north/south in the area between the mine pit mouth and the waste dump. Today, this is a deep gorge which discharges to the delta.

For the past few years, Mr. Brooks Park, a local Nevada rancher, has used a backhoe every spring to reroute the pit and adit flows down an access road. This is in an attempt to stop the highly contaminated flow from entering Leviathan Creek. This rerouting effort has had no significant effect on water quality in the creek.

Present Land Ownership

The area encompassing the Leviathan Mine project site is currently divided up among private and government ownership. Figure 2-2 shows how the site is parceled out to various owners. The region outside these parcels is managed by the U.S. Forest Service. There are 32 private parcels which are subdivided among four owners. Alpine Mining Enterprises owns 23 of these parcels (about 495 acres). This is the only land under private ownership within the project area. The other lands in private ownership are the remaining 9 parcels (about 191 acres) bordering the south end of the site. Table 2-1 describes all parcel ownerships. Only a small portion of Spoil Area A and the landslide fall outside the privately owned area shown on Figure 2-2, and are on U.S. Forest Service land.

Table 2-1. Current Land Ownership at and Around Leviathan Mine

Parcel Number/Name	Owner
5	Alpine Mining Enterprises (AME)[a]
6	AME
7	AME
8	AME
9	AME
10	AME
11	AME
12	AME
13	AME
14	Ernest L. Wasson[b]
15	Ernest L. Wasson
16	Ernest L. Wasson/R. T. Parker
17	AME
18	AME
19	Maurice J. Curtis
20	Maurice J. Curtis
21	Maurice J. Curtis
22	Maurice J. Curtis
23	AME
24	AME
25	AME
26	AME
27	AME
28	AME
29	AME
30	R. T. Parker
31	AME
32	AME
43	AME
Copper Bar Claim	Ernest L. Wasson
Pioneer Claim	AME
Nutty Henry Claim	AME
Area outside parcels	U.S. Forest Service

[a]Owned by James W. Neel and William C. Mann.
[b]Only owner with house on property.

REGIONAL CLIMATE, AIR QUALITY, AND HYDROLOGY

The project site is located on the eastern slope of the Sierra Nevada. Summer and early fall days are generally clear and sunny. Summer convection storms may occur on an average of 10 to 15 days each summer (U.S. Forest Service, et al., 1982). During the late fall, convergence of Pacific fronts and Great Basin high-pressure systems result in changeable weather. A wide variation in climatic conditions occurs due to the large elevation changes in the area. The mountains crest at elevations of about 9,000 feet and receive most of their precipitation as snowfall between the months of November and April. Although no on-site precipitation gages have historically been maintained at the mine, annual precipitation estimates developed in this chapter show the mean annual precipitation to be approximately 15 inches. Winter snowfalls provide the bulk of this annual precipitation. The snow pack from these storms virtually precludes access to the mine between December and April.

Climate and Air Quality

The mean annual temperature at Markleeville (some 2,000 feet lower in elevation than the minne) is approximately 50 degrees F. The average growing season for the area is about 100 days. Large-scale airflow is from the southwest with a secondary flow from the northwest in winter. Wind speeds increase with elevation. Dispersion of air is generally good in the project area due to active wind flow and high elevations.

The project area is classified as a Class II area for prevention of Significant Deterioration (U.S. Forest Service, et al., 1982). There are no data available on the air quality of the mine site or surrounding areas. The air quality of the area is probably good since there is adequate wind flow and the site is some distance from pollution sources and polluted areas.

Hydrology

Leviathan Mine lies adjacent to Leviathan Creek which is a major tributary of the 31.5 square mile Bryant Creek watershed (Figure 2-3). The 10.5 square mile Leviathan Creek watershed ranges in elevation from 6,400 feet at the confluence of Leviathan and Mountaineer Creeks to 8,963 feet at Leviathan Peak. This elevation range, in combination with the eastern slope location, causes a wide variation in climatic conditions over the watershed.

From its headwaters, Leviathan Creek flows northward for about 2 miles before traversing Leviathan Mine and then another 2-1/2 miles downstream to its confluence with Mountaineer Creek

to form Bryant Creek. From this confluence, Bryant Creek flows 4 additional miles downstream to the California-Nevada border and then another 3-1/2 miles to its confluence with the East Fork Carson River.

The only named tributary of Leviathan Creek is Aspen Creek which, as shown on Figure 2-3, flows northwesterly across the mine property from its headwaters for a distance of approximately 3/4-mile to its confluence with Leviathan Creek. This confluence occurs immediately north of a major landslide on the mine property.

From Figure 2-3, it can be seen that many creeks and streams drain this area. Seasonal flow patterns of these streams are typical of Sierra streams with low flows in the summer and high flows during the spring runoff and more intense winter events. Figure 2-4 shows the mean monthly flow for Leviathan Creek at Station 1 above the mine for water year 1982. Low flow (base flows) occur from July to October when the precipitation is low. From November to January, precipitation occurs primarily as snowfall and there are relatively low-flow conditions because there is limited runoff. As the snow pack begins to melt in February, eventually peaking out in May, runoff increases substantially. By June, the snowmelt is typically complete and flows decrease to the lower base flow.

Precipitation at Leviathan Mine

Precipitation in this area varies with elevation and distance from the crest of the Sierra Nevada. On the western slope of the Sierra Nevada, mean annual precipitation increases with elevation to a maximum of 50 to 60 inches per year at the crest. Precipitation on the eastern slope is much lower due to decreased moisture in the frontal systems after passing the crest, and the relationship to elevation is not nearly as distinct.

There are no precipitation records for the Leviathan Mine site. There are precipitation stations at Woodsford, California, 10 miles northwest of the mine; Minden, Nevada, 18 miles north of the site; Topaz Lake, Nevada, 7 miles east of the site; and Twin Lakes, California, approximately 19 miles west of the site. Figure 2-5 shows these stations. Based on data available from these stations, precipitation at Leviathan Mine was estimated.

The two sources of data used in this analysis are (1) "California Rainfall Summary", published by the California Department of Water Resources and (2) Climatological Data

for California and Nevada published by the National Oceanic and Atmospheric Administration (NOAA). The California Rainfall Summary provides long-term monthly mean precipitation data for many locations in California and Nevada (Table 2-2). The NOAA data provides daily precipitation totals as well as snowfall and snow on the ground. Monthly totals for water years 1981 and 1982 that were used in this analysis to develop precipitation estimates for Leviathan Mine are shown in Table 2-3.

Table 2-2. Mean Annual Precipitation for Stations Near Leviathan Mine

Station	Mean annual precipitation, inches	Period of record
Woodfords	20.50	1934-1980
Grover Hot Springs	32.38	1963-1980
Markleeville	19.29	1910-1978
Carson City	10.81	1923-1980
Tahoe City	30.57	1910-1980
Boca	21.46	1870-1980
Topaz Lake	10.42	1967-1980
Glenbrook	17.89	1945-1980
Donner Lake	39.27	1954-1980
Meyers	40.70	1956-1970
Truckee R.S.	28.97	1870-1980
Silver Creek	25.57	1910-1914
Squaw Valley	53.82	1957-1975
Twin Lakes	47.00	1920-1980
Bliss State Park	42.78	1963-1975
Dagget Pass	25.38	1971-1975
Mount Rose	26.10	1960-1965

Source: California Rainfall Summary, California Department of Water Resources--monthly total precipitation 1849-1980.

Table 2-3. Total Monthly Precipitation at Stations Near Leviathan Mine

Month	Precipitation, inches			
	Woodfords, California	Twin Lakes, California	Minden, Nevada	Topaz Lake, Nevada
Water Year 1981				
October	0.63	1.27	0.05	0.14
November	0.33	0.75	0.35	0.38
December	2.14	3.38	0.60	0.97
January	3.41	9.53	1.36	1.65
February	1.07	4.12	0.38	0.48
March	1.89	5.41	0.36	1.14
April	0.76	2.65	0.64	0.16
May	0.47	2.50	0.18	0.43
June	0.70	0.0	0.0	0.08
July	0.0	0.17	0.0	0.0
August	0.83	0.0	0.0	0.1
September	0.44	1.15	0.6	0.04
Total	12.7	30.9	3.9	5.9
Water Year 1982				
October	2.46	4.77	1.38	1.07
November	8.32	12.37	0.64	0.71
December	4.38	11.98	1.42	0.55
January	4.90	10.93	1.84	0.42
February	4.19	6.49	1.42	1.35
March	3.50	14.15	1.17	0.0
April	3.19	9.64	1.58	0.0
May	0.29	0.32	0.15	0.0
June	0.14	1.81	1.02	1.84
July	0.0	0.02	0.13	0.0
August	0.07	0.41	0.15	0.13
September	2.74	4.85	1.65	1.43
Total	31.4	77.7	12.6	7.5

Source: Climatological Data for California and Nevada, October 1980 through September 1982, National Oceanic and Atmospheric Administration (NOAA).

Mean annual precipitation isohyets (Figure 2-6) were developed for the region and the area around Leviathan based on the data in Tables 2-2 and 2-3. From this figure, the mean annual precipitation at Leviathan Mine appears to be approximately 14 to 15 inches per year. The equivalent value at Woodfords is 20.5 inches. Thus, the following ratio can be developed to compare Leviathan Mine with the Woodfords station, and to synthesize the monthly precipitation necessary to analyze runoff at Leviathan Mine:

Water Year 1981

Precipitation at Leviathan/Precipitation at Woodfords = 8.6/12.7 = 0.68

Water Year 1982

Precipitation at Leviathan/Precipitation at Woodfords = 20/31.4 = 0.64

Based on these results, it has been assumed that Leviathan receives approximately 70 percent of the precipitation recorded at Woodfords. As shown in Table 2-2, the precipitation record for Woodfords is nearly 50 years. Thus, using this long-term records and the assumed ratio described above, a precipitation frequency relationship can be synthesized for Leviathan Mine. The basis for this relationship is the return frequency analysis completed by the Department of Water Resources, based on 47 years of monthly data at Woodfords.

Figure 2-7 shows the monthly precipitation at Leviathan Mine for a 20 percent exceedence frequency (5-year return period) obtained by applying a 70 percent ratio to the Woodfords return frequency data. This results in a 5-year return wet year annual total of 17.1 inches at the Leviathan site. Figure 2-8 shows the 50 percent exceedence frequency (2-year return wet year) with an annual total of 14.3 inches; Figure 2-9 shows 80 percent exceedence frequency (1 in 5-year return period) with an annual total of 10.8 inches; and Figure 2-10 presents the mean precipitation at the site with an annual total of 14.4 inches. In comparing the monthly precipitation values on these figures to the annual total values for the same exceedance frequency, it must be borne in mind that, except for the mean annual plot, the monthly values will not sum to the annual total values.

Streamflow Analysis. Historic streamflow data are not available for Leviathan Creek except for the brief period when Anaconda was mining the site and when various studies on the area were performed. This historic data is quite unreliable and cannot be used to determine return frequencies for creek flows. As part of their monitoring efforts, the USGS gaged Leviathan Creek, tributary flows on the site, and Bryant Creek. Flow data are thus available for portions of water years 1981 and 1982. Figure 2-11 shows the flow measurement stations for which USGS

flow observations are available. The USGS has been gaging flow at Station 26, which is located on Bryant Creek above Doud Springs confluence since 1962. There is an 8-year gap between 1969 and 1978 when no data were collected. There are 12 years of data, however, which provide a relatively good base on which to synthesize streamflow in Leviathan Creek at the mine site. Table 2-4 summarizes the data available for Station 26.

Table 2-4. Mean Monthly Flow Data (cubic feet per second) for Station 26[a]

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1962	2.32	2.15	2.25	2.23	5.94	7.04	25.1	11.5	5.04	2.70	2.27	2.18
1963	2.86	2.64	2.64	12.1	13.0	6.0	11.0	21.0	17.0	5.63	3.13	3.27
1964	3.17	4.34	3.54	3.22	3.06	4.32	6.76	5.57	3.24	2.19	2.08	2.60
1965	2.50	2.88	4.60	6.04	5.56	5.94	21.3	18.5	6.16	3.18	3.24	3.01
1966	2.93	3.88	3.96	3.93	3.44	8.66	11.6	6.62	3.94	2.49	2.32	2.59
1967	2.70	3.06	5.51	5.79	6.00	23.5	12.0	52.1	24.5	6.83	4.98	4.93
1968	4.38	4.14	3.60	3.64	7.23	7.85	8.97	6.77	3.97	2.87	2.71	2.94
1969	2.91	3.23	3.10	15.4	5.41	20.8	71.8	71.5	36.0	9.16	5.59	5.02
1978	2.89	2.92	3.48	4.36	5.99	13.0	14.0	13.1	5.39	3.04	2.85	3.04
1979	2.93	3.10	2.52	4.55	4.66	7.90	9.68	9.49	4.33	2.94	2.68	2.39
1980	2.75	3.09	3.41	13.3	11.8	9.83	27.2	31.2	8.74	4.53	3.46	3.51
1982	-	-	-	-	-	9.42	39.7	25.9	9.33	6.18	3.31	3.59
Maximum	4.38	4.34	5.51	15.4	13.0	23.5	71.8	71.5	26.0	9.16	5.59	5.02
Minimum	2.32	2.15	2.25	2.23	3.06	4.32	6.76	5.57	3.24	2.19	2.08	2.18
20% exceedance	3.03	4.00	4.30	13.0	9.40	15.5	20.8	38.0	19.5	6.40	4.0	3.7
50% exceedance	2.89	3.09	3.48	4.55	5.94	8.24	13.0	15.8	5.78	3.11	2.99	3.03
80% exceedance	2.60	2.71	2.60	3.40	3.90	6.00	9.40	6.80	4.00	2.64	2.30	2.50

[a]USGS flow gaging station located on Bryant Creek above Doud Creek confluence, see Figure 2-11.

To extend the site flow records, it is necessary to establish a relationship between the flow records at Station 26 on Bryant Creek and Stations 1, 10, 16, and 17 at the site. Mean monthly flow data for 1982 from the USGS site monitoring program that was used for this analysis is shown in Table 2-5. These flow data were regressed against comparable flow data for Bryant Creek, and the linear regressions shown in Table 2-5 resulted. The r^2 values show a strong correlation between the flow at the Leviathan Creek stations, and flow at the Bryant Creek station. Station 16 had no flow records for dates that could be matched with the Bryant Creek station so it was developed first from a regression between Stations 16 and 17 and then between Stations 17 and 26. This produced an r^2 of 0.95.

To determine the return period for flow for a particular month for Station 26, the mean monthly flows from Table 2-4 were plotted on log probability paper. Figure 2-12 shows a typical plot using September data. The results for all the months are shown at the bottom of Table 2-4.

By combining the regression relationships developed in Table 2-5 with the return frequency hydrographs developed for Station 26, return frequency hydrographs were developed for Stations 1, 10, 16, and 17. Figures 2-13 through 2-16 show the synthetic hydrographs for Stations 1, 10, 16, and 17 for 20, 50, and 80 percent exceedence frequencies. Expressed in terms of return periods, the frequencies represent higher than average flow for the 5-, 2-, and 1-year return periods, respectively. Base flows are also shown on these figures which were derived from existing records of low flow.

Table 2-5. USGS Flow Data Used in Flow Regressions

Year 1982	Mean Monthly Flow, cfs			
	Station 1	Station 10	Station 17	Station 26
March	1.67	1.99	3.67	9.42
April	7.67	13.1	22.55	39.7
May	7.82	9.28	9.50	25.9
June	1.08	1.22	2.79	9.33
July	0.33	0.50	1.01	6.18
August	0.11	0.44	0.78	3.31
September	0.10	0.40	0.88	3.59

Regressions[a]

1. 26 vs. 1 : $r^2 = 0.90$ $Y = -0.70 + 0.24X$
2. 26 vs. 10 : $r^2 = 0.98$ $Y = -1.35 + 0.37X$
3. 26 vs. 17 : $r^2 = 0.96$ $Y = -2.02 + 0.57X$
4. 26 vs. 16 : $r^2 = 0.95$ $Y = -0.011 + 0.088X$

[a]X = Station 26; Y = Variable stations (1, 10, 16, 17)

These hydrographs provide a basis for establishing design flows in Leviathan and Aspen Creeks, and for analyzing the impacts of discharges from the mine site.

SITE TOPOGRAPHY AND DRAINAGE

Site topography and drainage of interest includes both pre-open pit conditions and post-mining conditions existing today.

Pre-Open Pit Mine Conditions

A pre-open pit topographic map, prepared by the Regional Board from 1941 aerial photography, has been used during this investigation to assess topographic and drainage conditions at the mine prior to initiation of open pit operations in 1952. Records of evaluation of the photography by previous investigators could not be located in the literature.

Results of our assessment are shown on Figure 2-17, including: (1) the historic alignments of Leviathan and Aspen Creeks, (2) the historic topography in the vicinity of the present mine tailings areas, waste dump, and open pit, and (3) our interpretation of historic landslides in the area. Of special note on this figure are:

1. The relationship between the creek alignments and the location of potential landslides.

2. The location of the unnamed tributary southwest of Leviathan Creek.

3. The zone of internal drainage in the south central portion of the mapped area.

The pre-open pit topographic map is available for review at the Regional Board office.

Three categories of potential landslides have been mapped using topograhic anomalies on Figure 2-17. No field verification of these areas was conducted nor was verification of these features made using the original aerial photographs from which this pre-open pit topographic map was generated. The pre-open pit potential landslides of interest to the Leviathan project are limited to those shown on Figure 2-17 as being: (1) in the waste dump area and (2) the pre-open pit mine extent of the large landslide now existing on the northerly area of the mine site. Although further verification, as for example by examination of the old aerial photos, of the extent of these landslides (and in the case of the waste dump area landslide, whether it indeed was a landslide) would be of passing interest, it was not undertaken. The reasons for not pursuing the verification of historic landslides in these two areas are: (1) the probable landslide in the waste dump area is now deeply buried by waste dump materials and therefore constrained from further movement and (2) the existing extent of the large northerly moving landslide on the north area of the site is well known and the fact that it existed prior to open pit mining has been confirmed by other means. In lieu of landslides, it must be recognized that the features shown

on the figure could be the result of such geologic phenomena as volcanism, differential rock weathering, and lithologic variations. Among the landslide categories mapped are:

1. Definite Landslides--This includes the areally extensive landslide which moved in a northerly direction. A sizable portion of this landslide still remains and will be discussed later in this report. This feature is recognizable due to its affect on topographic contour patterns and relationship to the area of internal drainage which existed near its southern (upper) end.

2. Probable Landslides--Two of these features were mapped both of which are in the southern part of the area. The level of certainty regarding these features is not as high as with the definite landslide. One of the probable landslides is located near the unnamed tributary to Leviathan Creek. It is presently overlain by the mine waste dump which will be discussed later. Another probable landslide exists in the southern part of the mapped area.

3. Possible Landslides--This is the third and lowest category of landslides interpreted on Figure 2-17. These features may have been located immediately east of Leviathan Creek in the central part of the property and northeast of Aspen Creek in the northern part of the property.

Post-Open Pit (Current) Mine Conditions

Discussion of the various features on the mine site is facilitated by the following description of the numerous mine elements and the use of Figure 2-18. Mine elements to be discussed, except for the large active northerly moving landslide to the north of the mine pit, were all created by on-site mining activities and include the mine pit, spoil tailings, waste dump, older mine workings, graded roads, several lesser landslides, and springs and seeps.

Open Pit. As depicted on Figure 2-18, the mine pit occupies approximately 19 percent of the mine property and represents an approximately circular-shaped area in the south central portion of the property which was excavated to provide access to subsurface sulfur-bearing ores. The pit has a plan surface of about 50 acres, which represents 19 percent of the mine property. Comparison of pre-mine and post-mine topography indicate the maximum depth of removal in the mine pit was about 350 feet. The lowest elevations on the pit floor are currently about 7,060 feet. The pit is essentially devoid of vegetation.

At present, slopes along the mine pit walls range to over 200 feet in height and are inclined at various angles to essentially vertical. Slope failures reportedly were numerous during excavation of the pit and were caused by a combination of excessive slope height, excessive slope inclination, and the limited strength of the materials exposed on the slopes. Numerous slope failures still exist on the pit walls, particularly those on the east and west sides. At present, the entire pit is characterized by internal drainage. During spring runoff, surface flow fills the depression in the pit and overflows through a breach on the west side of the pit in a ditch along an unpaved road.

Spoil Tailings. Spoil tailings which mantle the majority of the central portion of the property are subdivided in this report into three separate spoil areas (Spoil Areas A, B, and C) as shown on Figure 2-18. Their individual plan surface areas and percentage of total mine property occupied are: Area A--103.6 acres and 39 percent; Area B--32.3 acres and 12 percent; and Area C--14.4 acres and 5 percent.

The spoil areas include areas covered to various depths by loosely dumped overburden and mine spoils which were generated during excavation of the open pit. Although some sulfur ore and other mineralized zones likely occur in the spoil areas, they are not considered to be as mineralized as the mine waste dump which is described elsewhere in this section. Aside from a few small trees scattered throughout, the spoil areas are generally devoid of vegetation.

Spoil Area A lies along the west side of Aspen Creek and contains numerous slopes, variable-slope inclinations, and numerous surface depressions where water ponds and infiltrates. Spoil Area A, as revealed by subsurface exploration (DH-23 and DH-23A) and review of pre-mine and post-mine topography, ranges to depths of as much as 142 feet. The northerly half of Spoil Area A mantles much of the head area of the remaining active landslide.

Spoil Areas B and C are much smaller in size than Area A and lie along and to the east of Leviathan Creek. They are generally not as thick as Area A, and range in depth up to a maximum of approximately 40 feet. Except for the upper few feet in DH-22, no exploratory borings encountered materials assigned to these spoil areas. In several locations, such as on the slope above the crusher, the evidence indicates that Spoil Areas B and C are just a thin veneer of loose earth materials overlying bedrock. Most of Area B occupies such slopes, although sizable portions of Area C occur on relatively flat areas. For the most part, Spoil Areas B and C lack the large surface depressions which are characteristic of Area A. Leviathan Creek has eroded across a portion of Spoil Area C.

Waste Dump. The waste dump is a conical-shaped, 25.9-acre area (10 percent of the mine property) located in the southwestern corner of the site. The waste dump is covered to depths as great as 132 feet (as indicated by the log of DH-1AP) by waste materials which were loosely dumped. The waste dump contains a greater overall residual mineralization than the spoil areas. Waste dump materials have blocked off the original channels of Leviathan Creek and its unnamed tributary to the southwest and appear to have been placed over a probable landslide identified solely by evaluation of pre-mine topography. Two relatively large and deep surface features on the north-facing slope of the waste dump which have the appearance of erosion features are, in reality, borrow areas used by Anaconda to obtain material for filling and leveling in the delta area of the site. Springs are found along the toe of the north slope.

Older Mine Workings. The limited historic record of old mine workings reveals that numerous adits, drifts, shafts, raises, and stopes were excavated at the mine prior to the initiation of open pit mining. With the exception of Adit No. 5, all of these older mine workings have apparently been excavated in and around the area presently occupied by the open pit. The exact location, alignment, grade, and invert elevation of these older mine workings is not well defined in the literature and, in numerous instances, is not known at all. The locations of remaining ore deposites are similarly not known.

In an attempt to identify those mine workings which still may exist, mine company maps and literature on file with the Regional Board were reviewed, as were memoranda of conversations between Regional Board representatives and former personnel from the mine companies. Particularly useful maps include those prepared by the Anaconda Company (Drawing 234, dated September 10, 1958, and a Pit Composite Map, dated November 7, 1961).

Results of this review are shown on Figure 2-19. Adit No. 5, which represented the lowermost excavated underground feature, is still in existence although not accessible for interior inspection. Based on its reported invert elevation and upon drill exploration (DH-17A, DH-17B, and DH-17C) for this project, this adit lies approximately 60 to 70 feet below the floor in the southern part of the mine pit. This depth is about 20 feet below the floor of the pit near the breach. The collapsed portal of this adit is located where a spring discharges contaminated water on the west exterior wall of the pit at about elevation 7,050 feet. This spring is groundwater flow which leaks around or through the concrete bulkhead reportedly emplaced near the adit portal in 1962.

Adit

Other workings of interest on Figure 2-19 include: the raise which extended upward from Adit No. 5 to the level of Adit No. 3 (much of Adit No. 3 was removed during pit excavation), and the drifts which likely exist at the east end of Adit No. 5 and which are still within the pit area. These areas may lie within the zone of groundwater saturation and will be discussed later in this report.

Shown on Figure 2-19 are limited portions of Adit Nos. 2 and 3 at the east side of the mine pit which may not have been removed during pit excavations, and the estimated elevations and locations of the portals for all the old adits, except Adit No. 5. These other facilities were all reportedly dry or nearly so during their excavation and usage.

Graded Roads. Though not specifically mapped on Figure 2-18, numerous roads were constructed by the mining companies by rough grading operations to provide access to adjacent highways, to smelters in Nevada, and to all portions of the mine. More recent unpaved roads were constructed by the Regional Board and USGS during this investigation for exploration and to replace roads damaged by ongoing erosion and landslide movement. These roads are still subject to erosion and slope failures in numerous locations.

Landslides. This discussion relates principally to the large active landslide which is moving northerly across the northern portion of the property (see Figure 2-18). This feature occupies approximately 100 acres, in plan area of which about 34 acres are to the north of Spoil Area A. As noted in the discussion of pre-open pit mine topography (Figure 2-17), the large active landslide is a historic feature and existed prior to any mining activities. The original headwall scarp of the landslide has been removed by excavation of the open pit. However, it is probable that a portion of the slide plane of the ancient landslide could still be located in the south-facing wall on the north side of the open pit although it is now obscured by talus and slough from the pit walls.

The pre-mine and post-mine extent of this major landslide has been identified from review of 1940 and 1982 topographic maps. This review indicates that in the 42-year period, continued movement has occurred at the toe and along the northeasterly flank (i.e., near Aspen Creek) of the landslide. The maximum amount of lateral movement which has occurred in the 42 years at the toe of the slide is approximately 130 feet. This suggests that the maximum long-term rate of movement has been about 3 feet per year. According to an internal Regional Board memo from Mr. Thibeault to Mr. Hampson (October 12, 1982, page 1), much of this movement reportedly occurred while Anconda was still mining at Leviathan. Movement in the toe area is facilitated by the continued downcutting of material by flow in

Leviathan Creek and hence, the removal of support. Removal of lateral support along the flank of the slide by Aspen Creek has caused continued movement in a northeasterly direction.

Also noteworthy from the 1940 to 1982 topography comparison is the extent of the southern portion of the landslide which is now covered by fill in Spoil Area A and the extent of the former headwall area of the landslide which is now occupied by the open pit. The locations of drill holes in Spoil Area A and the amount of fill added at these drill sites are shown on Figure 2-20. The maximum fill loading onto the landslide as encountered in the borings is about 30 feet (DH-19B). Although no borings were drilled in the pit area where the headwall landslide scarp formerly existed, estimates of the maximum depths of earth materials removed from (unloaded from) the head of the landslide are on the order of 100 to 150 feet. Based on these data, it appears that open pit mining activities, in particular, removal of the earth materials' driving weight at the head of the landslide, have likely resulted in a reduction of the total driving weight on the entire landslide mass. Regardless of whether or not this is the case, the slide is active and will continue to move.

The southern portion of the landslide which underlies Spoil Area A is nearly devoid of vegetation and contrasts markedly with the dense vegetation cover in the natural, northern portion of the landslide. Several trees within the bedrock portion of the landslide are tilted and bent and represent the classic case of a "drunken forest" within an active landslide. Other evidence for continued movement of the landslide is provided in the Regional Board files (internal memo dated October 12, 1982, a discussion with a former Anaconda Company employee), wherein it is reported that the Anaconda Company had difficulty keeping water and sewer systems functioning in the landslide area. Locations of the landslides shown on Figure 2-18 have been adapted from the geologic mapping conducted for this investigation by the State Board's Division of Technical Services. The State's geologic mapping is discussed later in this section. Another landslide and slope stability problem at the mine has been created by the downcutting of Leviathan Creek along the eastern flank of the waste dump. Stream downcutting has removed support at the toe of these high slopes, causing local failure. These landslides are not shown on maps in the report because of scale limitations.

The locations and areal extent of other recent landslides which have resulted directly from mining activities are illustrated on Figure 2-18. Many of these have occurred on the high, steep interior walls of the open pit. According to Franks (1969, p. 3), landslides on the pit walls commenced by 1957 and continued to hamper open pit operations until the mine was closed in 1962.

Other information concerning on-site landslides and the types of failures is presented in memo reports from the State Water Resources Control Board's Division of Technical Services (see Appendix B).

Other Results of Mining. Figure 2-21 illustrates another result of open-pit mining and placement of spoil tailings and waste dump materials. This figure presents the locations of surface springs and seeps mapped by geologists of the State Board's Division of Technical Services and the USGS during the summer of 1982 as modified by brief, concurrent reconnaissance-level mapping by Geotechnical Consultants, Inc. (GTC). Flow rates shown on Figure 2-21 were not noted for all locations and represent estimates only.

As shown, springs are located at the north toe of the waste dump, at the portal of Adit No. 5, within Spoil Area A, and near the toe of the active landslide. Seeps and moist areas are more seasonal and of lesser flow than the springs and have been mapped in numerous locations. Two areas of ponded water occur essentially year-round in Area A and seasonally in the floor of the pit.

Another change in conditions resulting from mining activities is the quality of both surface water and groundwater. Details and documentation of these issues are presented elsewhere in this report.

Figure 2-20 illustrates another change in conditions resulting from mining activities. This figure shows the thicknesses, as determined during subsurface exploration for this study, of the earth materials which have either been placed onto or removed from the ground surface. As identified in the drill holes, maximum fill placement was 142 feet in Drill Holes 23 and 23A, while maximum earth removal was 355 feet in Drill Hole 2C2. Major removals and additions of earth materials within the large active landslide are also shown on Figure 2-20.

Rough calculations indicate that approximately 13 million cubic yards of material was removed during excavation of the open pit. Of this volume, approximately 9.5 million cubic yards still remains on site in the waste dump and spoil tailings, while the remaining 3.5 million cubic yards were hauled off site.

Figure 2-21 illustrates the locations and areal extents of the numerous topographic depressions which have been created at ground surface within the mine property. As indicated, most of these depressions are located within Spoil Tailings Area A, although important ones also are located in the open pit.

Two additional results of the mining activities include creation of areas of ponded sediments within the open pit and areas of water-deposited sediments which have recently been eroded from the waste dump and spoil tailings by both major creeks. Those recently eroded materials from the waste dump have been deposited along leviathan Creek in the area of the mine site referred to herein as the delta (see Figure 2-18).

GEOLOGIC CONDITIONS

Regional geologic mapping reveals the northeastern portion of Alpine County, in which Leviathan Mine is situated, is underlain principally by volcanic breccias and tuffs of andesitic composition, although rhyolitic, dacitic, and basaltic tuffs and flows are also known to occur (Clark, 1947, p. 10; John, et al., 1981). Recent work by Luedke and Smith (1981) corroborates the predominance of andesitic volcanics in the Leviathan region and further reports the age of these volcanics to be in the range of 9.5 to 15.0 million years before present as determined by radiometric age dating techniques. These ages correspond in geologic age to the middle to late Miocene.

Because these volcanic rocks are known to be extensively altered, they represent the chief sources for the mineral wealth (precious and base metals, and sulfur) produced within the county. Leviathan Mine represents the single, largest source of sulfur in the region.

Rock Units Mapping

At the request of the Regional Board, geologists from the State Board's Division of Technical Services conducted detailed field mapping at Leviathan Mine during the summer of 1982. The resulting map, presented herein on Plate 1, shows the rock units, rock contacts, and geologic structure (including faults, joints, and bedding attitudes). In our work, no attempt has been made to correlate rock types, contacts, or structure depicted on this map with those previously mapped at various map scales by the Anaconda Company (1951 and 1961), Evans (1966), Clark (1977), John, et al. (1981), or U.S. Borax--Technical Department (1981). The State Board geologists, wherever possible, maintained the stratigraphic nomenclature of John, et al. (1981), for the mapping. ref.

Geologic units mapped on Plate 1 consist of volcanic, sedimentary, and shallow intrusive igneous rocks. Detailed descriptions of these units are provided in the report prepared by the State Board's Division of Technical Services which is presented in Appendix B. In summary, the sedimentary rocks consist of volcanoclastic sandstone, conglomerate, siltstone,

and lahar. The volcanics and shallow intrusives are principally andesites, although one basalt unit was mapped. These flows and intrusions are complexly interbedded and intrude the sedimentary units and one another as well. Because of this geologic history and due to the variable, but intense amount of alteration which makes positive rock identification difficult, correlation between rock units and over long distances is generally not feasible. This difficulty of determining the stratigraphic sequence at the mine and correlating data from one drill hole to another was also noted in work conducted by Wilson and Wells (1951, p. 6).

Significant conditions shown on Plate 1 include the large areal extent and disruption to the creek channels created by movement of the active landslide; the large areal extent of the spoil tailings and waste dump; the numerous landslides and areas of ponded sediments in the open pit; the considerable variation in rock types and the complex geologic contacts as might be expected in a region associated with volcanism and intense rock alteration in the recent geologic past; and the variability in geologic structure whereby rock units near the waste dump dip to the south while units in other portions of the mine generally dip to the north.

Plate 1 is supported by several geologic cross-sections, including Cross-Section A-A' (Figure 2-22) prepared by the State Board's Division of Technical Services and by Geologic Sections AA - A'A' through FF - F'F' (Figures 2-23 and 2-24) which were prepared for this investigation by GTC. These cross-sections depict the relationship between geologic conditions and both pre-mine and post-mine topography. Specifically to be noted on the sections are the locations and thicknesses of fills in the spoil tailings and waste dump, the location of the active landslide, the size and amount of earth removals within the open pit, and the difficulty in correlating rock types across the mine property. The sections are annotated wherever possible with definitive subsurface information, including groundwater level data from drill holes located proximal to the cross-section lines.

Rock Mineralization

Also important to the geology of the area and the resulting pollution problems at the mine is the mineralization within the volcanic rocks. According to Wilson and Wells (1951, p. 8), andesite and tuff have served as the host rocks for the deposition of elemental sulfur, although the two rock types responded differently to mineralization and accompanying alteration, thereby producing distinctive ore types. The principal ore body at Leviathan Mine is a flat, northwest-trending elliptical lens, approximately 90 feet in maximum thickness and 2,400 feet in maximum length (Clark, 1977, p. 36).

The original ore body does not crop out at ground surface on the mine property but rather was situated 200 to 300 feet below original ground surface at the site of the present open pit. The amount and location of the remaining sulfur ore is not known.

Wilson and Wells (1951, p. 8) report that the pure, coarsely crystalline sulfur mineralizes the andesite typically in bunches, stringers, and occasional large masses. They also note that this ore is characterized by the erratic presence of extremely fine-grained pyrite (FeS_2) and marcasite (a diomorph of FeS_2) which are intergrown with quartz. Wilson and Wells further observe that pyrite is quite uniformly present, as narrow parallel bands or as irregular bunches, along both the upper and lower limits of the mineralized zone (1951, p. 9).

Clark (1977, p. 36) reports that sulfur ore in tuff is disseminated uniformly, although it locally occurs as fillings within fracture planes. The U.S. Borax Technical Department report notes that sulfur veins as much as 12 inches thick were found in the tuff. Further, Clark (1977, p. 36) corroborates the Wilson and Wells observation that pyrite and marcasite occur not only throughout the ore body but also along the upper and lower contacts of the mineralized zone. Mapping by the State Board's Division of Technical Services (memorandum dated August 25, 1982, p. 2) also detected pyrite in patches and bands up to 10 cm thick in local rocks on the walls of the open pit. The pyrite was noted here to be covered with a dull gray oxidized coating. As mentioned previously, the presence of these iron sulfides is important to the pollution problem because they tend to readily oxidize and weather, particularly in the presence of water.

As reported by the California Division of Mines (1939, p. 488-489), several sulfate minerals have been identified at the mine. These are secondary minerals which were formed by the oxidizing action of water on certain sulfide or sulfur-bearing minerals. Among those identified in that 1939 report are: chalcanthite, a blue hydrous cupric sulfate deposited near mine openings by mine waters; iron-copper chalcanthite, a pale blue hydrous iron-copper sulfate which was found in the lower mine adits; halotrichite, a whitish hydrous iron-aluminum sulfate deposited in fibrous growths in lower mine adits; melanterite, a white to yellow or green, hydrous ferrous sulfate which occurs in all mine openings and results from decomposition of pyrite; and romerite, a rare brown-colored hydrous iron sulfate. Evans (1966, p. 66) suggested that some, if not all, of these oxidized minerals are forming on the floor of the open pit where, as he noted, "ground or surface water is impounded".

Geologic Structure

Planar geologic structures (faults, folds, bedding, and joints) are not well exposed at the mine due to the large amount of fill covering the area, and to the weathered and altered conditions of many of the rocks. These structures have been mapped wherever possible and discussed by many authors (Wilson and Wells, 1951, p. 6-7; State Board's Division of Technical Services memorandum p. 10-11; and U.S. Borax, Technical Department).

In general, the local faults tend to strike northerly to northwesterly in conformance with the regional structural grain on the east flank of the Sierra Nevada, and to have variable dips to the east or west. Much of the faulting at the mine appears to predate the mineralization and, thus controls the distribution of ore to some degree. The amount of displacement on most of these faults and their relative degree of activity are not known.

Only few of the sedimentary units display bedding planes. Where mapped, the bedding is variable and reflects a combination of its deposition on an original irregular paleotopography and possible folding after deposition and intrusion. Generally, bedding south and west of the waste dump strikes east-west and dips to the south at shallow angles from the horizontal. In the vicinity of the open pit and the landslide to the north, bedding retains the same general strike but dips to the north at shallow angles (State Board's Division of Technical Services memorandum p. 11, and corroborated by Wilson and Wells, 1951, p. 6-7).

The intensity and continuity of jointing and fracturing varies widely among the rock units at the mine. In general, these structures strike nearly east-west, but display dissimilar dips which range from shallow dips to the south to steep dips to the north.

Regional Faulting and Seismicity

Regional, small-scale maps which depict faulting and seismicity in this portion of the Sierra Nevada were prepared by Greensfelder (1974), Stover (1977), and Real, et al. (1978) and have been reviewed for this investigation. Though not presented in this report, their maps reveal that four earthquakes of Richter magnitude 4.0 to 4.9 have occurred with epicenters located within five miles of the mine during the period 1900 to 1974 (Real, et al.). In addition, three events of magnitude 5.0 to 5.9 have occurred which have epicenters located at distances ranging from 11 to 17 miles from the mine during the same period. The nearest larger event was of magnitude 6.0 to 6.9 and occurred in Nevada, approximately 28 miles northeast of the mine.

Data presented by Greensfelder (1974) suggests that two north-northwesterly trending unnamed faults, each approximately 12 to 14 miles in maximum length, have been mapped south of the mine on the eastern flank of the Sierra Nevada but within several miles of the mine. According to the legend on his map, Greensfelder indicates: these faults are only approximately located; each fault has a maximum expected earthquake magnitude of 6.5; and strong evidence for the activity of each fault is lacking.

Another fault, the Jack Valley fault in Nevada, is shown by Greensfelder (1974) as having a maximum expected magnitude of 7.0. This fault trends southerly toward the general mine region but has not apparently been mapped into California. The fault activity rating assigned to this fault by Greensfelder (1974, p. 8-9) suggests that it has experienced either late Quaternary or Holocene displacement.

Contours of bedrock acceleration prepared by Greensfelder suggest the general mine area could experience a rock acceleration on the order of 0.5g.

Additional discussion of seismicity as it affects design of Leviathan project features is provided in subsequent chapters of this report.

Earth Materials

Subsurface geologic and geotechnical conditions at the mine were explored by the USGS by drilling 59 borings which ranged in depth between about 10 and 200 feet. These borings were logged by personnel provided principally by the USGS but also by the drilling contractor. Undisturbed samples of earth materials at variable depths were obtained during drilling for subsequent laboratory testing of various physical and chemical properties. Locations of the drill holes are shown on Figure 2-20. This figure also depicts which holes were furnished with PVC casings in order to form groundwater monitoring holes. A summary of drill hole information from the USGS exploration program and data from the limited soils laboratory testing conducted by GTC are provided in Appendix B.

A summary of the drill holes excavated within each of the mine elements is presented in Appendix B. As noted, several borings in Spoil Area A were sufficiently deep to progress through these fill materials and into the underlying major landslide. Two other borings in the upgradient/bedrock region were originally begun in tailings materials.

The Appendix B drill hole summary includes tables identifying, for each hole, the pre-mine and post-mine elevation

at the drill site, the amount of fill added or soil removed from the site, the total depth of the boring, and the respective perforated interval for the casing installed, if any.

Earth materials encountered in the borings consist of artificial fills (as in the waste dump and the spoil piles), recently reworked fill now deposited in the delta, ponded sediments and fill in the open pit, and bedrock of varying types, compositions and degrees of weathering (as in the landslide, the upgradient area, or as encountered beneath the fill throughout the property).

Artificial fill as encountered in the drill holes is exposed in the waste dump, in Spoil Areas A, B, and C, and in the open pit. Typically, these materials were end-dumped or bottom-dumped by earth-moving equipment during open pit construction. They are comprised by heterogeneous, unsorted mixtures of sand, silt, and gravel and contain varying amounts of clay and boulders. Colors are variable, also, ranging from yellow-brown or orange-brown to red-brown, and containing frequent color mottlings of gray to gray-brown or blue-gray.

Visual inspections of fill samples from the spoil tailings reveal the materials to range from sandy silt with gravel (Unified Soil Classification group symbol ML), to silty or clayey gravel (GM), to silty sand with gravel (SM). Gravel clasts are typically angular in shape and of volcanic composition. Cobbles to boulders undoubtedly occur randomly throughout the spoil tailings.

Insitu moisture contents and dry densities for spoils materials are typically on the order of 25 to 40 percent and 75 to 85 pounds per cubic foot (pcf), respectively. This corresponds to actual percent saturations on the order of 85 to 100 percent and to typical relative compactions in Spoil Area A of about 80 percent, respectively (the latter is based on one compaction curve obtained from a composite of several samples of earth materials from Spoil Area A). Grain size distribution curves of spoil materials show these fills are typically well-graded. Using the Hazen approximation to assess the magnitude of permeability revels a permeability for fill in Spoil Area A in the range of 3.5×10^{-2} to 2×10^{-5} centimeters per second (cm/sec).

Details of the types of soil tests conducted, the results, and a discussion of the Hazen approximation technique are provided in Appendix B. The material presented in Appendix B includes a brief discussion of the results of on-site permeability testing conducted in November and December of 1982.

Visual inspection of fill samples from the waste dump indicates the materials also are typically sandy silt to silty or clayey gravel to silty sand with gravel. Occasionally, lenses of yellow to greenish brown silty clay (low to high plasticity) were observed in the samples. As with the tailings, the gravel clasts are angular in shape and of volcanic composition. Undoubtedly, cobble- and boulder-sized clasts of volcanic origin occur ramdomly in the waste dump. The range in sizes of these boulders can be observed in the bottom of the eroded channel of Leviathan Creek where it has cut down through waste dump materials.

Insitu moisture contents and dry densities in the waste dump are typically on the order of 25 to 40 percent and 75 to 95 pcf, respectively. For the samples reviewed, corresponding percent saturations and relative compactions are approximately 75 to 100 percent and 80 to 85 percent, respectively; the latter is based on one compaction curve obtained from a composite of several earth materials samples from the waste dump. Grain-size distribution curves of waste dump fills show the materials are well-graded. The magnitude of permeability for waste dump materials as assessed using the Hazen approximation is in the range of 1.7 to 3.5 x 10^{-5} cm/sec.

Ponded sediments occur to depths of at least 5 feet below the floor of the open pit near the breach. As encountered in DH-2A1 and 2A2, these materials generally consist of brown to red clayey sand and sandy clay; the deposits are soft, sticky, and generally saturated. Actual soil samples of ponded sediments for soils laboratory testing were not obtained during drilling operations.

Fill which has been redeposited from erosion of the waste dump by Leviathan Creek now occurs in the delta in addition to waste dump material placed there by Anaconda. These materials tend to be loose, unconsolidated, yellow-brown to brown, damp to saturated accumulations of silty sand and sandy silt, and contain varying concentrations of gravel, cobbles, and small boulders.

Earth materials in the natural portion of the large landslide (i.e., that area of the slide not overlain by Spoil Pile A) consist of light green to brown, damp to wet, soft to dense, clayey silt (ML), sand and gravel with silt (GM), to silty sand (SM). Insitu moisture contents and dry densities are typically on the order of 15 to 50 percent and 75 to 100 pcf, respectively. Corresponding percent saturations are approximately 75 to 100 percent. Relative compactions are not available because compaction tests of these materials could not be performed in the laboratory due to a lack of sufficient volume of representative earth materials and to the gross heterogenity of the materials. Materials in the landslide,

according to grain size distribution curves, are well-graded. The Hazen approximation suggests permeability is on the order of 3×10^{-2} to 6×10^{-3} cm/sec in the landslide materials.

Slope Stability

As depicted on Figure 2-18 and Plate 1, numerous landslides having varying areal extents have been mapped by investigators on the property. Those landslides depicted on these two figures are considered to be active, definite landslides. Not illustrated on the figures due to scale limitations are the landslides along the northeasterly toe of the waste dump pile where it is intersected by Leviathan Creek. Flow in the creek continues to undercut the adjoining waste dump slopes, which then are subject to failure.

The principal slope failure on the property presently exists north of the open pit (see Figure 2-18, Plate 1, and Cross-Section BB-B'B' on Figure 2-23). This landslide is historic in nature and existed prior to mining activities on the property. It resulted from a combination of adverse geologic structure, lubrication of these adversely oriented geologic planes by water from precipitation and streamflow in Aspen Creek, and fracturing and weathering of the bedrock which altered and weakened the rocks.

Mining activities have removed a portion of the headwall scarp (by excavation of the open pit) and added weight to some of the remaining portion of the landslide (by placing fill on Spoil Area A). The net result of removing soil materials and adding fill has likely caused a slight reduction in net driving weight on the failure. However, the failure continues to move northerly downslope, and since 1940, this movement has been approximately 130 feet. Slope movement of the landslide is facilitated by the continued erosion of slide debris at the toe of the slide by flow in Leviathan Creek. Several springs are located in the toe area of this slide (see Figure 2-21).

Based on the surface area of the landslide and the suspected depth to the shear plane(s), this failure likely contains several million cubic yards of unstable materials. Evidence for movement also included tilted and curved trees (part of a "drunken forest") and numerous scarps throughout the mass (see Plate 1). Cross-Section BB-B'B' (Figure 2-23) illustrates the relationship between pre-mine and post-mine conditions at the landslide, the approximate shear plane(s), and the relative locations of the springs and general level of the groundwater surface beneath the slide (the latter is based on water level readings for October/November 1982 provided by USGS).

The landslide will continue to move because: (1) the adverse geologic structure still exists, (2) water for lubrication and driving weight is still available from deep percolation of direct precipitation, from infiltration of ponded water in surface depressions on the mass and perhaps from an unknown amount of infiltration of flow from Aspen Creek, and (3) debris at the toe of the mass continues to be removed by Leviathan Creek.

Numerous landslides also exist within the mine pit, and these, too, must be considered active or potentially active. They have occurred because the slope heights and slope inclination created during excavation of the open pit exceeded the shear strenghts of the exposed earth materials. For the most part, these failures are above the zone of saturation in the pit. The areal extents of these failures range from a few square feet to a few acres. These slides are considered to be shallow, surficial types of slope failures. The actual depths of these failures are unknown due to a lack of subsurface exploration on the slopes of the open pit.

For the most part, the relatively high and steep slopes of the waste dump and spoil areas are generally free of significant failures, even though slope heights are as great as 125 feet and slope inclinations are as steep as 32 degrees. Only one sizable failure has been mapped in the spoil tailings and that is for a slide of unknown depth that has moved westerly downslope along the west-facing slope of Spoil Area B (see Plate 1 and Geologic Section EE-E'E' on Figure 2-24).

Small-scale failures were observed along the easterly toe of the waste dump where it is intersected by Leviathan Creek. Downcutting and erosion of the fill by the creek has locally removed support from the oversteepened slopes, thereby causing them to fail. Such failures can be expected to continue.

HYDROGEOLOGY

Figure 2-25 illustrates the interpretation of groundwater level data provided by the USGS from their monitoring of observation holes during October and November 1982. Actual depth to water measurements were corrected for elevations using reference point elevations and drill site locations provided by USGS. Also depicted on Figure 2-25 are the drill hole sites actually monitored, the respective elevation of the static (non-pumping) water levels, and the approximate location and elevation of several springs and areas of ponded water on the property. Of the 59 borings drilled for the project, a total of 48 were formed into groundwater level monitoring holes with the use of perforated casing. Casing data for drill holes equipped with perforated casing for water level monitoring are summarized in Appendix B.

Groundwater contours on Figure 2-25 are illustrated using dashed lines to indicate that the contours are approximate and serve to define only the regional flow pattern. These approximate contours were prepared by interpolation between the actual data points referenced on the figure. In viewing these contour approximations, it must be realized that: (1) groundwater gradients and flow responses may be different between the different rock and soil types on the site and (2) the differences in the elevations of the gravel packs and casing perforations from one data point to another and the fact that gravel packs and perforations are in earth materials which differ from data point to data point also influences the accuracy of the contours. It is with understanding of these limitations that the evaluation of groundwater movement must be made.

Proximal groundwater flow upgradient from (south of) the property occurs within the volcanic bedrock and flows in a northwesterly direction toward the site. The estimated groundwater gradient for regional upgradient flow near the open pit is on the order of 0.6 to 0.5 feet per foot (ft/ft). Farther west near the waste dump the gradient for regional groundwater is on the order of 0.06 to 0.08 ft/ft.

Groundwater gradients vary across the mine property depending on the mine element across which flow is occurring. Near the waste dump, gradients are on the order of 0.10 ft/ft, while across Spoil Area B and the landslide they are on the order of 0.2 ft/ft and 0.15 ft/ft, respectively.

From south to north across the west side of the mine pit, however, a very flat water level surface exists. Also, water level contour shapes in the area suggest subsurface flow in a southwesterly direction out of the pit toward the waste dump/delta area. These contour patterns and water elevations suggest that high groundwater conditions exist in the ponded sediments and artificial fill in the pit and that the pit is drained by adit flow and by surface and subsurface flow through the pit breach. Furthermore, the surface flow from the spring near the portal of Adit No. 5 and the surface flow of water from the pit breach occur within loose, porous, and permeable artificial fill materials. Hence, both these flows tend to contribute water back to the groundwater outside the pit by direct infiltration. These percolating fluids eventually move westerly in conformance with the local groundwater gradient toward Leviathan Creek in the waste dump/delta area.

Local irregularities in the groundwater contour pattern occur near the contact between Spoil Area A and the native landslide. These irregularities could reflect differences in recharge between the two areas, the presence of ponded water actually within the north end of these tailings, or perched water tables forming within and above local failure planes.

Water level contour patterns near the delta and the waste dump suggest that groundwater here is supplying flow directly to Leviathan Creek as base flow via seepage from high groundwater levels. It is probable that this effect is seasonal with higher creek flow occurring in the spring as a result of larger snowmelt and runoff. The groundwater flow patterns would likely reverse in the summer and indicate recharge to the groundwater via seepage of creek flow into the porous, artificial fill materials in the area.

Actual water levels, indicated on Figure 2-25, reveal that the depth to groundwater in the ponded sediment area in the pit was at or near ground surface at the time of the October/ November 1982 USGS monitoring program. These water levels are illustrated on Geologic Sections AA-A'A' through FF-F'F' on Figures 2-23 and 2-24 to depict the relationship between the various mine elements, pre-mine and post-mine conditions, and these local groundwater levels. Of interest on Geologic Section DD-D'D' are the comparative levels of the Adit No. 5 invert and groundwater beneath the floor of the mine pit. This section reveals that, of the entire 980-foot length of Adit No. 5, only the easterly ±60 feet of the invert was apparently below the water table in late-1982. It is important to note that: (1) the adit invert is difficult to accurately define because existing mine maps which show Adit No. 5 use assumed relative elevations for adit reference points and have a different coordinate system for locating the underground openings and (2) water levels monitored within the casing emplaced in DH-17A, 17B, and 17C along the adit alignment are within bedrock and thus are considerably deeper than the water level originally noted in the open bore hole of DH-17C at the time of drilling. It appears that the shallow groundwater levels observed during drilling were in the fill materials overlying bedrock, and because of the casing completions, these shallow waters may have been sealed off from the deeper casing perforations.

Water, which is seasonally ponded at ground surface in the vicinity of the ponded sediments in the open pit just east and southeast of the breach, is considered to result from rising groundwater and from accumulating surface water runoff from the watershed within the open pit. Drainage of this water occurs by several methods, including: (1) direct overland surface flow out of the open pit when the water is ponded, (2) direct evaporation fromm the ponded water surface itself, (3) direct evaporation from the capillary fringe once free water is no longer ponded, (4) direct subsurface outflow from the pit through the breach, and (5) deep percolation into bedrock. Loss of this water by transpiration is small to nonexistent. In addition, drainage of this water to the south (i.e., toward the adit) is small due to: (1) the lack of a significant gradient in that direction, (2) the relatively large distance of travel,

and (3) because the adit acts like a horizontal well which produces a limited discharge--thus, its radius of drawdown influence is relatively small.

Drainage of water accumulating below ground surface in the southern part of the open pit is also provided by flow along Adit No. 5. This flow eventually re-emerges at ground surface at the spring near the portal of this adit. Water could gain access to this adit in several ways, including: (1) direct infiltration through permeable sediments overlying the adit alignment, (2) infiltration through backfill or caved-in materials now filling such prior openings as drill holes, rock fractures, faults, or joints, (3) infiltration through old raises and slopes known to have been constructed near the alignment but which are now caved-in, and (4) direct inflow from rising groundwater levels which are responding to hydrologic changes. The relative magnitude of each of these mechanisms is unknown.

As groundwater rises in the southern part of the pit, water eventually gains access to Adit No. 5, beginning at its easterly terminus near elevation ±7,061 feet, since this end is considered to be higher in elevation than the portal spring near elevation ±7,050 feet (refer to Figure 2-19). Once groundwater enters this portion of the adit, it tends to follow the path of least resistance (i.e., the most permeable path). This, then, is along the invert of the remainder of the adit alignment toward the portal. Flow may take place more or less as open channel flow in the adit invert, assuming the adit is open and unobstructed.

To account for the normal rate of portal flow, only a very limited depth of flow is considered to be necessary to occur above the adit invert. Thus, if a boring were not located directly along the invert, it is possible that it might not encounter groundwater. This, then, helps explain some of the apparent anomalies in groundwater levels monitored in the three borings near the adit alignment (DH-17A, 17B, and 17C).

Several other factors should also be considered when using water level data presented on Figure 2-25. Among the factors that could affect water level readings are: (1) there was an unavoidable time lag between installing perforated casing in the borings and developing (cleaning) the borings principally by bailing techniques, (2) the level of development possible with bailing under adverse circumstances is unknown, (3) most of the borings contain perforations solely within bedrock and, hence, water level monitoring may not reflect hydrogeologic conditions in the shallow, porous, poorly consolidated sediments (such as fill and ponded sediments), and thus hydraulic communication between these formations is unknown, and (4) no measurements were obtained during the monitoring program of flow rates or

water level drawdown and recovery while bailing the wells and, hence, drainage characteristics, effects of water level declines on Adit No. 5 flow, and local aquifer characteristics information are not known. The results of variable-head permeability tests conducted at most of the borings are presented in Appendix B.

BIOLOGICAL RESOURCES

The wildlife, aquatic life, and vegetation of the project area are discussed in this section.

Wildlife

A wildlife survey was not conducted as part of this project. The information in this section was taken from the environmental impact report (EIR) for the California Silver Zaca Mine Expansion (U.S. Forest Service, et al., 1982). The Zaca Mine is located approximately four miles southwest of Leviathan Mine at approximately the same elevation (7,000 feet).

Alpine County provides summer range for most of the Carson interstate deer herd and a small portion of winter range for the Carson and West Walker deer herds. A few deer were observed on the project site during one of the field visits. Black bears, mountain lions, and bobcats are present at the Zaca Mine site and may be present at Leviathan Mine.

Numerous bird species have been observed at Zaca Mine and are likely to be present at Leviathan Mine. Game birds include blue grouse, mountain quail, mourning doves, and band-tailed pigeons. Raptors such as the red-tailed hawk, sparrowhawk, prairie falcon, great horned owl, and turkey vulture have been observed at Zaca Mine. A variety of songbirds were observed at Zaca Mine and probably occur at Leviathan Mine.

A complete list of wildlife species found at Zaca Mine is presented in Appendix C. Some of these species are likely to be present at Leviathan Mine. The disruption of the natural topography, the general lack of vegetation, and the poor quality of Leviathan Creek as a wildlife drinking water source probably prevent many wildlife species from inhabiting the Leviathan project area.

No known threatened or endangered species are thought to occur in the project area. There are no critical habitats for threatened, endangered, rare, or sensitive species in the project area. The endangered Southern Bald Eagle has been sited in Alpine County but it is unlikely to be found in the project area. The wolverine, pine marten, and prairie falcon are listed

as sensitive species in California. The wolverine and pine marten have been sited in Alpine County but they have not been seen at Zaca or Leviathan Mines. The prairie falcon has been observed at Zaca Mine but it has not been observed at Leviathan Mine. The red fox, a fully protected furbearer in California and federally listed as status undetermined, has been observed at Zaca Mine during the winter. It is not known if the red fox occurs at Leviathan Mine during the winter.

Aquatic Life

Prior to the operation of Leviathan Mine, Leviathan and Bryant Creeks supported a substantial trout population. Fish are currently present above the mine but they do not occur downstream from the mine (Regional Board, 1975). The East Fork Carson River is one of the more important trout fishing streams of California and Nevada. According to the Regional Board (1975), trout have periodically been driven from the East Fork Carson River downstream from the confluence with Bryant Creek in response to occasional higher than usual concentrations of toxic materials from the mine. Fish kills in the East Fork Carson River occurred in 1952 and 1959 as a result of slugs of water containing toxic chemicals from the mine. The East Fork Carson River, upstream from the confluence with Bryant Creek, contains rainbow, cutthroat, and brown trout, whitefish, mountain and Tahoe suckers, speckled dace, and Piute sculpin (U.S. Forest Service, et al., 1982). The Lahontan cutthroat trout, federally listed as threatened, is found in pure populations in the East Fork Carson River above the confluence with Bryant Creek.

According to the Regional Board (1975), aquatic organisms were absent from Leviathan Creek below the mine and Bryant Creek at the time of their study. The USGS conducted two sampling trips for benthic invertebrates on May 7 and November 4, 1982. The results of their surveys are presented in Table 2-6. Although the results of two sampling trips are not conclusive, the data show that the number of species, the density, and biomass below Leviathan Mine are lower than upstream of the mine or in Mountaineer Creek. The diversity index is generally lower in Leviathan Creek below the mine than upstream or in Mountaineer Creek. The diversity index is the ratio between the number of species and the number of individuals. When toxic concentrations of metals or other pollutants are introduced into a stream, the diversity generally decreases. Many species die off under the adverse conditions. Those that are able to withstand the conditions increase in numbers. The impact of the mine on aquatic life is clearly shown by the data presented in Table 2-6.

Table 2-6. Benthic Invertebrate Survey

Sampling station	Month	Mean density, No/m^2	Number of species	Shannon-Wiener diversity index	Mean biomass, gm/m^2 wet weight
Leviathan, upstream of mine	May	523	16	2.28	0.17
	Nov	10,828	32	3.16	4.60
Leviathan, below Aspen Creek	May	44	5	2.00[a]	0.01
	Nov	38	8	2.95	0.10
Mountaineer Creek	May	16,648	22	1.14	15.15
	Nov	3,133	30	4.05	4.35
Bryant Creek at culvert	May	32	3	1.21[a]	0.01
	Nov	179	14	3.25	2.17
Bryant Creek at gaging station	May	59	7	2.39[a]	0.03
	Nov	450	7	1.43	2.08
Bryant Creek above confluence	May	37	3	1.31[a]	0.01
	Nov	15	2	0.84	0.003

[a]Value probably not valid due to low total numbers.

Vegetation

A comprehensive discussion of on-site vegetation is provided in Appendix A.

SUMMARY OF MINE-RELATED CHANGES

Changes in the base conditions at the mine which have resulted from historic mining activities include:

1. An open pit, a waste dump area, spoil tailings areas, and a delta at the ground surface.

2. Numerous adits, drifts, portals, shafts, raises, and stopes at different elevations in and around the site of the present open pit.

3. Major modifications to site surface runoff, including depressions at ground surface where water now tends to pond.

4. Changes in the alignment of sections of Leviathan and Aspen Creeks, including burial of a possible landslide and obstruction of Leviathan Creek and its unnamed tributary by the creation of the waste dump.

5. Placement of large volumes of loose earth materials over major portions of the mine property.

6. New springs and seeps have appeared such as those at the north edge of the waste dump.

7. Significant changes in the quality of surface water and groundwater.

8. Changes in the elevation and flow directions of groundwater, principally in the vicinity of the pit.

9. Slope heights and slope inclinations in the open pit, waste dump, and spoil tailings which are potentially unstable.

10. Areas of ponded sediments in the open pit.

11. New landslides in numerous locations on the property, including along all ungraded roads and where Leviathan Creek cuts through the waste dump.

12. Extensive bare areas experiencing significant surface erosion, such as on the waste dump and the spoil tailings.

13. Water-deposited, and thus very unstable, sediments eroded from the waste dump and spoil tailings by both major creeksas typified by the delta area.

14. Unloading of the head of the active landslide by excavation of the open pit and loading of the remainder of the unstable mass by overburden materials dumped in Spoil Tailings Area A.

15. Increased access of water and atmospheric oxygen to large volumes of mineralized waste dump and tailings materials.

16. An open pit which ponds surface runoff, causes seasonal surface discharges of polluted water, and provides major recharge to underlying groundwater. The groundwater seeps heavily contaminated from the collapsed portal of Adit No. 5.

17. Removal and burial of native vegetation in nearly all of the mine property.

REVIEW OF LITERATURE

Review of available geologic, geotechnical, hydrologic, and hydrogeologic data and literature for the environs of the mine has been conducted to identify regional and local conditions and

to assess applicable abatement procedures. Specific reports which were reviewed and utilized during the conduct of the investigation are listed with comment under separate disciplines below. Complete references are provided in the next section.

Geology

Key reports which discuss geologic conditions in and around the mine include those by:

The Anaconda Company--maps and reports dated 1951, 1958, 1961, which depict rock units and locations of underground workings in and around the open pit.

California Division of Mines and Geology--1939, 1949, 1951.

California State Water Resources Control Board, Division of Technical Services--1982, which provides details of their field mapping efforts at the mine.

California Regional Water Quality Control Board, Lahontan Region--files, internal memos, and reports dated 1968, 1975, and 1982.

Chesterton and Lydon, 1957.

Clark, 1977--for the California Division of Mines and Geology.

Evans--report dated 1966 together with a geologic map modified from an original map prepared by Curtis, 1951, for a thesis at University of California, Berkeley.

Franks--letter report dated 1969.

John, et al., 1981--which maps the rocks in the mine area but at a small scale.

Luedke and Smith, 1981--who reported upon the distribution and ages of volcanic rocks in the region.

U.S. Borax, Technical Department--drill hole logs and reports dated 1981.

U.S. Geological Survey--boring logs of drill holes excavated for the Leviathan Mine subsurface exploration program conducted by the USGS. (These data are available for review in the offices of the California Regional Water Quality Control Board, Lahontan Region.)

Seismicity and Faulting

Reports discussing seismicity and faulting are regional in content (and, thus, not site-specific to Leviathan Mine) and limited in quantity. Those few reports reviewed for this investigation include those by:

Jennings, 1973--which provides general locations and relative ages of faults.

Luedke and Smith, 1981--which provides the locations and ages of volcanic rocks.

Real, et al., 1978--which maps the epicenters of earthquakes equal to or greater than magnitude 4.0 which occurred between 1900 and 1974.

Stover, 1977--which maps earthquakes in the country between 1965 and 1974.

Hileman, et al., 1973--which discusses seismicity in California.

Geotechnical Data

There is a paucity of historic data concerning geotechnical data for the mine. Virtually, the only discussions of geotechnical problems at the mine are presented by:

California Division of Mines and Geology, 1977, p. 37--which indicates that blasting was often required during open pit mining due to rock hardness (see also Nordyke, 1955, p. 177-180, for additional details of mine blasting techniques required to not only break the overburden but to minimize the known fire hazard associated with the high sulfur content in the ore).

California State Water Resources Control Board, Division of Technical Services, July 6, 1982--a memorandum which presents the results of their reconnaissance-level mapping of the active on-site landslide.

California Regional Water Quality Control Board, Lahontan Region, October 12, 1982--internal memorandum which briefly reports upon Anaconda Company problems with their water and sewer systems within the active landslide area.

Franks, 1969, p.3--who mentions that landslides in the open pit hampered Anaconda Company operations in the open pit between 1957 and the cessation of mining in 1962.

Clark, 1977, p. 36--which also indicated that one of the reasons for closing the mine in 1962 was that the pit walls were caving and, thus, required regrading to flatter slopes.

As a result of this investigation, engineering properties of some of the on-site earth materials are available for the first time. The results of soil tests conducted by Geotechnical Consultants, Inc., on soil samples obtained by the USGS during their field exploration are presented in Appendix B.

Mine History

Due to the relatively long duration of activity at the mine, to the fact that the mine has had numerous owners, and to the sporadic and intermittent nature of the mining activities, details of tunneling are not well documented. Information concerning open pit activities is better documented, however.

The reader is referred to the following reports for mine history information.

Anaconda Copper Mining Company (letter dated September 25, 1951.

California Division of Mines and Geology, 1977 and 1957.

California Regional Water Quality Control Board, Lahontan Region--report dated November 25, 1968, and internal memos dated August 20 and October 12 1982.

Evans, 1966.

Nordyke, 1955.

U.S. Borax, Technical Department, March 4, 1981.

Wilson and Wells, 1951.

Surface and Groundwater

Reports providing information on surface and groundwater are numerous for Leviathan Mine. Virtually, all of these reports provide data on surface water flows and quality. Until the 1982 USGS groundwater monitoring program at the mine, there were no data on groundwater levels and quality. Unfortunately, for the preponderance of historic surface water data, despite being voluminous and from numerous sampling sites, there has been no consistency in: monitoring point selection; repetitive sampling from the identical monitoring point; and repetitive analysis of similar chemical parameters.

Among the significant surface water and hydrology reports reviewed specifically for this investigation are:

California Regional Water Quality Control Board, Lahontan Region--1970 and 1975.

California Regional Water Quality Control Board, Lahontan Region--numerous data files concerning surface water quality.

State Water Resources Control Board, Division of Water Rights--undated report prepared by R. Paul Art, senior engineer; and a memorandum dated June 26, 1969.

Jopling, undated.

Skelly and Loy, 1979.

U.S. Borax, 1967 and undated article.

Groundwater data in the historic record is virtually nonexistent. The only mention of groundwater in available reports on mine history merely mention that groundwater was not a problem during tunneling operations (California Regional Water Quality Control Board, Lahontan Region, internal memo, August 29, 1982). Groundwater data are now available for the first time as a result of the subsurface exploration and groundwater monitoring program conducted by the USGS; groundwater levels and groundwater quality data were generated from numerous drilling sites on the property. In addition, the USGS has provided a map depicting locations of surface seeps and springs as mapped during the summer of 1982.

Acid Mine Drainage Abatement

Discussion of acid mine drainage abatement methods are abundant in the literature, but almost exclusively report upon problems and conditions in the coal fields. Among the published reports which were reviewed for our investigation in and near California are those by:

Montana Department of Natural Resources and Conservation, 1977--which discusses silver-lead mine drainage problems.

Skelly and Loy, 1979--the preliminary report for Leviathan Mine conditions.

U.S. Geological Survey, 1978--which discusses problems in Shasta County.

Several other reports were reviewed which provide information on acid mine drainage formation and abatement, although principally in the coal fields. Those reports specifically reviewed include:

Cartwright and Hunt, 1981.

Cartwright and Hunt, 1981.

Gannett Fleming Corddry and Carpenter, Inc., 1977.

Lindorff, Cartwright, and Herzog, 1981.

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California State Water Resources Control Board, Division of Technical Services. Geologic Mapping--Leviathan Sulfur Mine. Memorandum to Gerard Thibeault, Lahontan Regional Board, and report on Geology of the Leviathan Sulfur Mine and Vicinity. Twenty-two pages and plates of geologic field mapping and locations of seeps and springs. October 1982.

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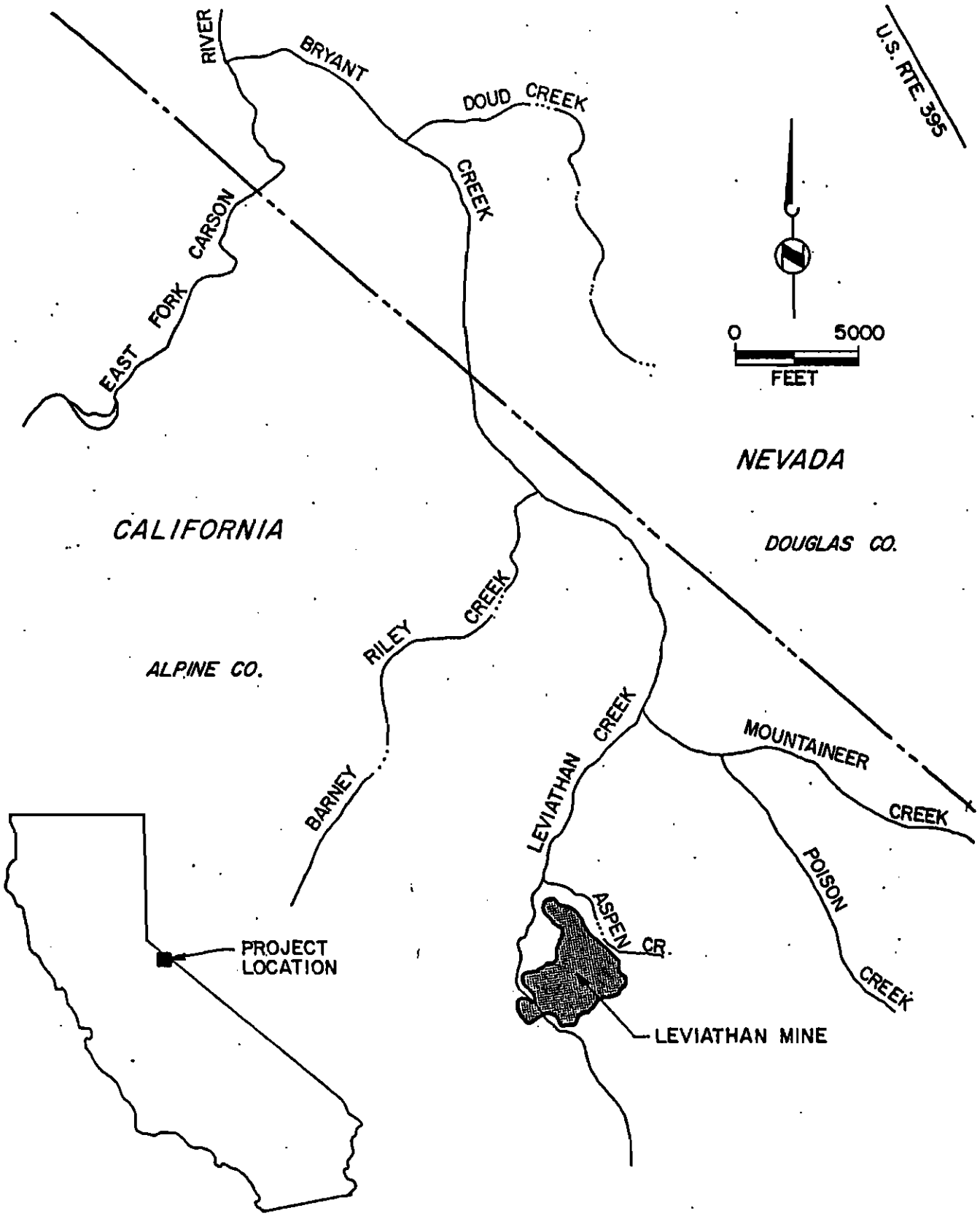
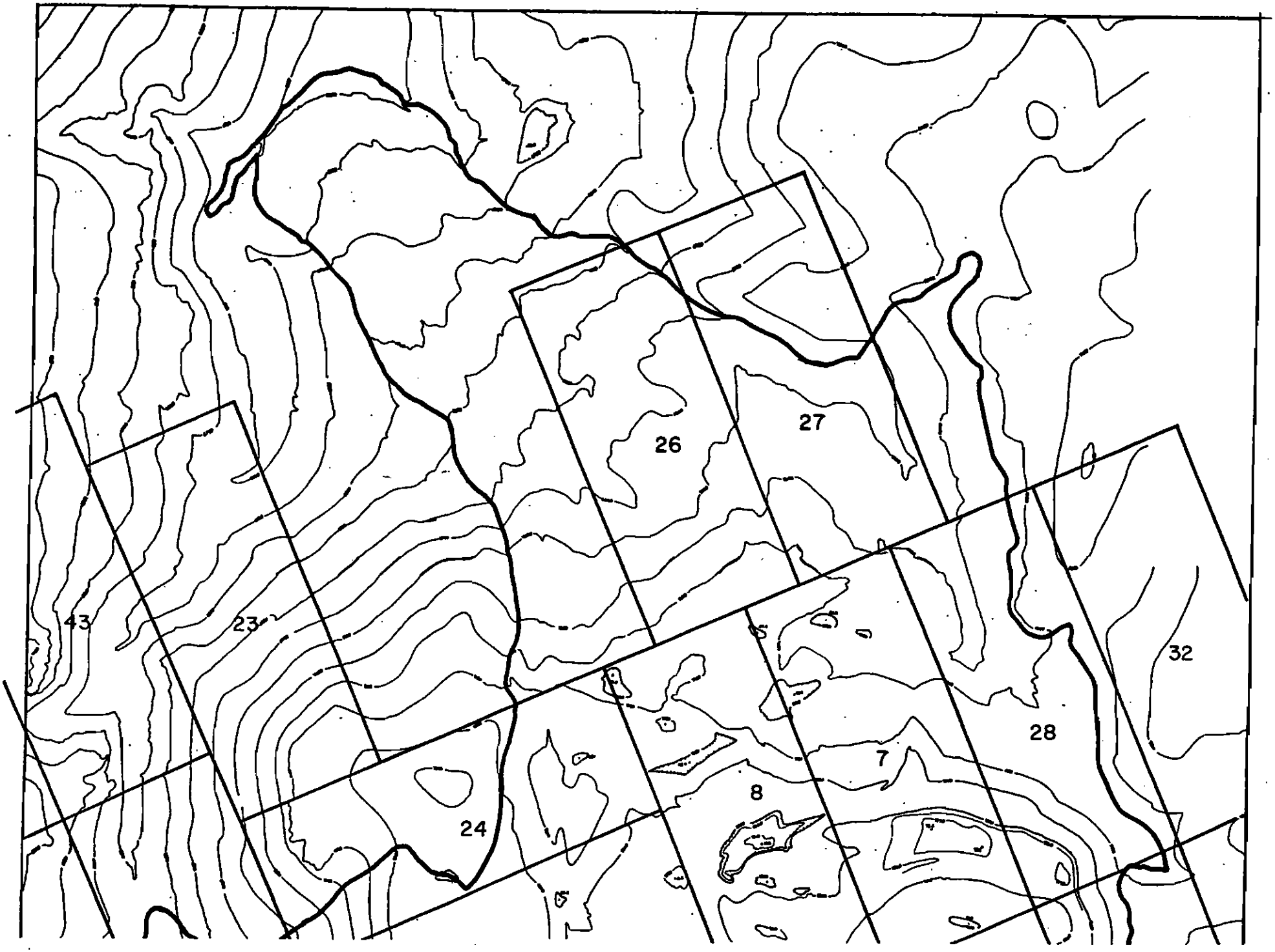
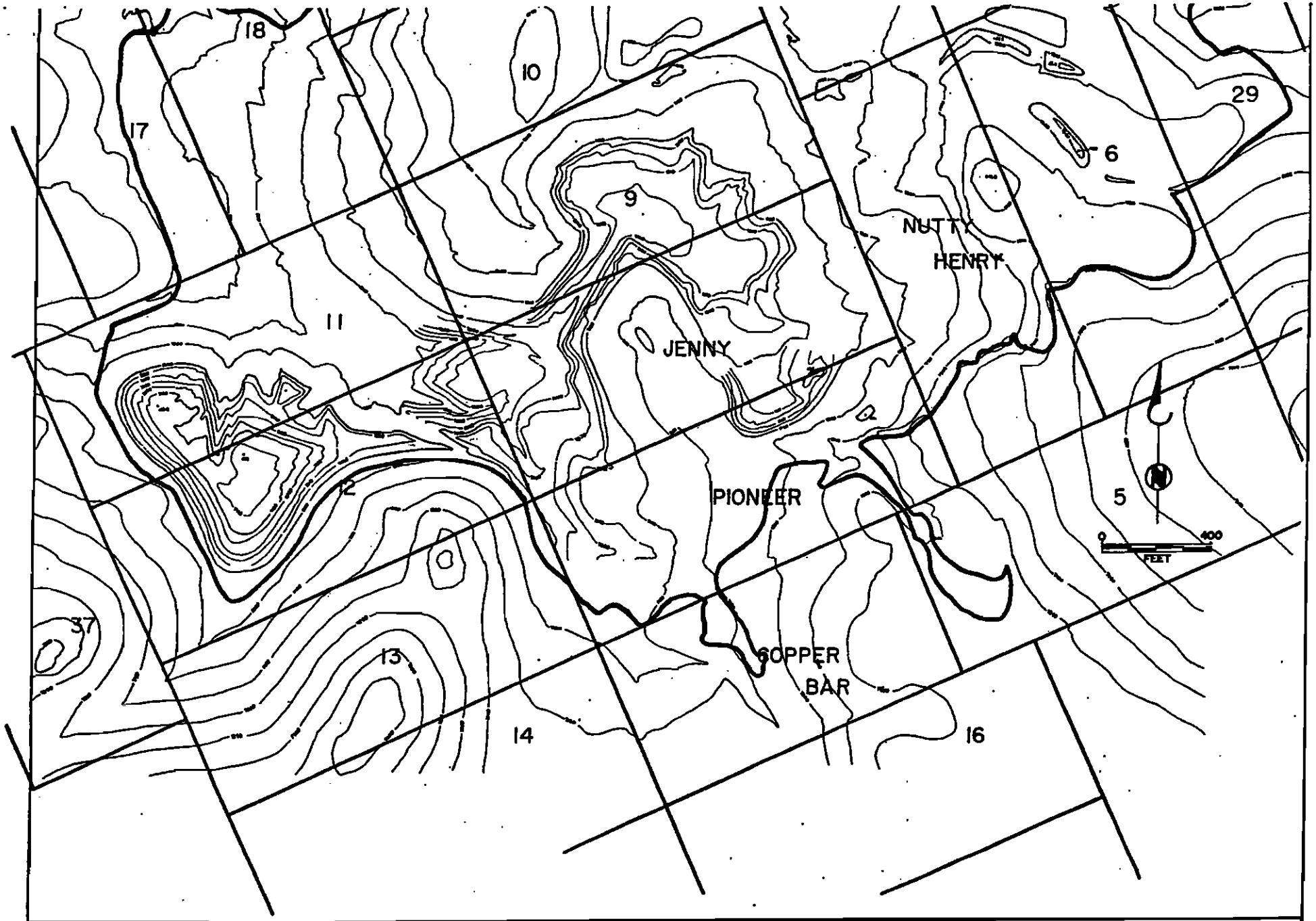


Figure 2-1 Leviathan Mine Project Location Map


43
23
24
26
27
8
7
28
32



BROWN AND CALDWELL
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FIGURE 2-2 LAND OWNERSHIP

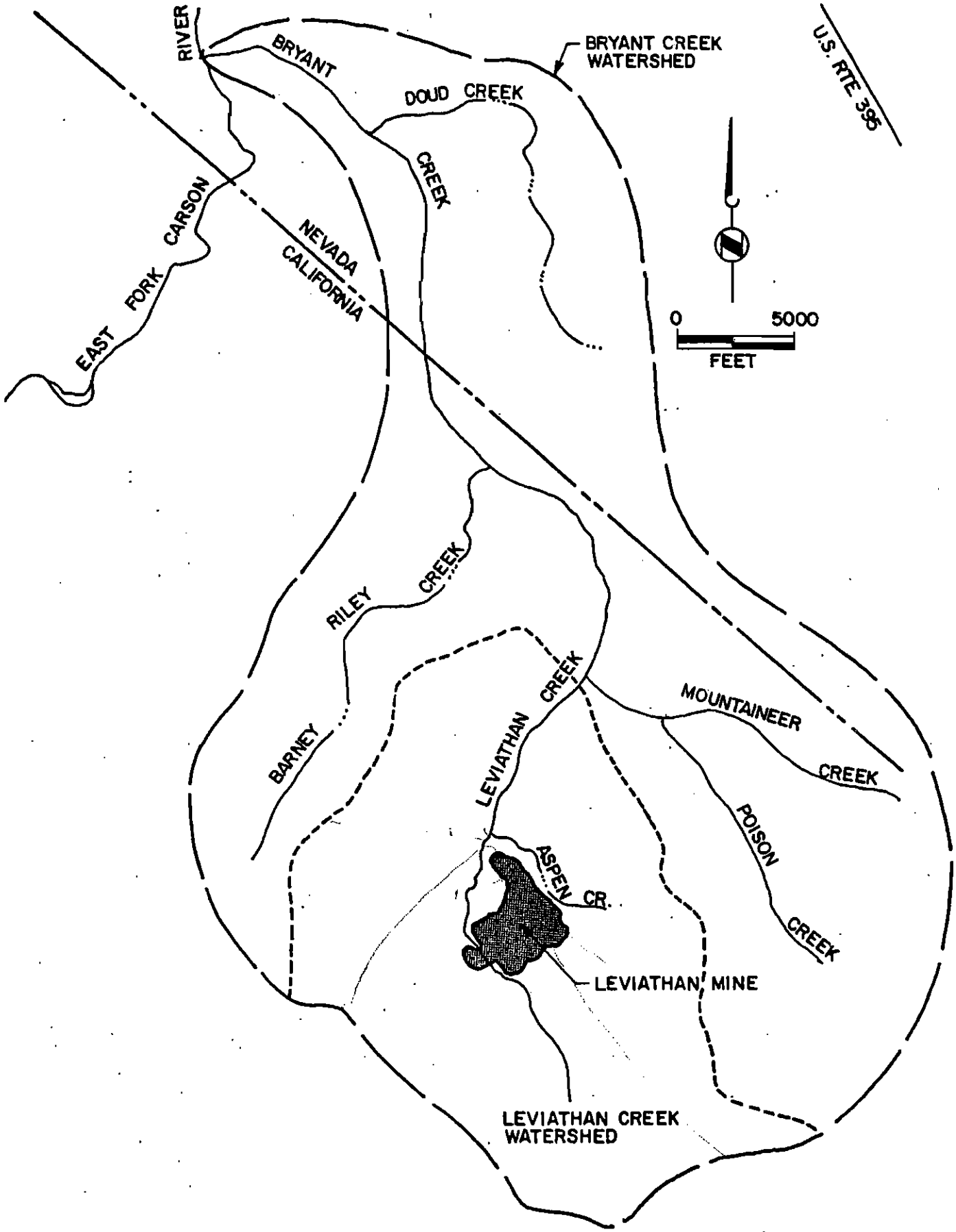


Figure 2-3 Bryant and Leviathan Creek Watersheds

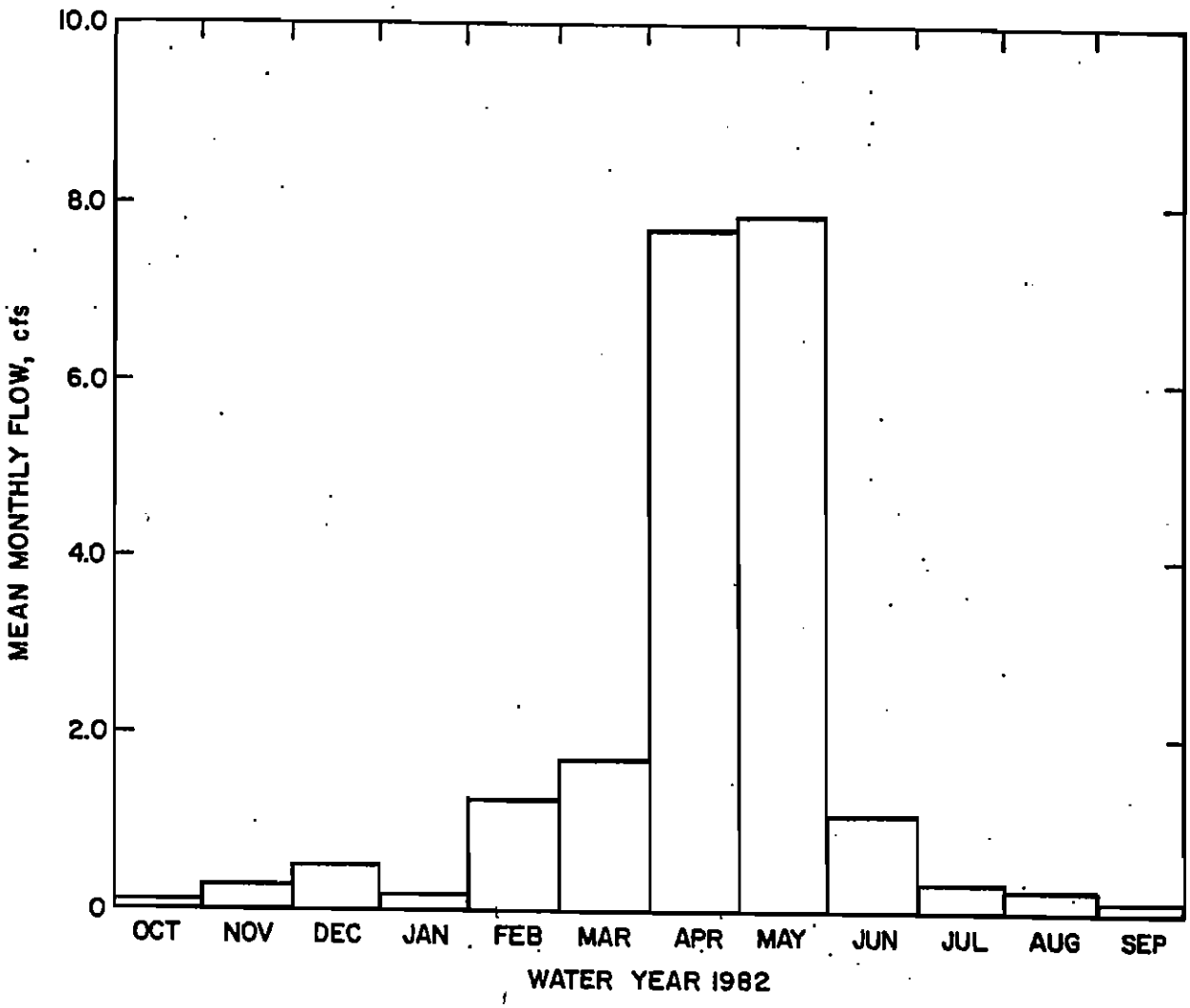


Figure 2-4 Leviathan Creek Mean Monthly Flow at Station 1 (Above Leviathan Mine) in Water Year 1982

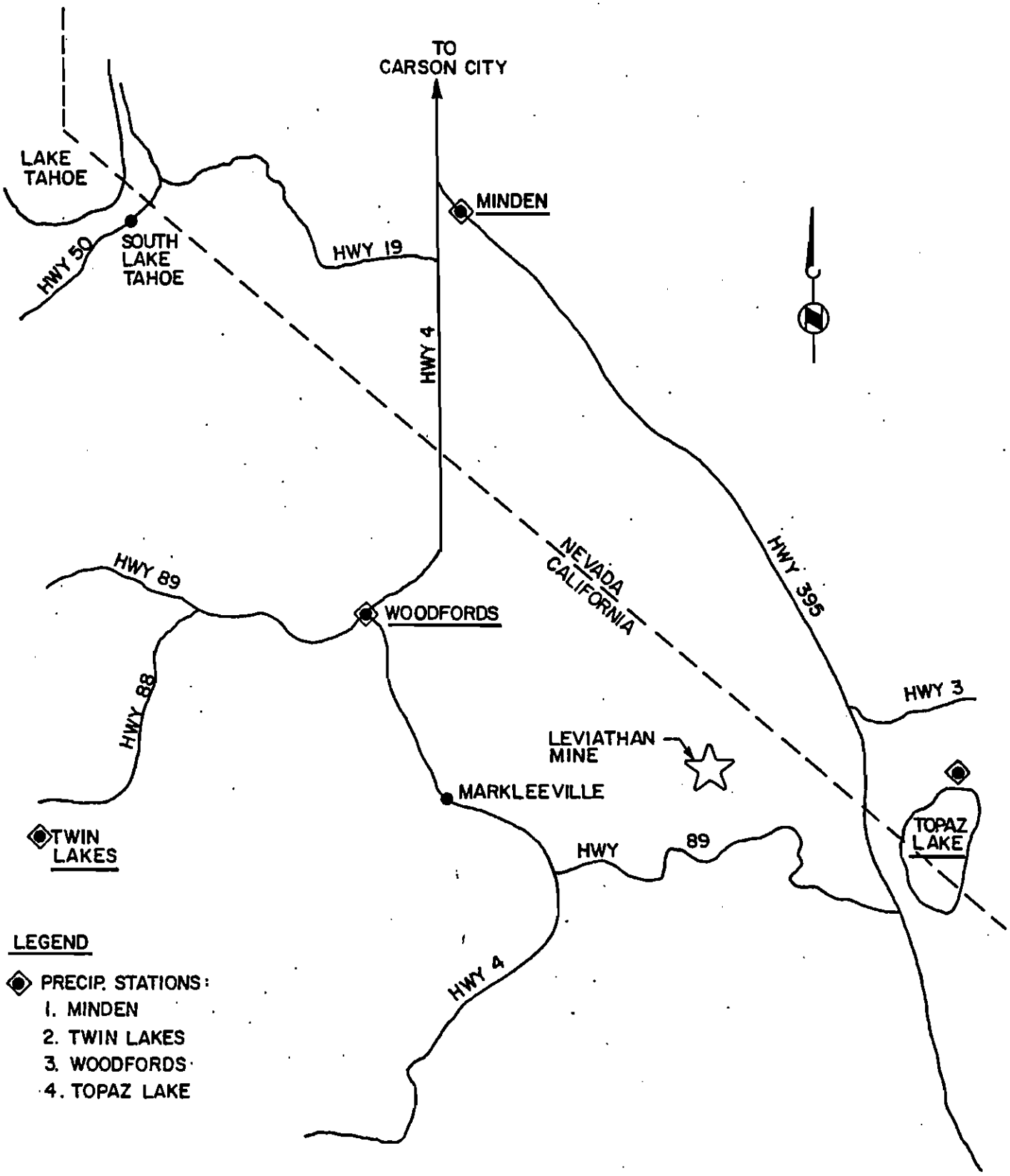


Figure 2-5 Precipitation Monitoring Station Near Leviathan Mine

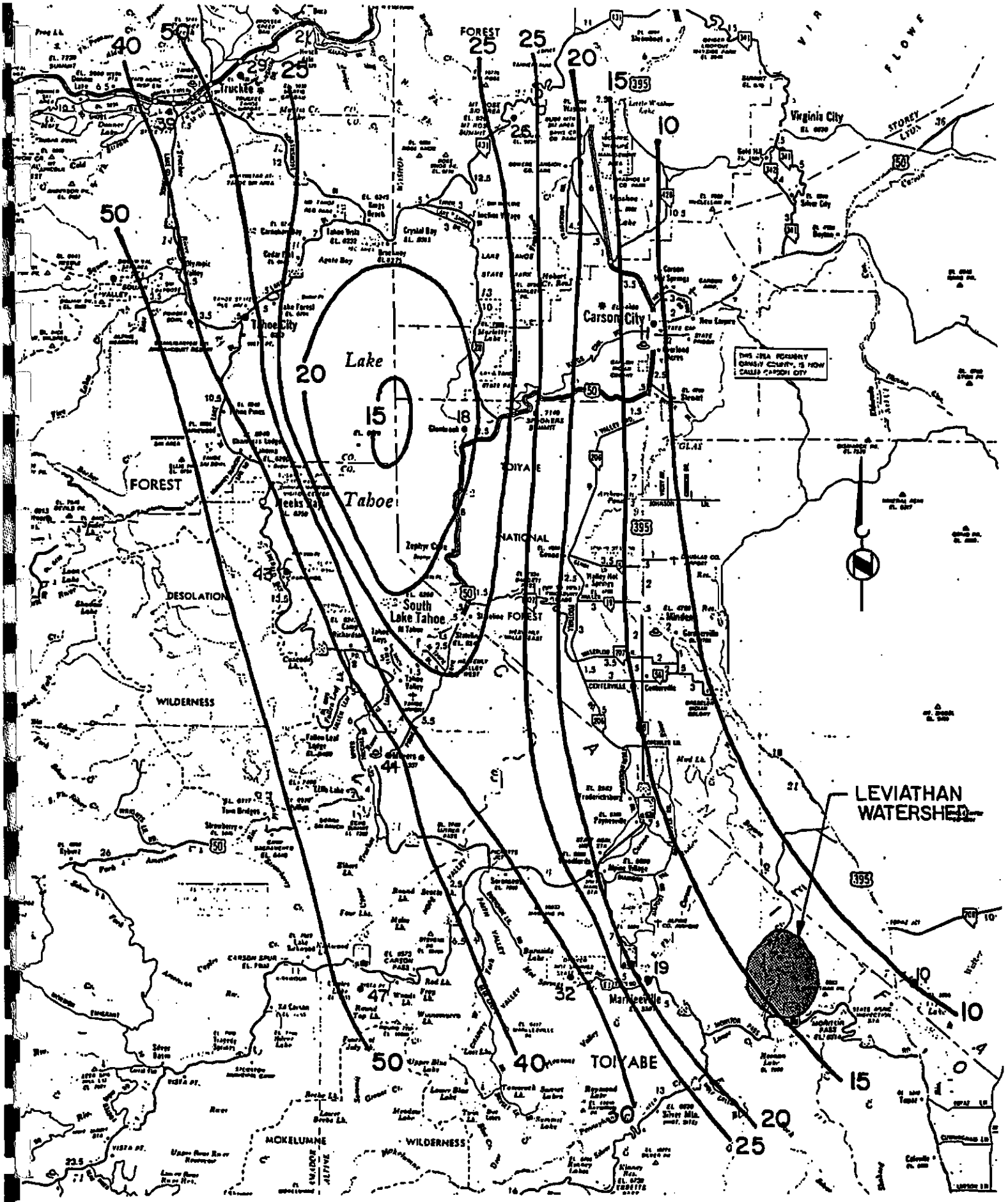


Figure 2-6 Mean Annual Precipitation Isohyets for Leviathan Mine Region, Inches

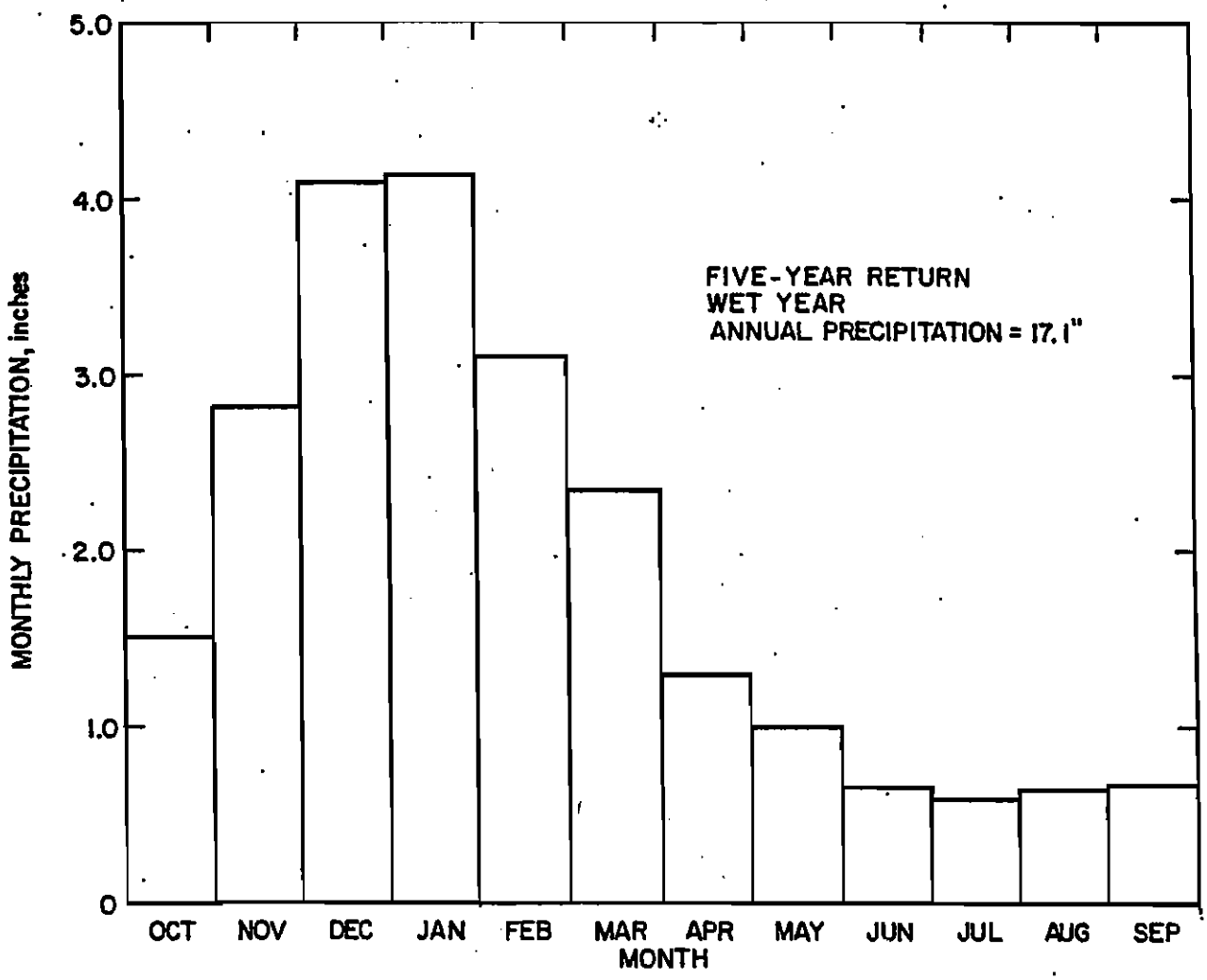


Figure 2-7 Estimated Monthly Precipitation at Leviathan Mine (20% Exceedence Frequency)

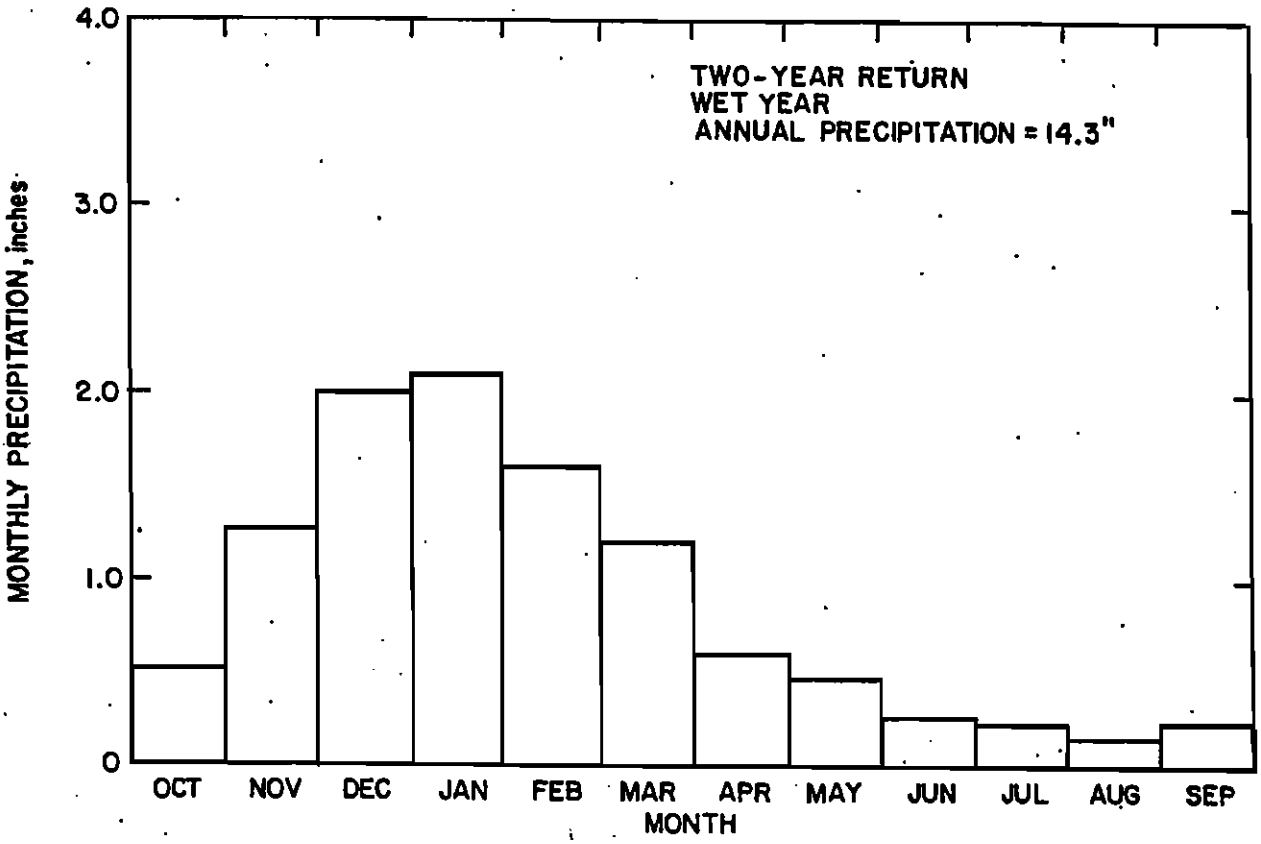


Figure 2-8 Estimated Monthly Precipitation at Leviathan Mine
(50% Exceedence Frequency)

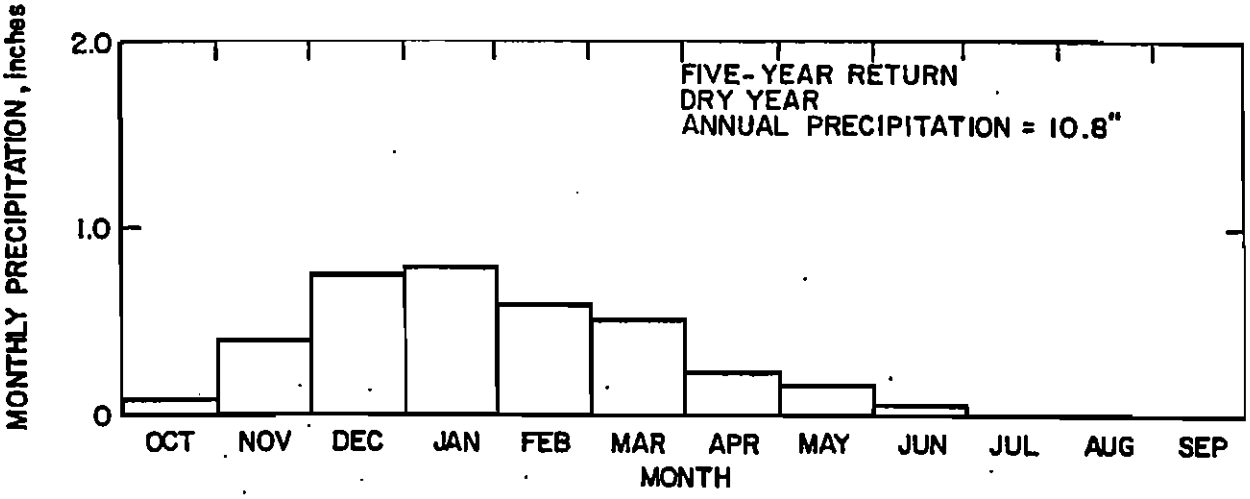


Figure 2-9 Estimated Monthly Precipitation at Leviathan Mine (80% Exceedence Frequency)

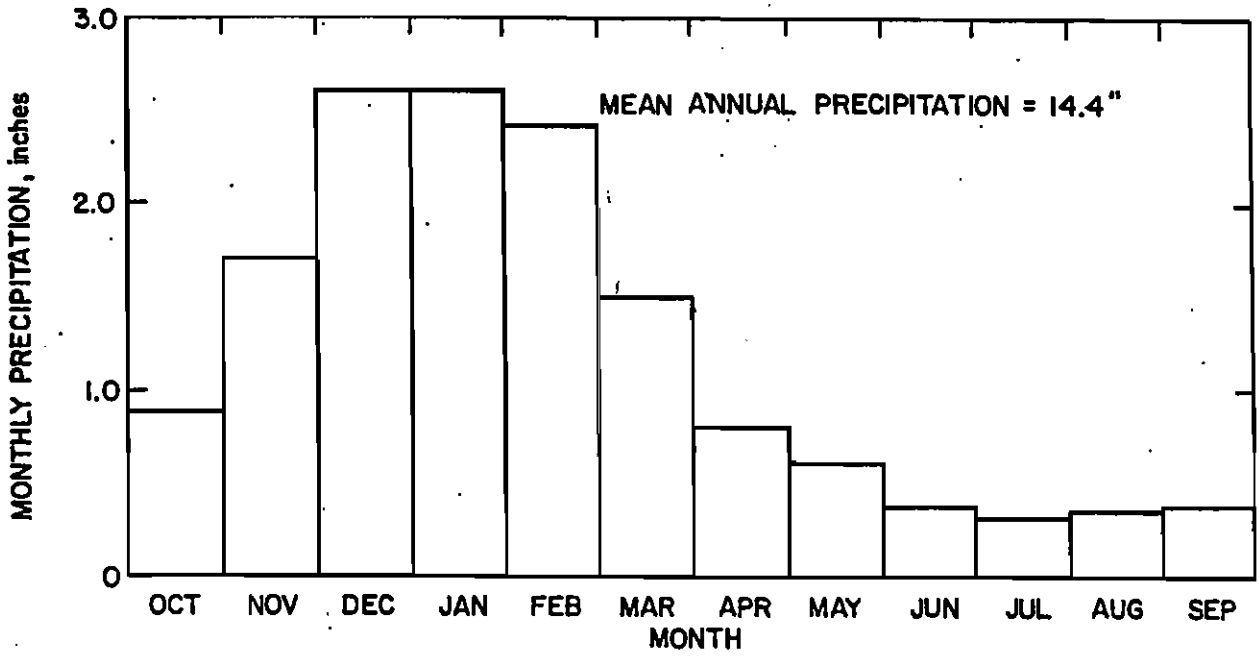


Figure 2-10 Estimated Mean Annual Precipitation at Leviathan Mine

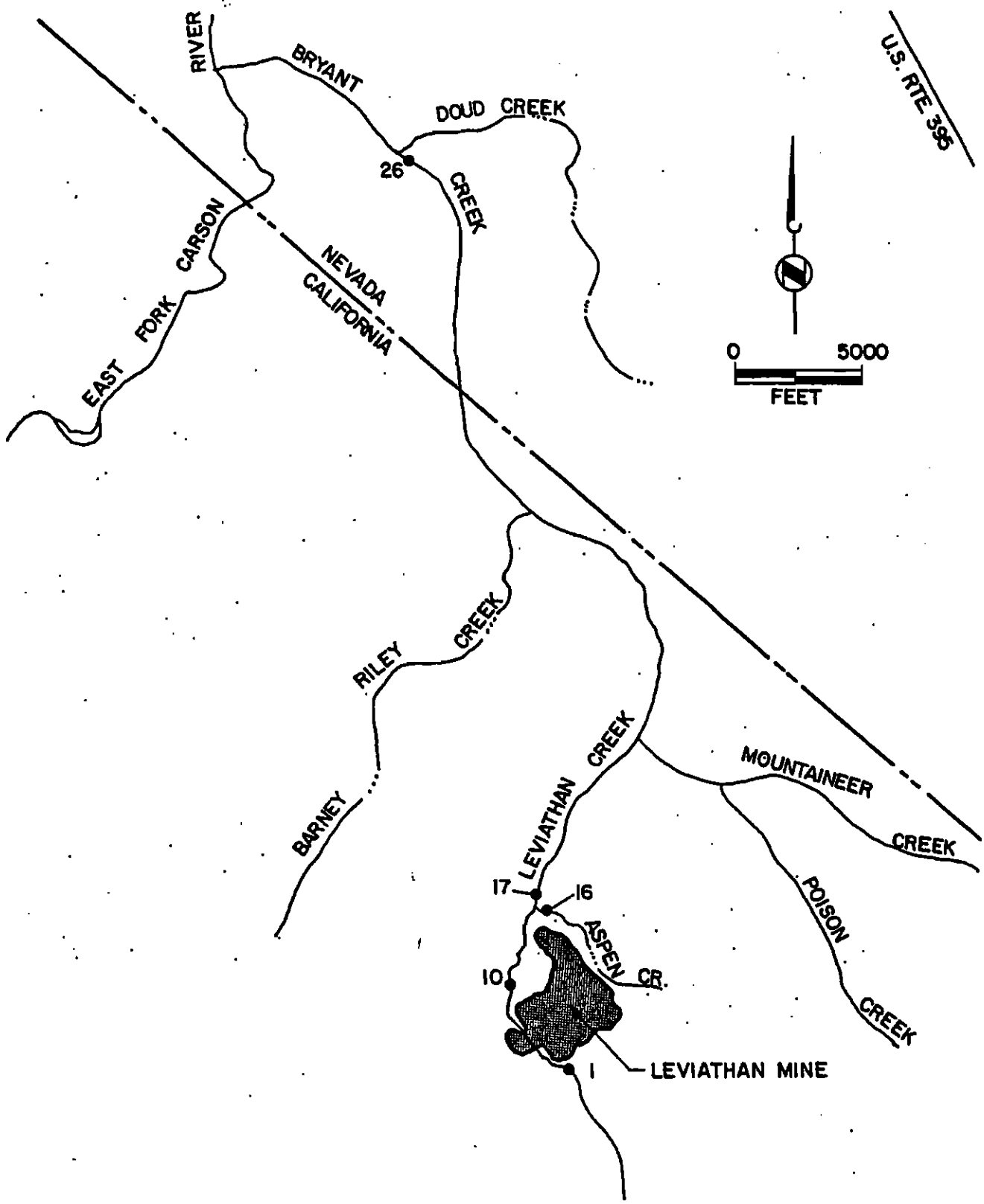


Figure 2-11 USGS Flow Measurement Stations Used in Streamflow Analyses

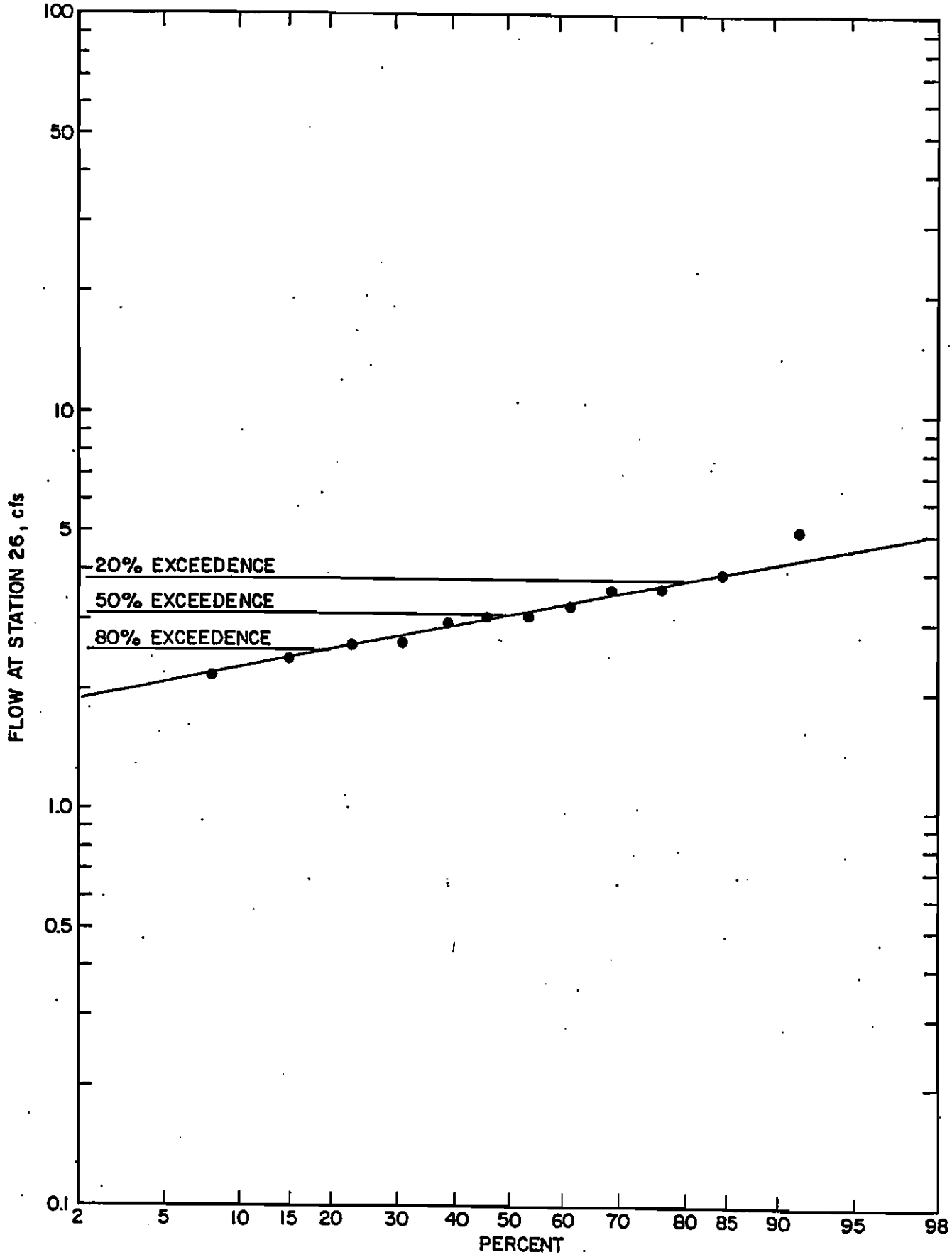
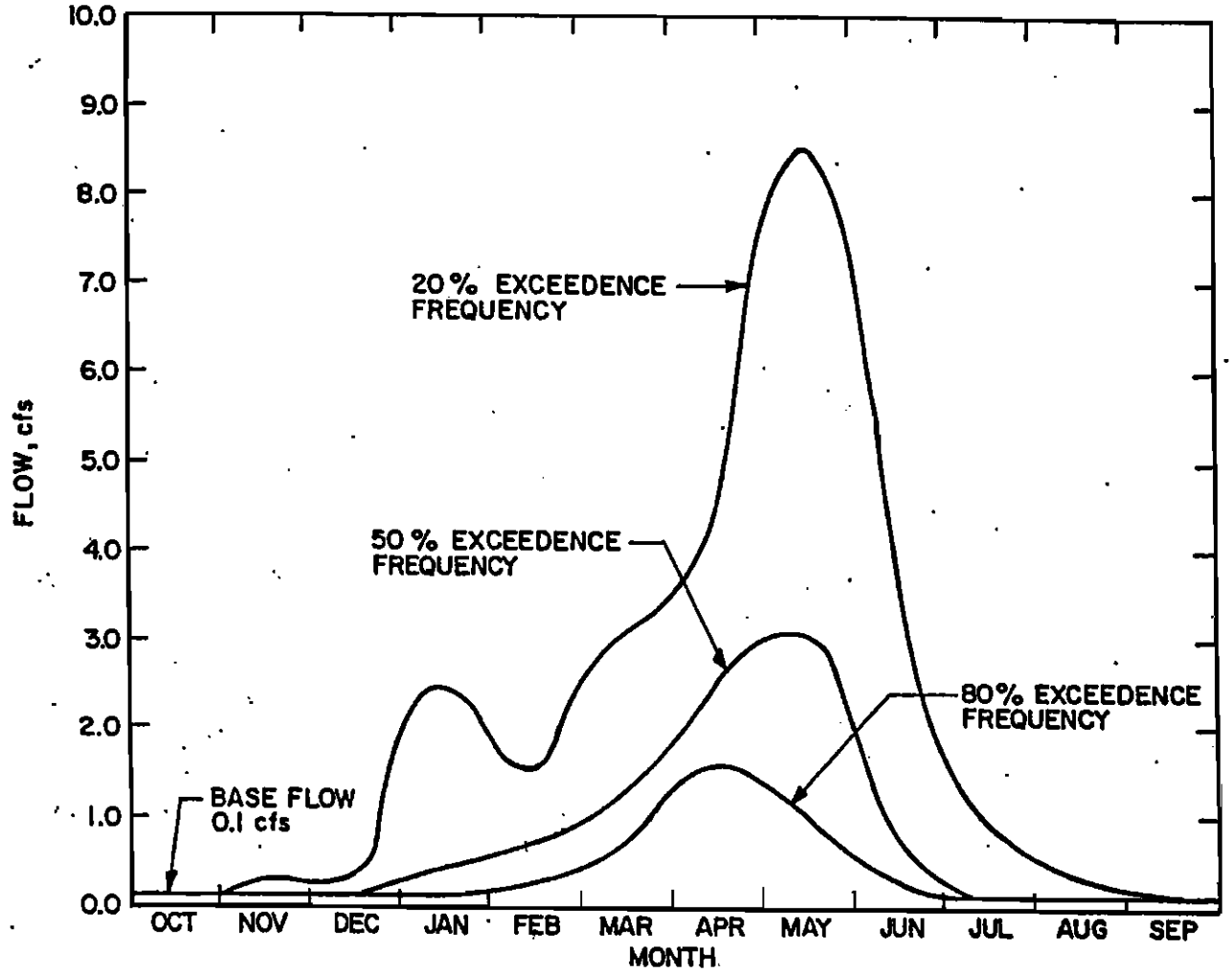
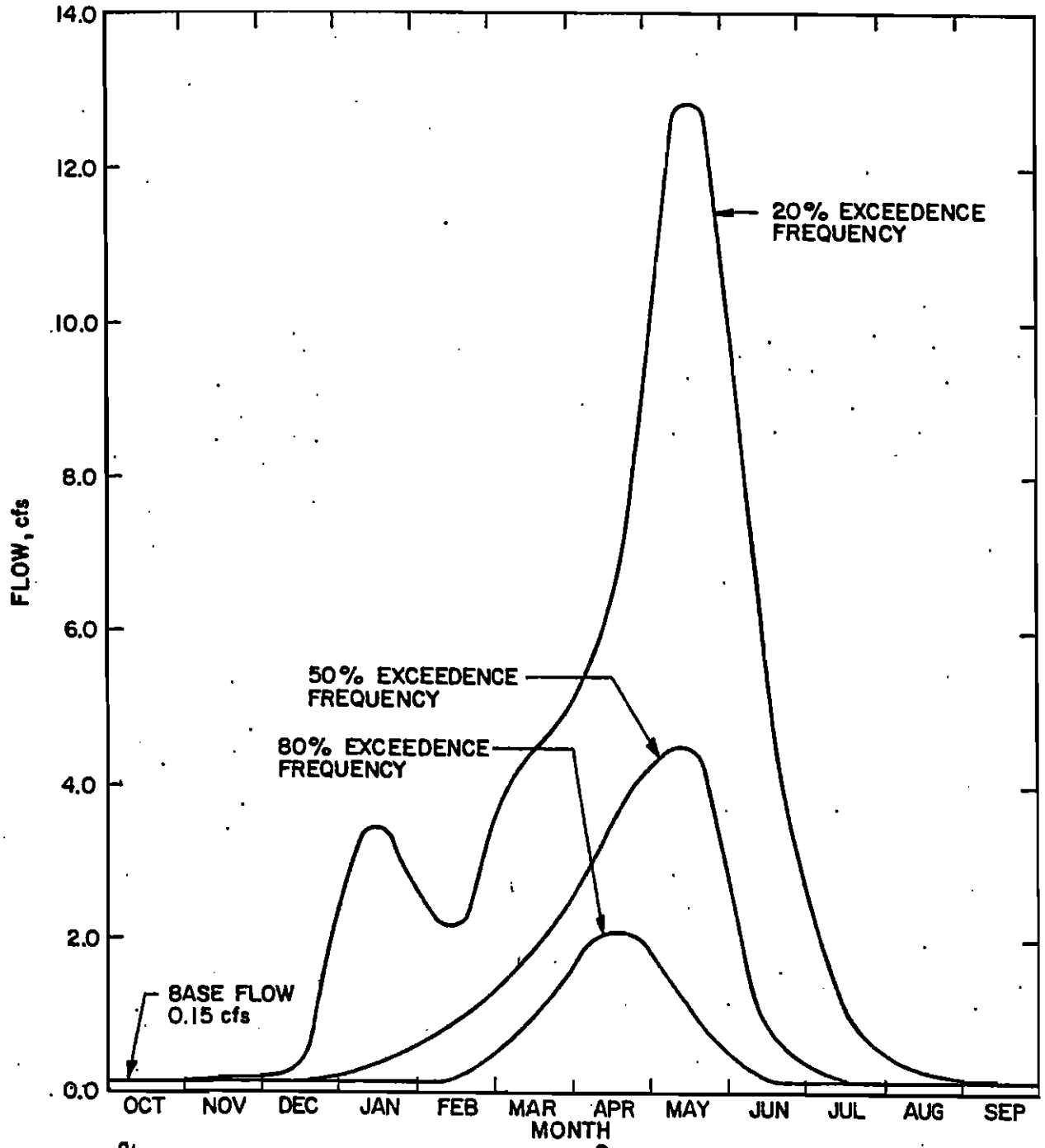


Figure 2-12 Typical Probability Plot of Station 26 Flows - September



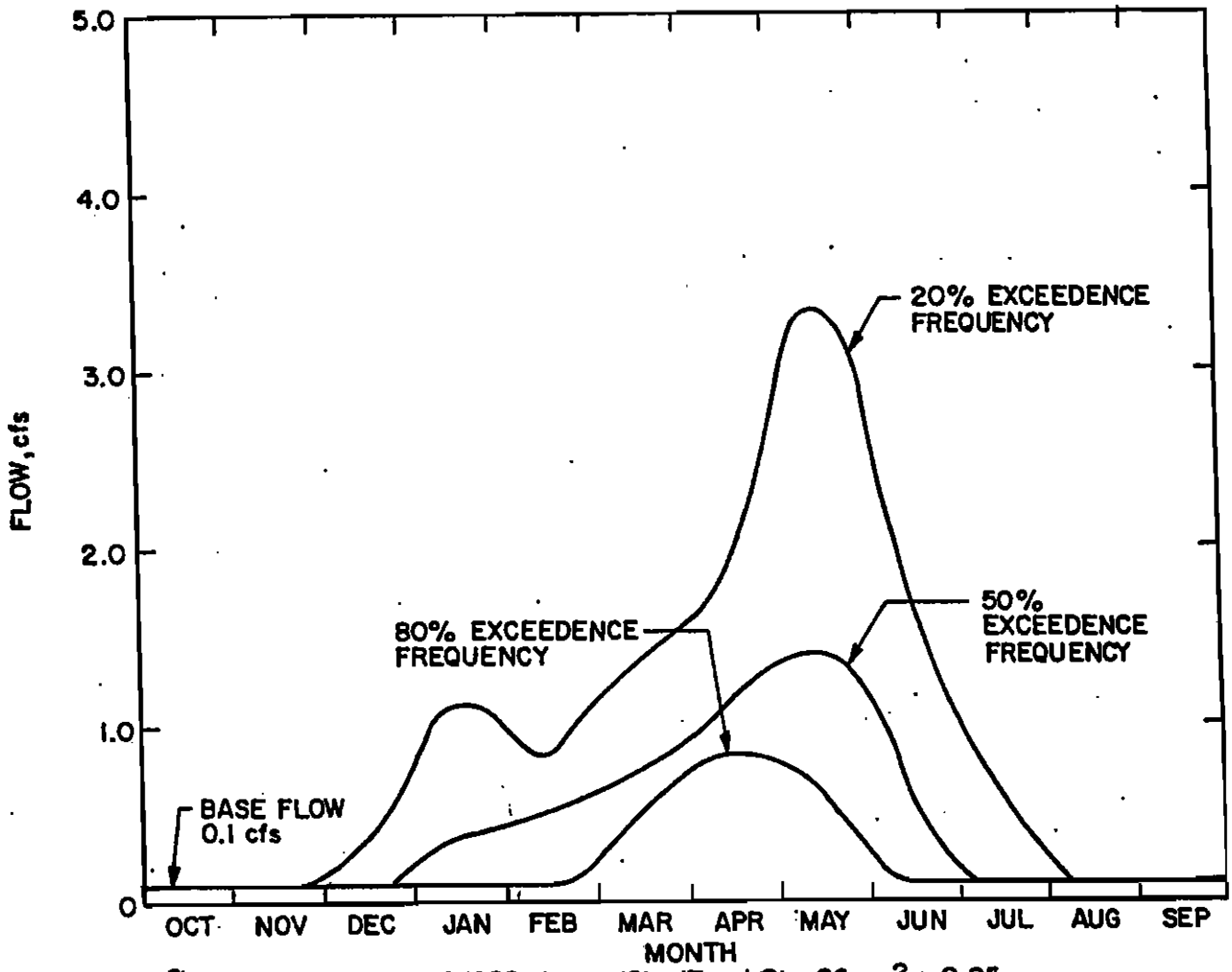
g/ Based on regression of 1982 data w/Sta. 26: $r^2 = 0.90$

Figure 2-13 Station 1 Synthetic Hydrograph g/



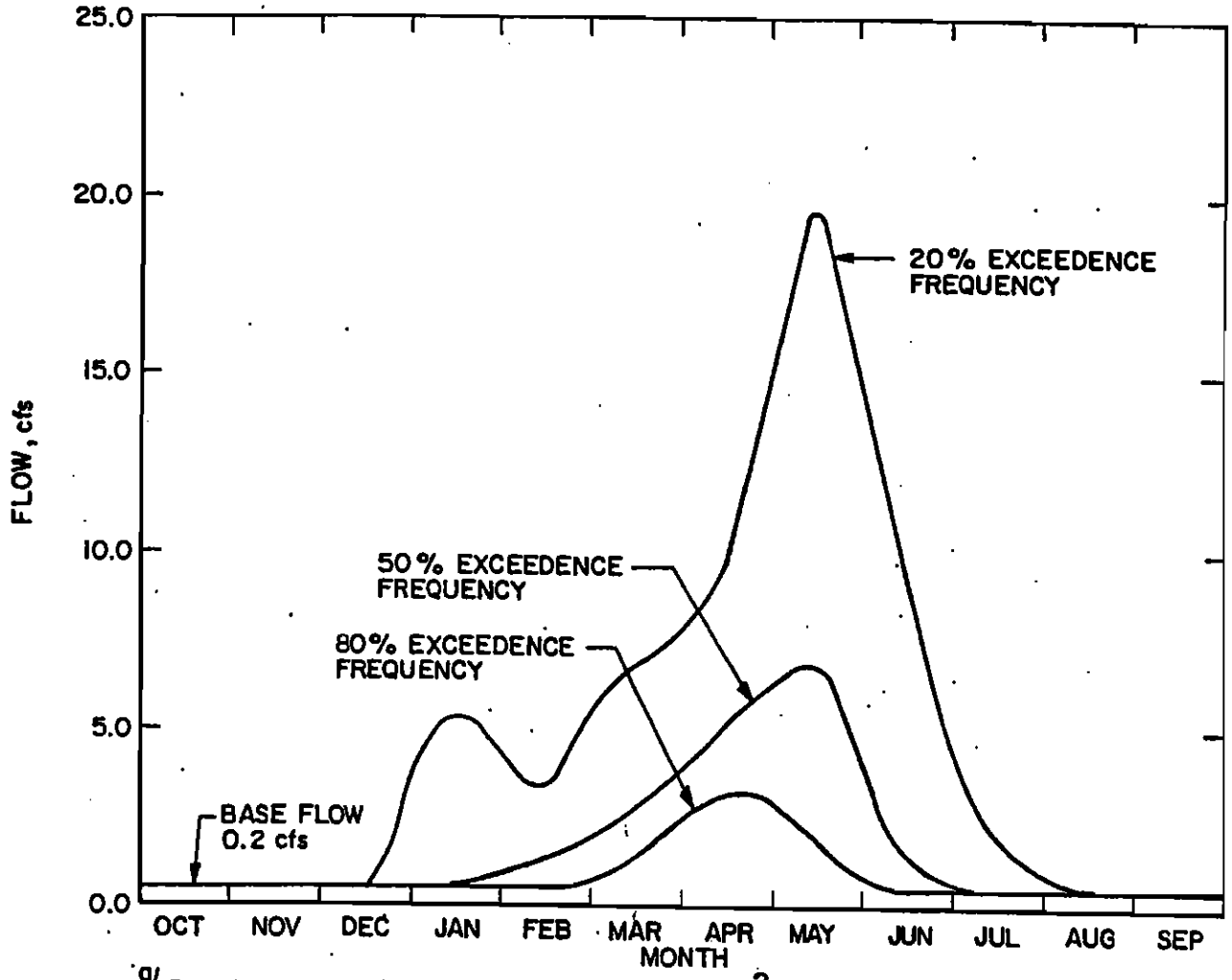
a/ Based on regression of 1982 w/Sta. 26: $r^2 = 0.98$

Figure 2-14 Station 10 Synthetic Hydrograph a/



[g]Based on regression of 1982 data w/Sta. 17 and Sta. 26 : $r^2 = 0.95$

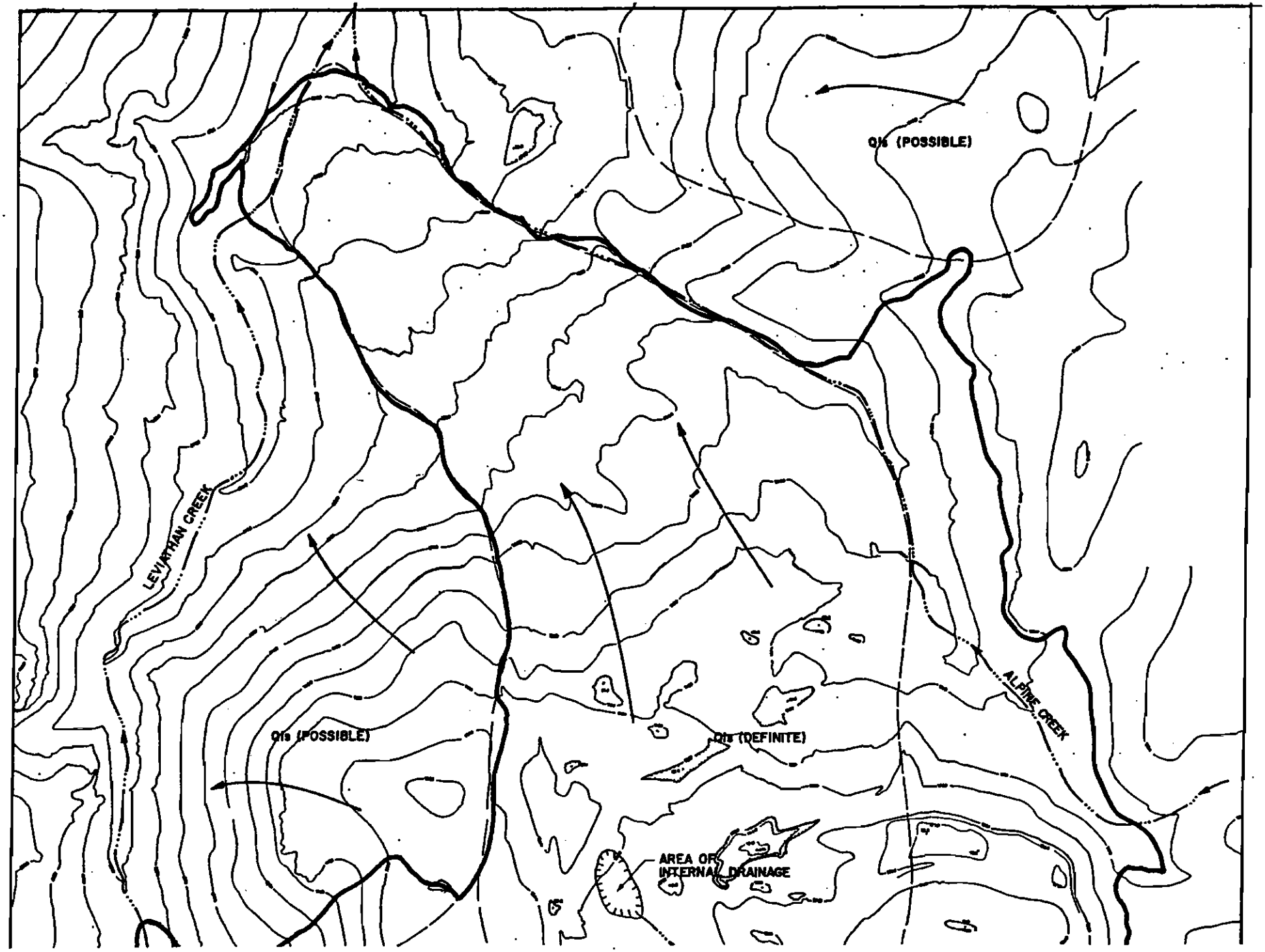
Figure 2-15 Station 16 Synthetic Hydrograph [g]

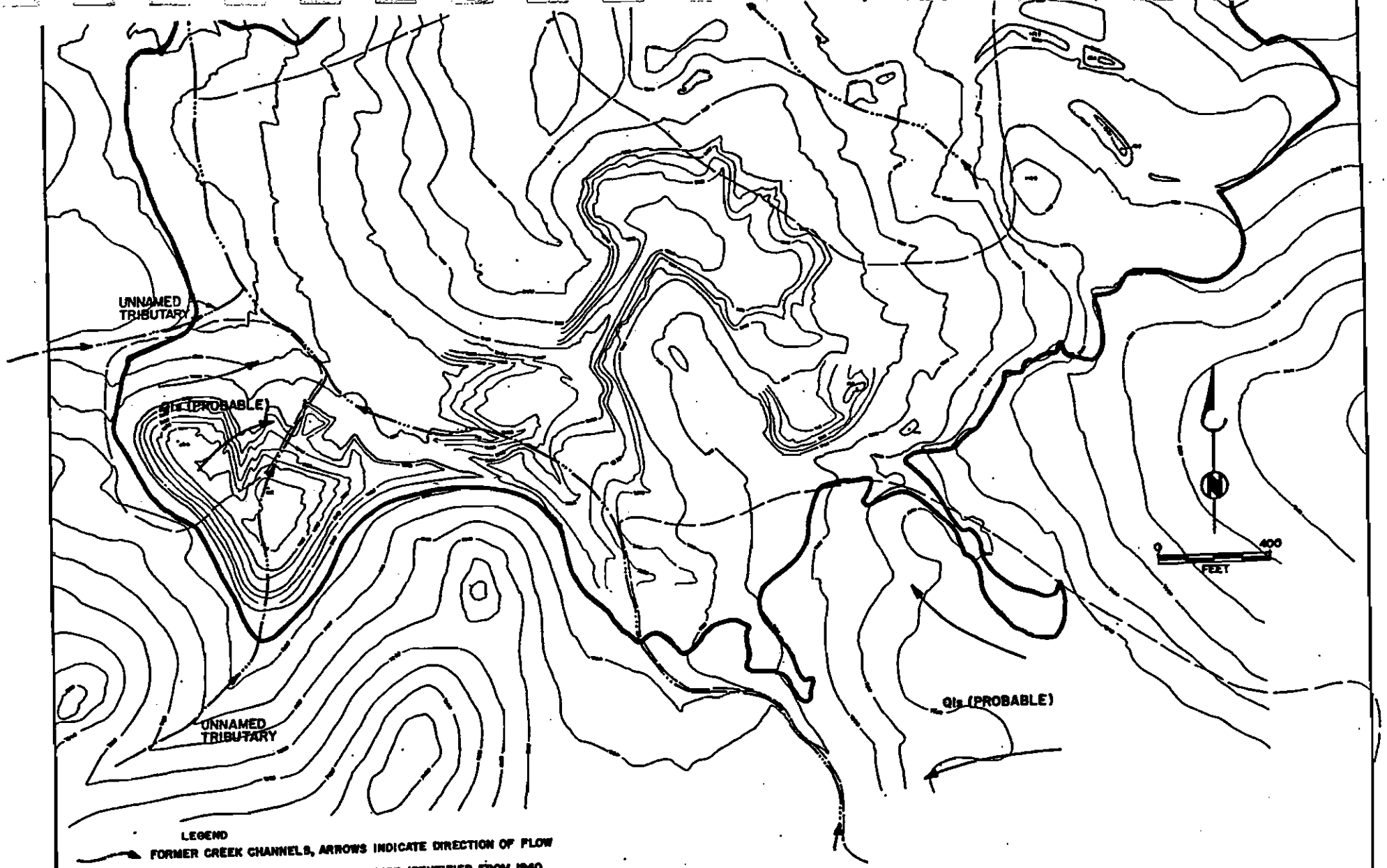


g/ Based on regression of 1982 data w/Sta. 26: $r^2 = 0.96$

Figure 2-16 Station 17 Synthetic Hydrograph g/

TURN PAGE FOR
NEXT FIGURE


Qls (POSSIBLE)
LEVIATHAN CREEK
Qls (POSSIBLE)
Qls (DEFINITE)
ALPINE CREEK
AREA OF
INTERNAL DRAINAGE



LEGEND

FORMER CREEK CHANNELS, ARROWS INDICATE DIRECTION OF FLOW

ESTIMATED AREAL EXTENT OF LANDSLIDE IDENTIFIED FROM 1940 TOPOGRAPHIC MAP, ARROW SHOWS DIRECTION OF MOVEMENT

Qls INDICATES LANDSLIDE, SHOWING RELATIVE ESTIMATE OF CERTAINTY OF EXISTENCE:
(DEFINITE) = HIGH LEVEL OF CERTAINTY
(PROBABLE) = MODERATE LEVEL OF CERTAINTY
(POSSIBLE) = LOW LEVEL OF CERTAINTY

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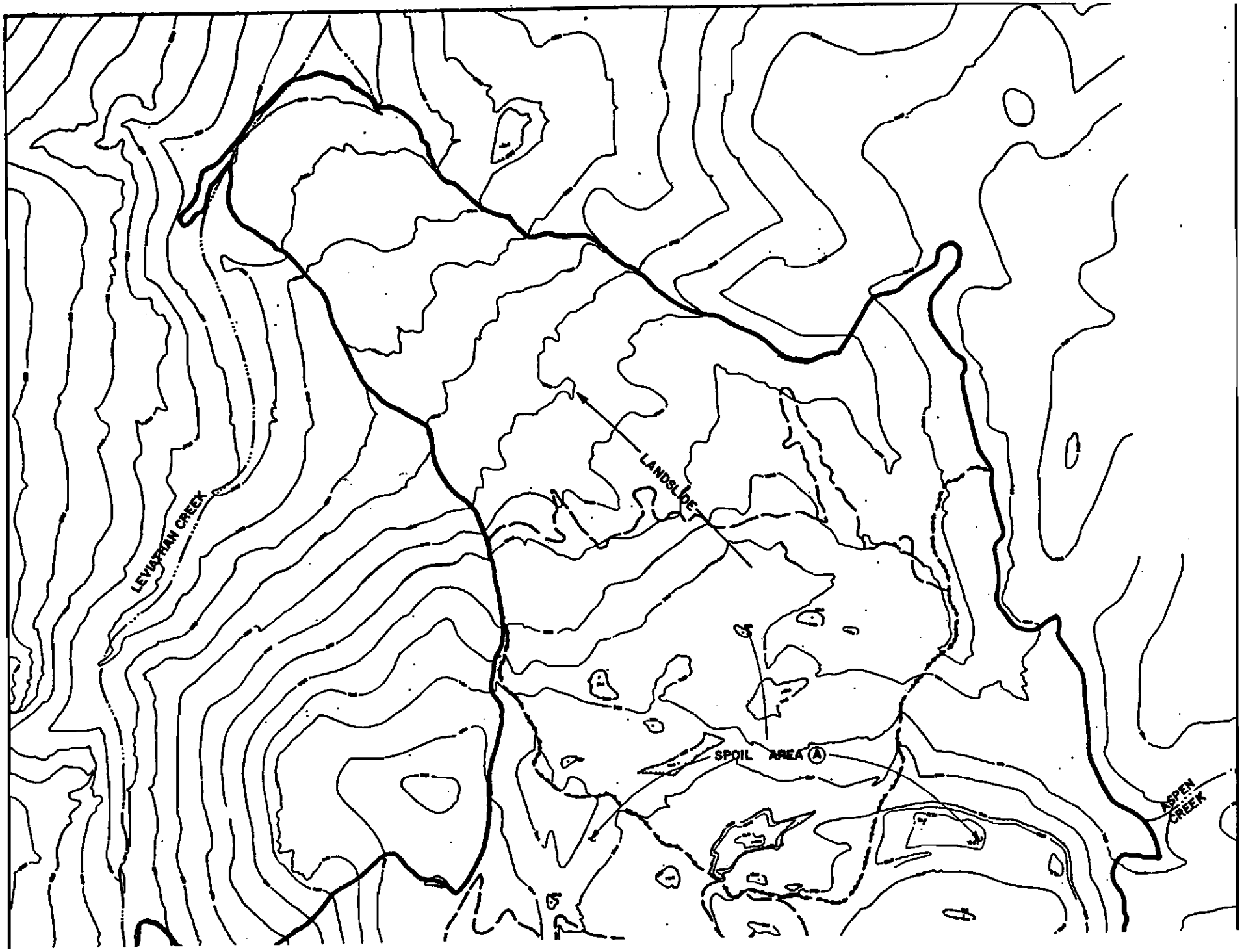
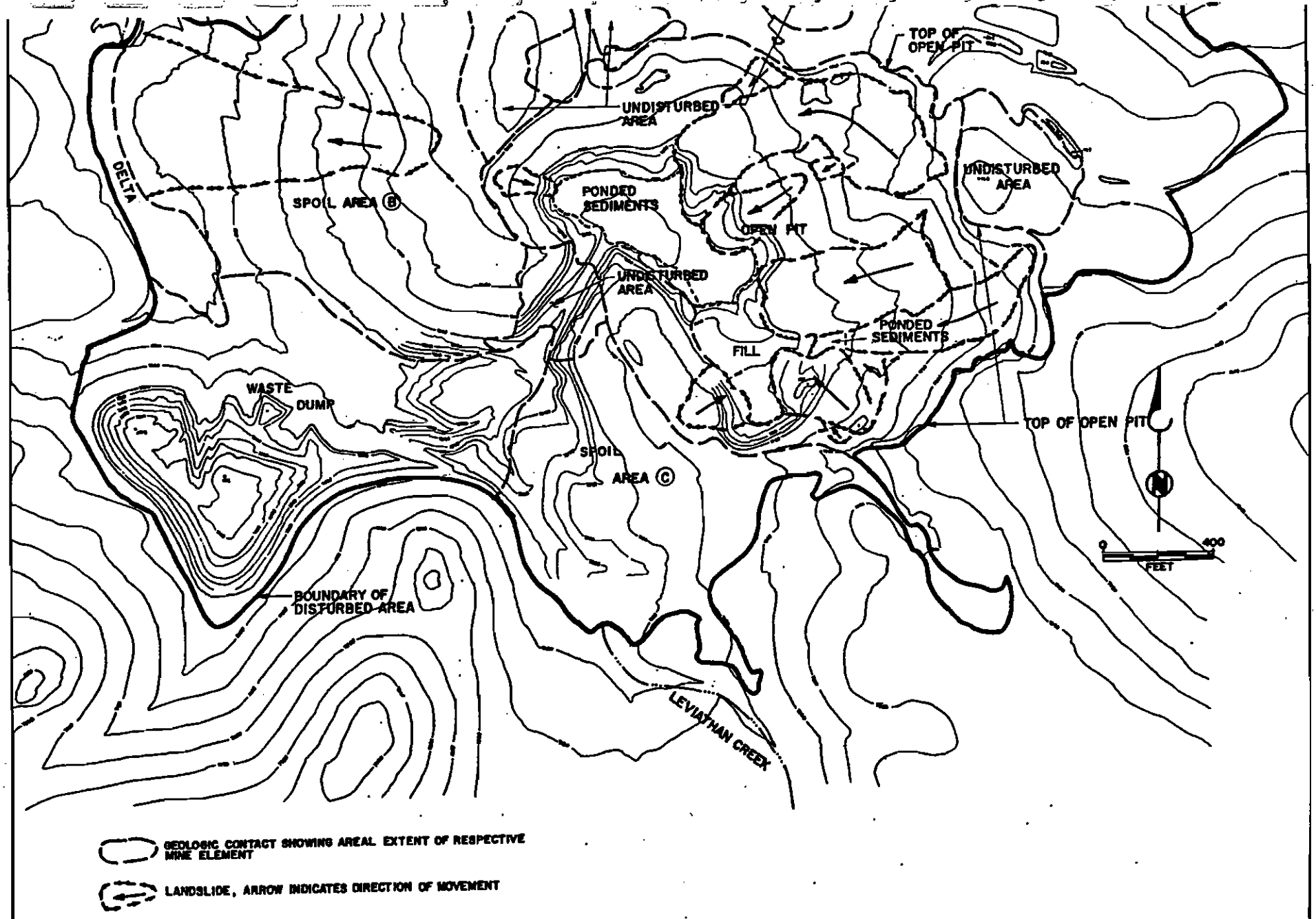
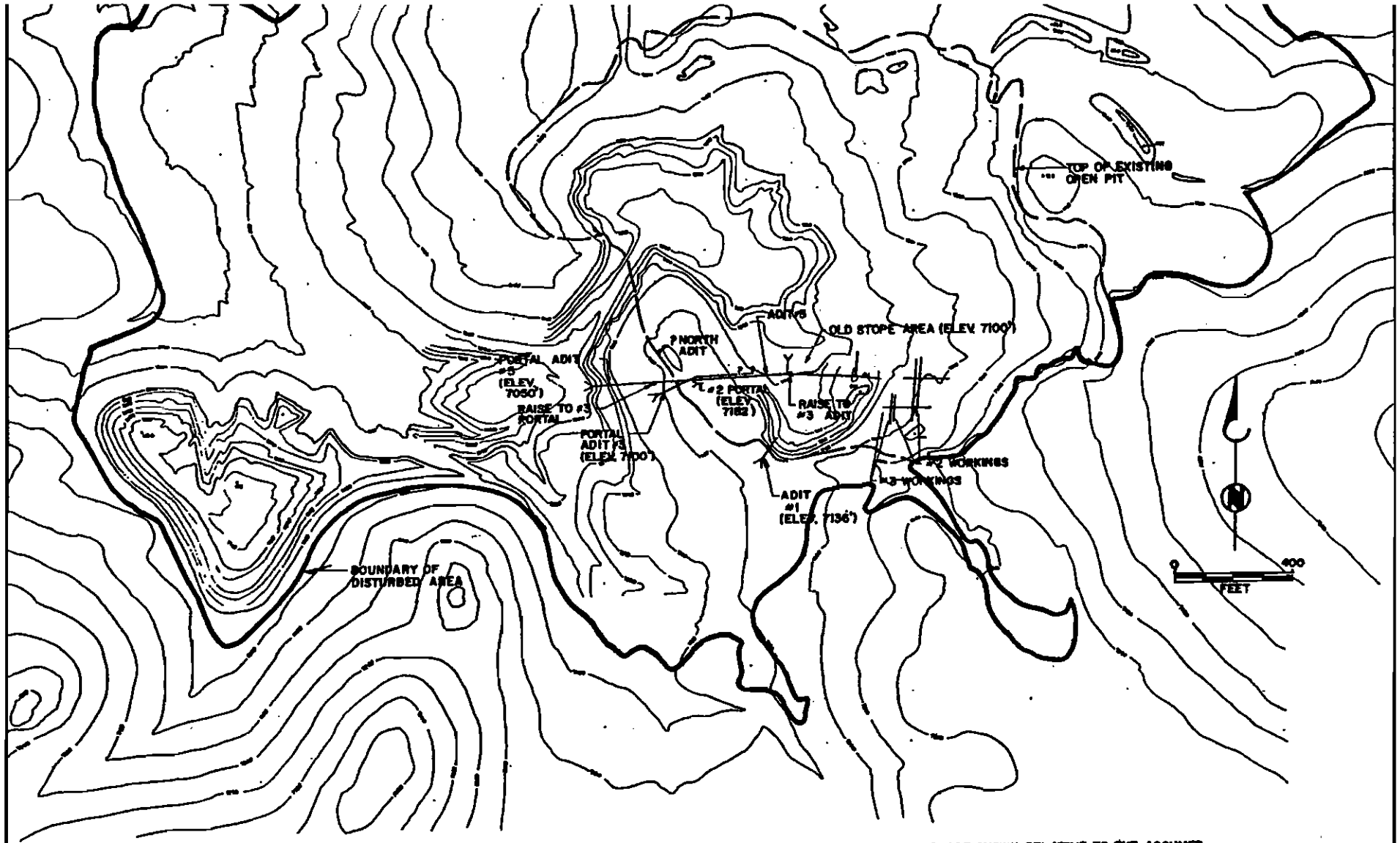
FIGURE 2-17 MAP OF SURFACE FEATURES, PRE-OPEN PIT MINE CONDITIONS


LEVIATHAN CREEK
LANDSLIDE
SPOIL AREA (A)
ASPEN CREEK



BROWN AND CALDWELL
CONSULTING ENGINEERS

FIGURE 2-18 MAP OF SURFACE MINE ELEMENTS, POST-OPEN PIT MINE



LEGEND-

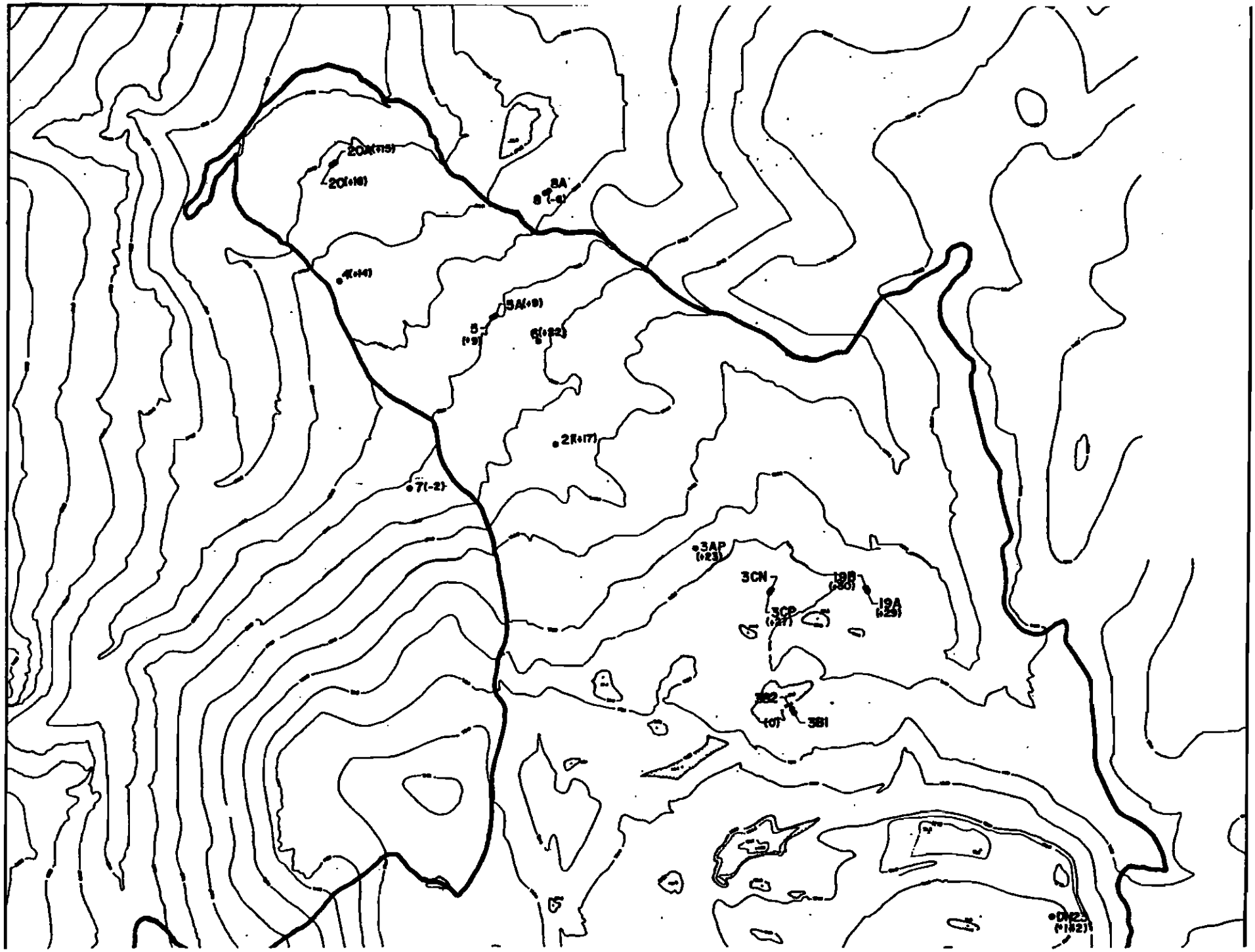
ADIT (ELEV. 7136') — NUMBER, APPROXIMATE LOCATION, AND APPROXIMATE ALIGNMENT OF ORIGINAL MINE WORKING WHICH IS STILL PROBABLY IN EXISTENCE; ELEVATIONS SHOWN ARE ADAPTED FROM EXISTING MINE MAPS AND MAY NOT CORRESPOND TO PRESENT ELEVATION DATUM

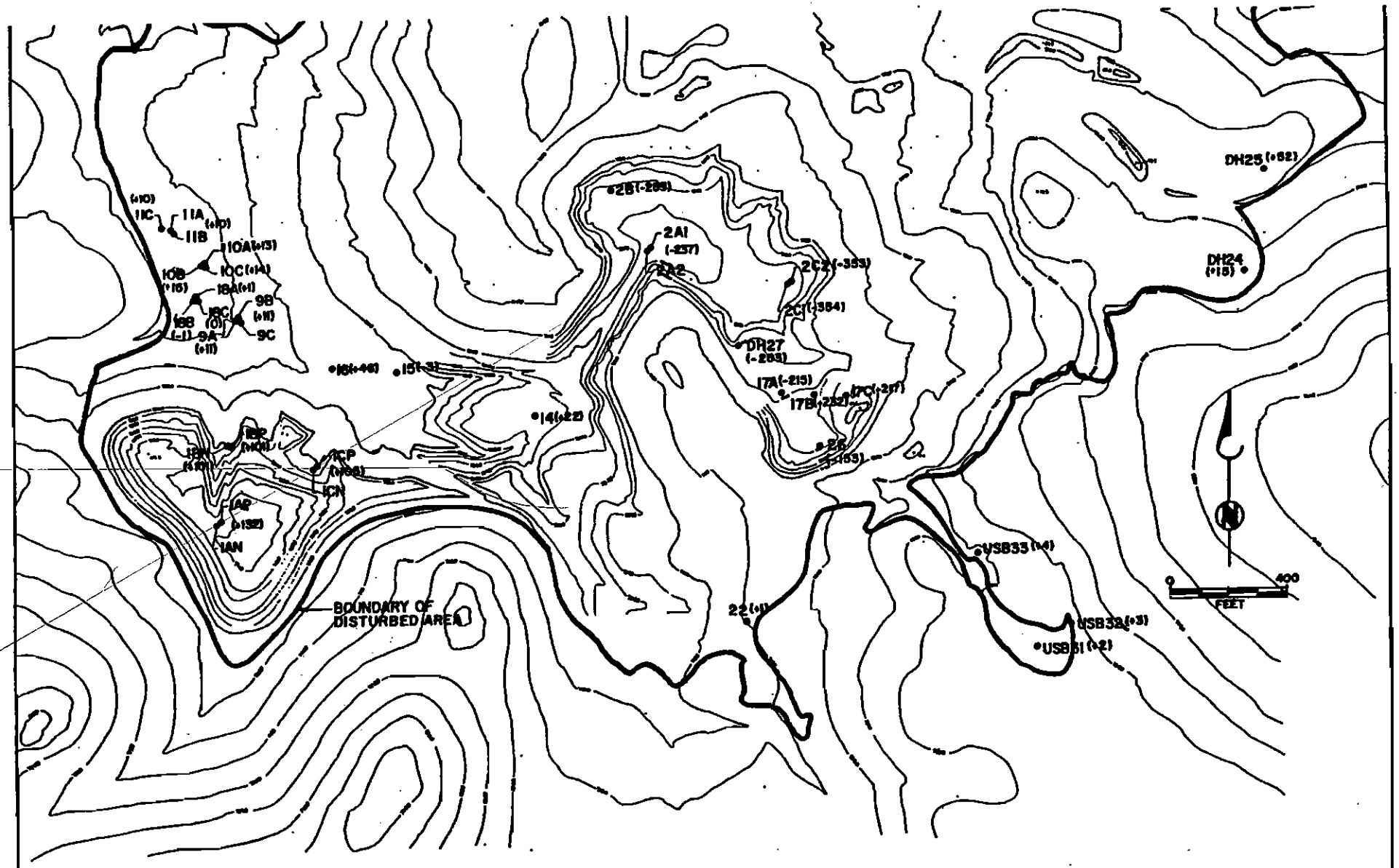
NOTE: PORTAL ELEVATIONS FOR ADIT NOS. 1 AND 2 ARE SHOWN RELATIVE TO THE ASSUMED ELEVATION GIVEN FOR ADIT NO. 1 ON EXISTING MINE MAPS. ADIT NO. 3 IS REPORTEDLY APPROXIMATELY 84 FEET ABOVE ADIT NO. 5. ONLY THE ELEVATION SHOWN FOR ADIT NO. 5 PORTAL IS CONSIDERED REASONABLY ACCURATE.

BROWN AND CALDWELL
CONSULTING ENGINEERS

FIGURE 2-19 MAP OF PROBABLE REMAINING UNDERGROUND MINE WORKINGS

TURN PAGE FOR
NEXT FIGURE


20A(+15)
20(+16)
8A
8(-6)
7(+4)
5A(+9)
5
(+9)
6(+22)
2(+17)
7(-2)
3AP
(+23)
3CN
19B
(+30)
19A
(+29)
3CP
(+27)
3B2
(0)
3B1



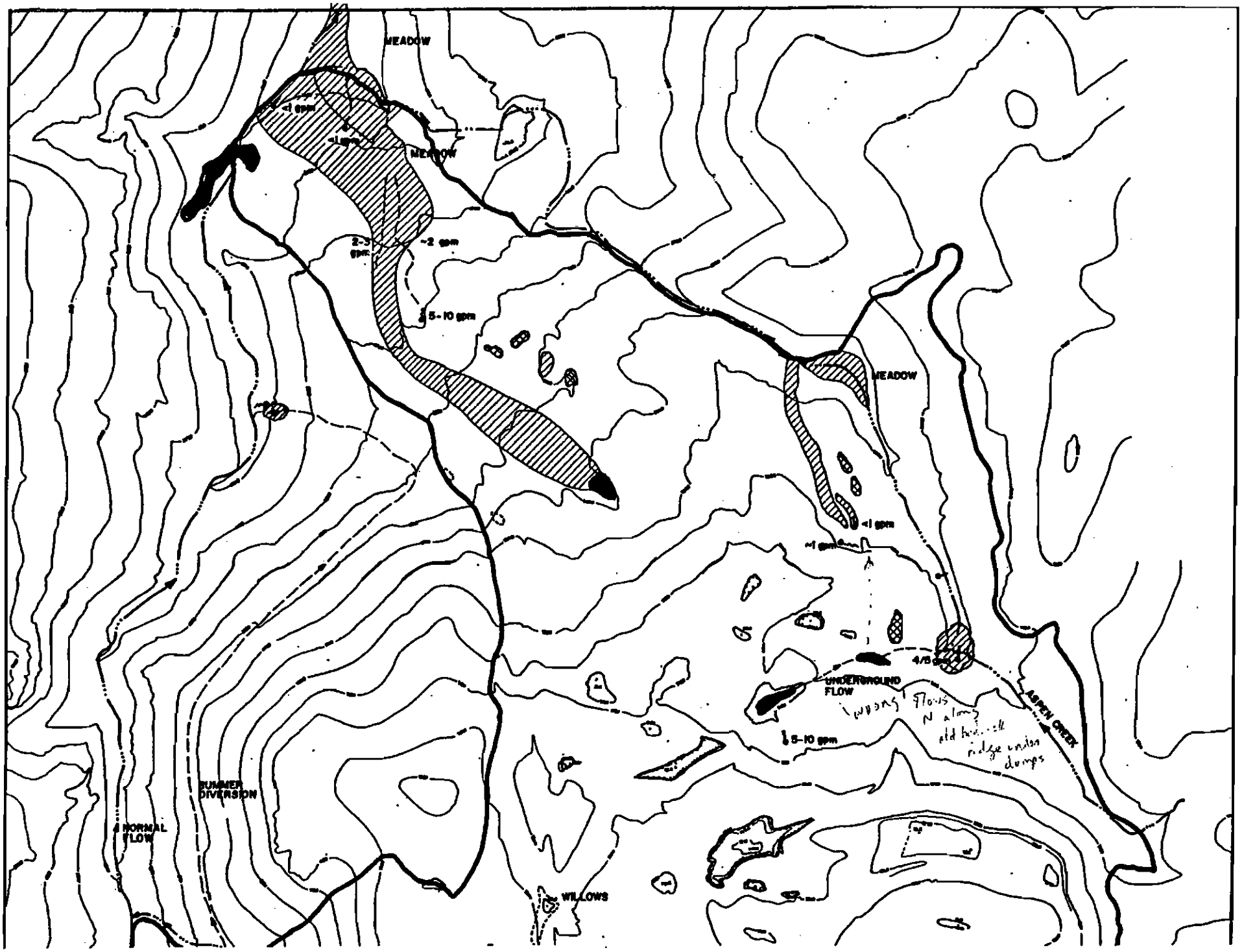
LEGEND

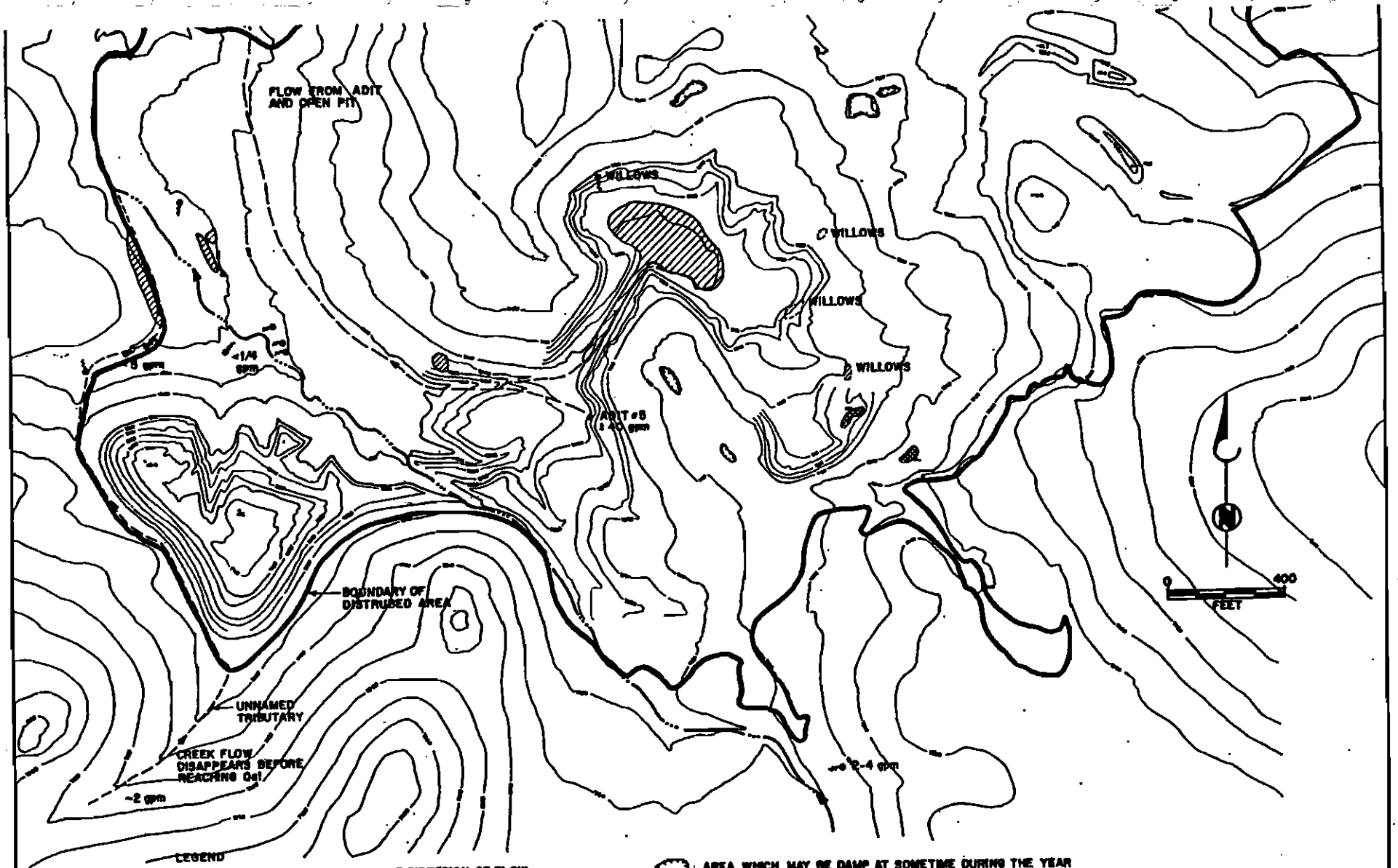
16 (+46) NUMBER AND LOCATION OF DRILL HOLE. NUMBER IN ( ) GIVES ELEVATION CHANGE FROM PRE-MINE TO POST-MINE CONDITIONS.

+ = THICKNESS, IN FEET, OF FILL ADDED
- = DEPTH, IN FEET, OF MATERIAL REMOVED
• = NO CHANGE

BROWN AND CALDWELL
CONSULTING ENGINEERS

FIGURE 2-20 GENERAL ELEVATION CHANGES, PRE-MINE TO POST-MINE CONDITIONS


MEADOW
<1 gpm
<1 gpm
MEADOW
2-3 gpm
~2 gpm
5-10 gpm
MEADOW
<1 gpm
<1 gpm
UNDERGROUND FLOW
5-10 gpm
ASPEN CREEK
SUMMER DIVERSION
NORMAL FLOW
WILLOWS



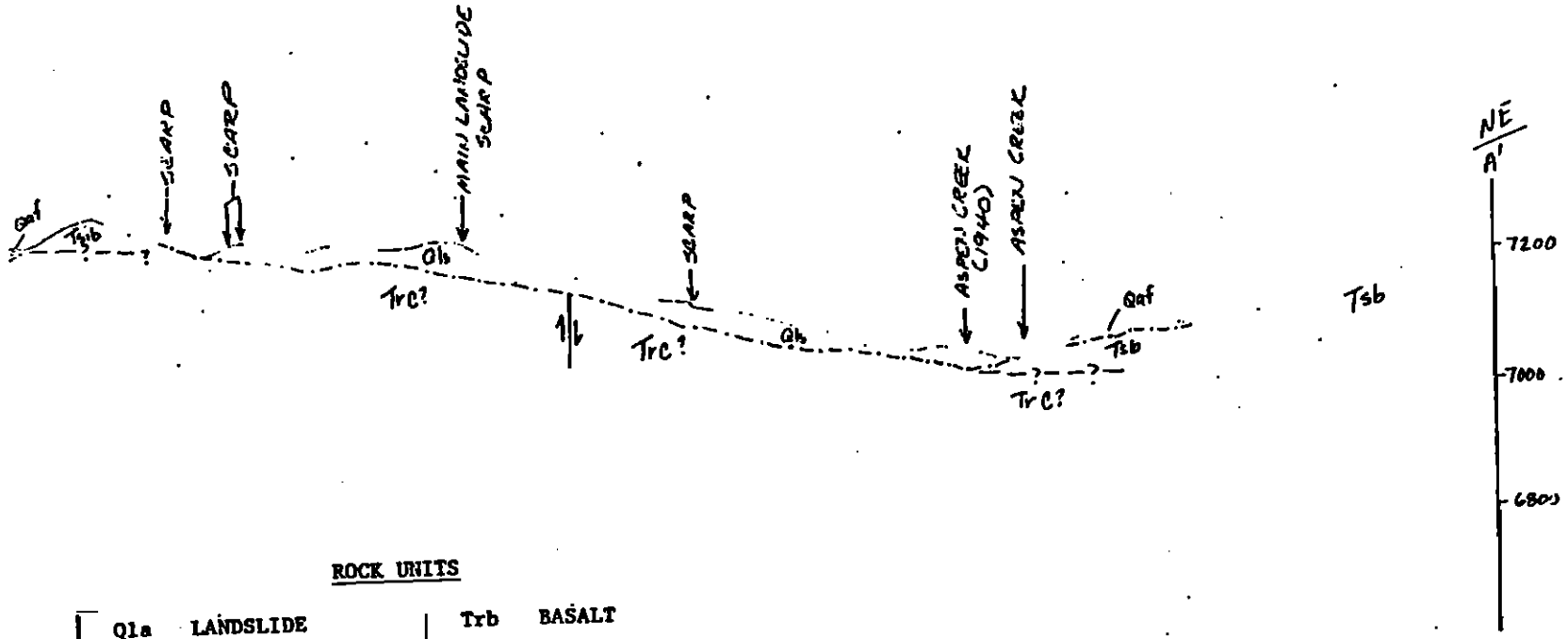
LEGEND

- PRESENT CREEK CHANNELS, ARROW INDICATE DIRECTION OF FLOW
- SPRING LOCATIONS, SHOWING FLOW ESTIMATES FOR SUMMER 1982
- AREAS OF PONDED WATER
- AREA FOR PONDING, BUT DRY DURING FIELD WORK
- EXISTING SEEP OR DAMP AREA
- AREA WHICH MAY BE DAMP AT SOMETIME DURING THE YEAR
- WILLOWS — AREA OF PHREATOPHYTE GROWTH

NOTE: Data and sites adapted from Regional Board mapping (1982), and from GTC reconnaissance (1982)

BROWN AND CALDWELL
CONSULTING ENGINEERS

FIGURE 2-21 MAP OF EXISTING SURFACE WATER FEATURES



ROCK UNITS

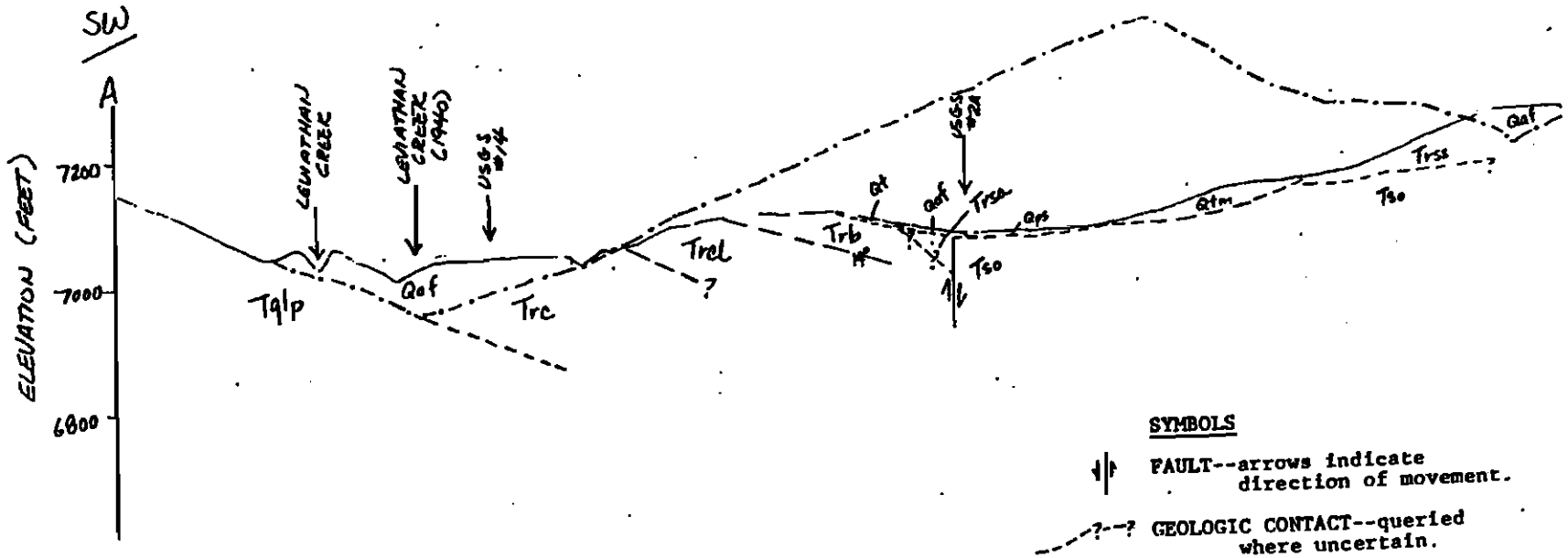
QUATERNARY

Qls	LANDSLIDE
Qps	PONDED SEDIMENTS
Qaf	ARTIFICIAL FILL
Qt	TALUS
Qt_m	TALUS RESULTING FROM MINING

Trb	BASALT
Trc	LOWER SEDIMENTARY SEQUENCE
Trcl	Lahar
Tqlp	QUARTZ LATITE PORPHYRY

TERTIARY

Tsib	SILICIFIED IRON-STAINED BRECCIA
Trs	UPPER SEDIMENTARY SEQUENCE
Trss	Sandstone
Trsa	Argillically Altered Sandstone
Tso	Ore Rock



SYMBOLS

FAULT--arrows indicate direction of movement.

?--? GEOLOGIC CONTACT--queried where uncertain.

PREMINE TOPOGRAPHY--7/21/1940

0 200′ 400′

CROSS-SECTION A-A′

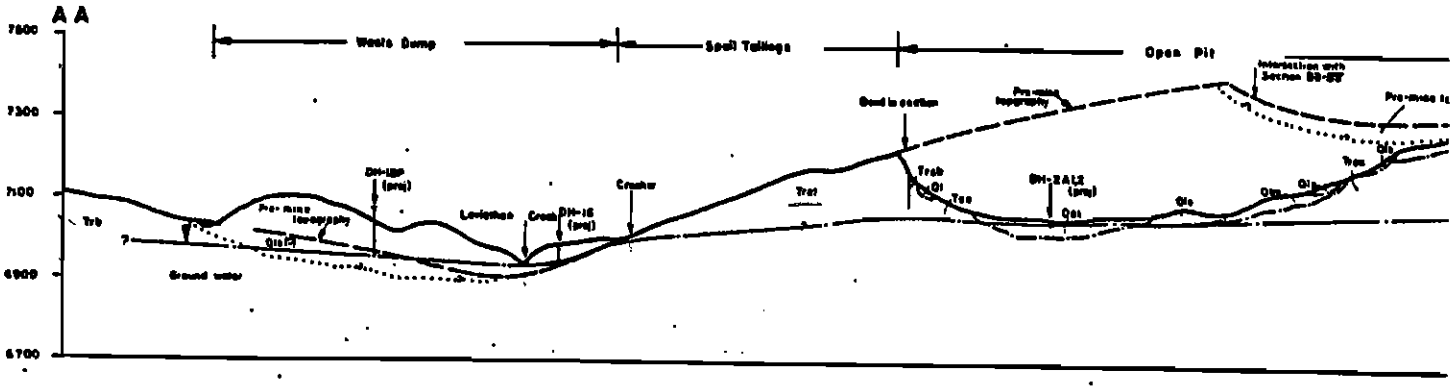
LEVIATHAN SULFUR MINE AND VICINITY

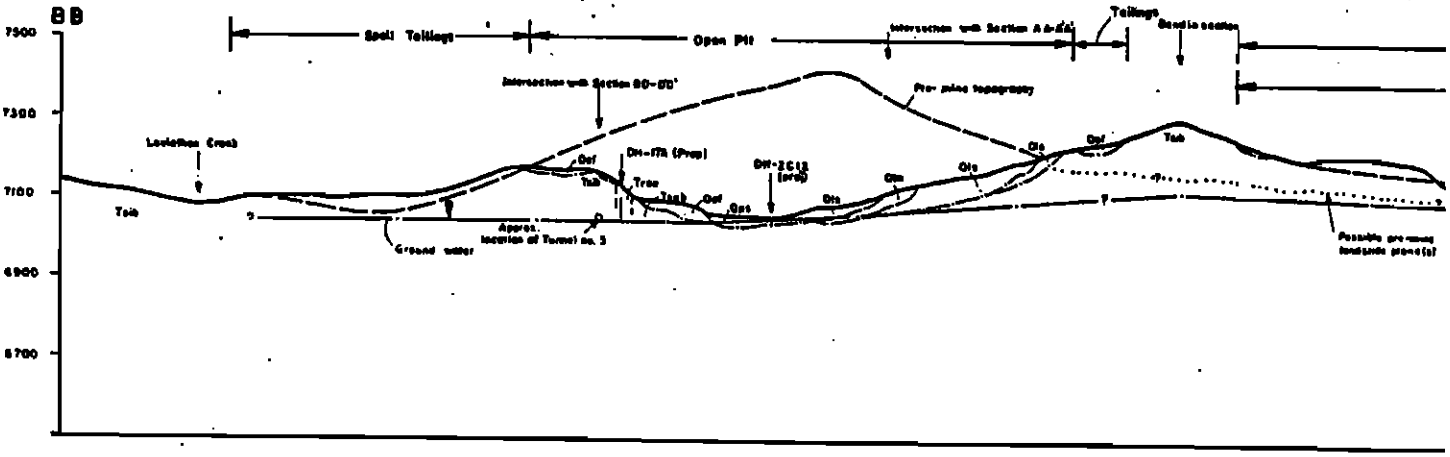
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF TECHNICAL SERVICES

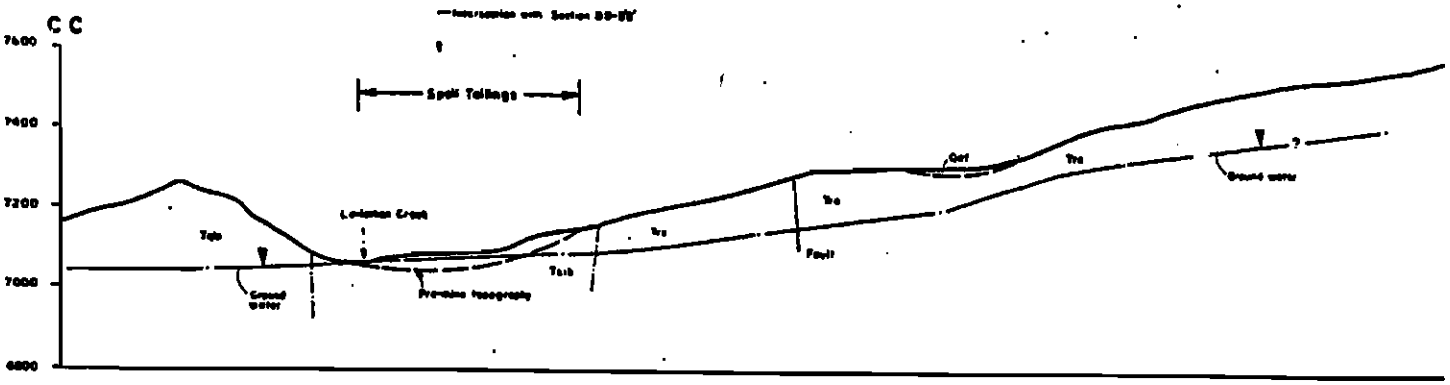
OCTOBER 1982

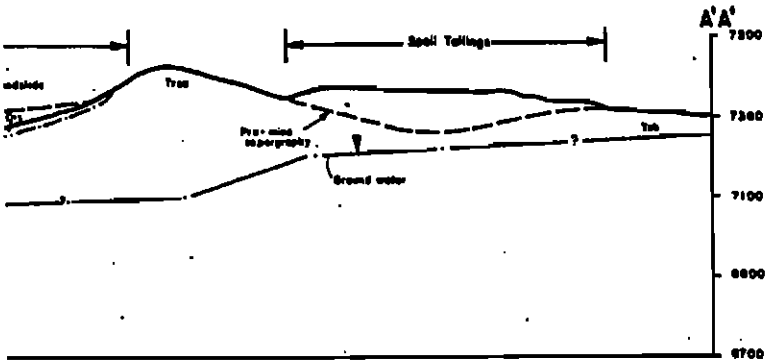
SEE PLATE 1 FOR LINE OF SECTION.

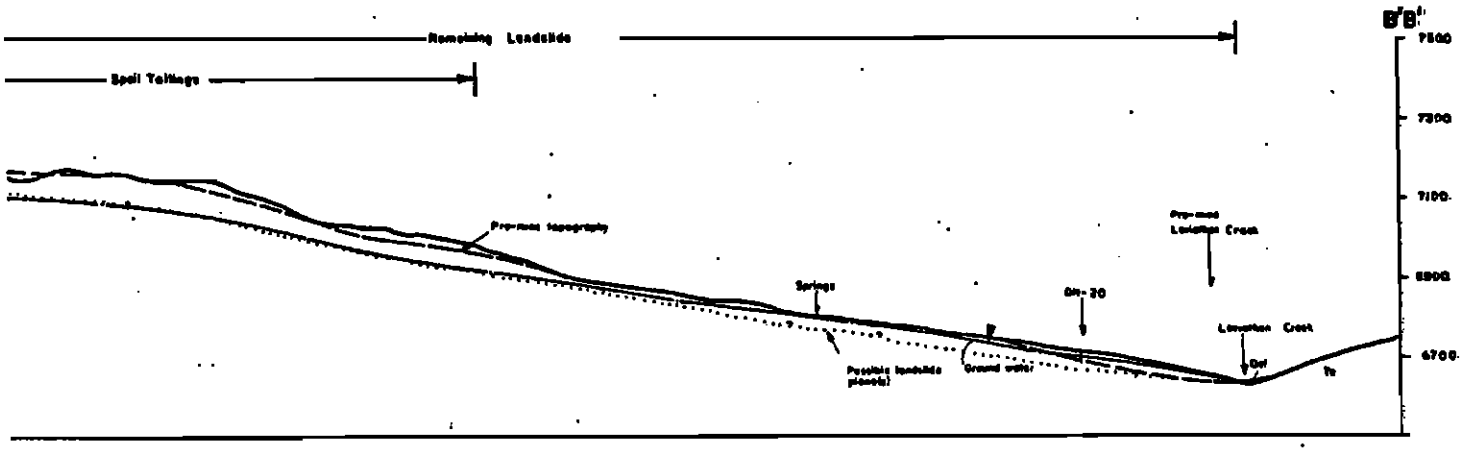
FIGURE 2-22


A A
7500
7300
7100
6900
6700
Waste Dump
Spoil Tailings
Open Pit
Intersection with Section BB-BB'
Pre-mine topography
Band in section
Crusher
Leviathan Creek
Ground water


B B
7500
7300
7100
6900
6700
Spoil Tailings
Open Pit
Intersection with Section AA-AA'
Tailings
Band in section
Intersection with Section BD-BD'
Pre-mine topography
Leviathan Creek
Ground water
Approx. location of Tunnel no. 3
Possible pre-mine landslide plane(s)


C C
Intersection with Section BB-BB'
7600
7400
7200
7000
6800
Spoil Tailings
Leviathan Creek
Ground water
Pre-mine topography
Fault





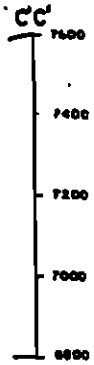
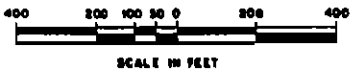


FIGURE 2-23
GEOLOGIC SECTIONS AA-A'A' THRU CC-C'C'



NOTE: For above diagrams

1. Ground water levels shown for Oct./Nov. 1982
2. See legend on Plate I

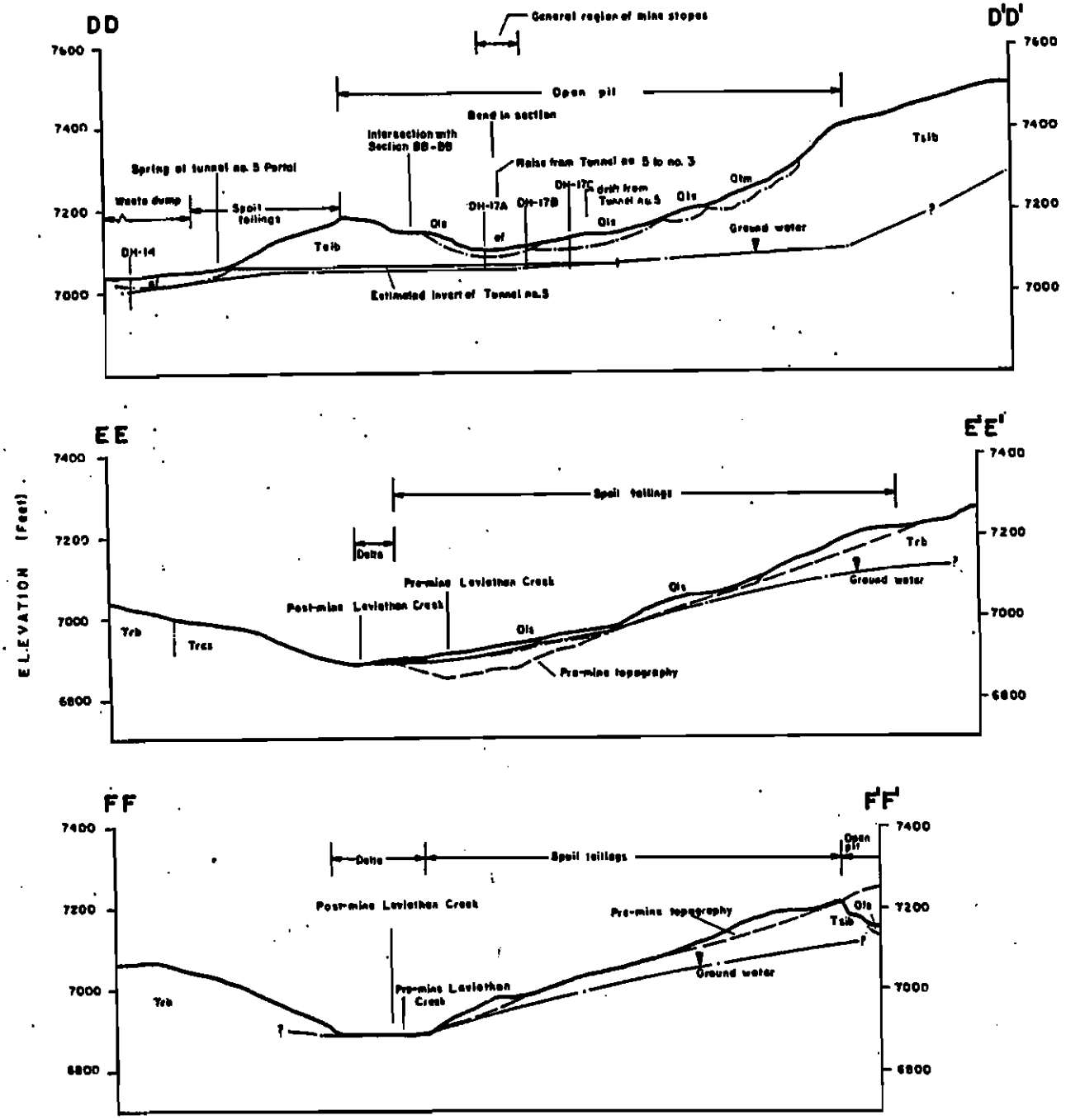


FIGURE 2-24

GEOLOGIC SECTIONS DD-D'D' THRU FF-F'F'

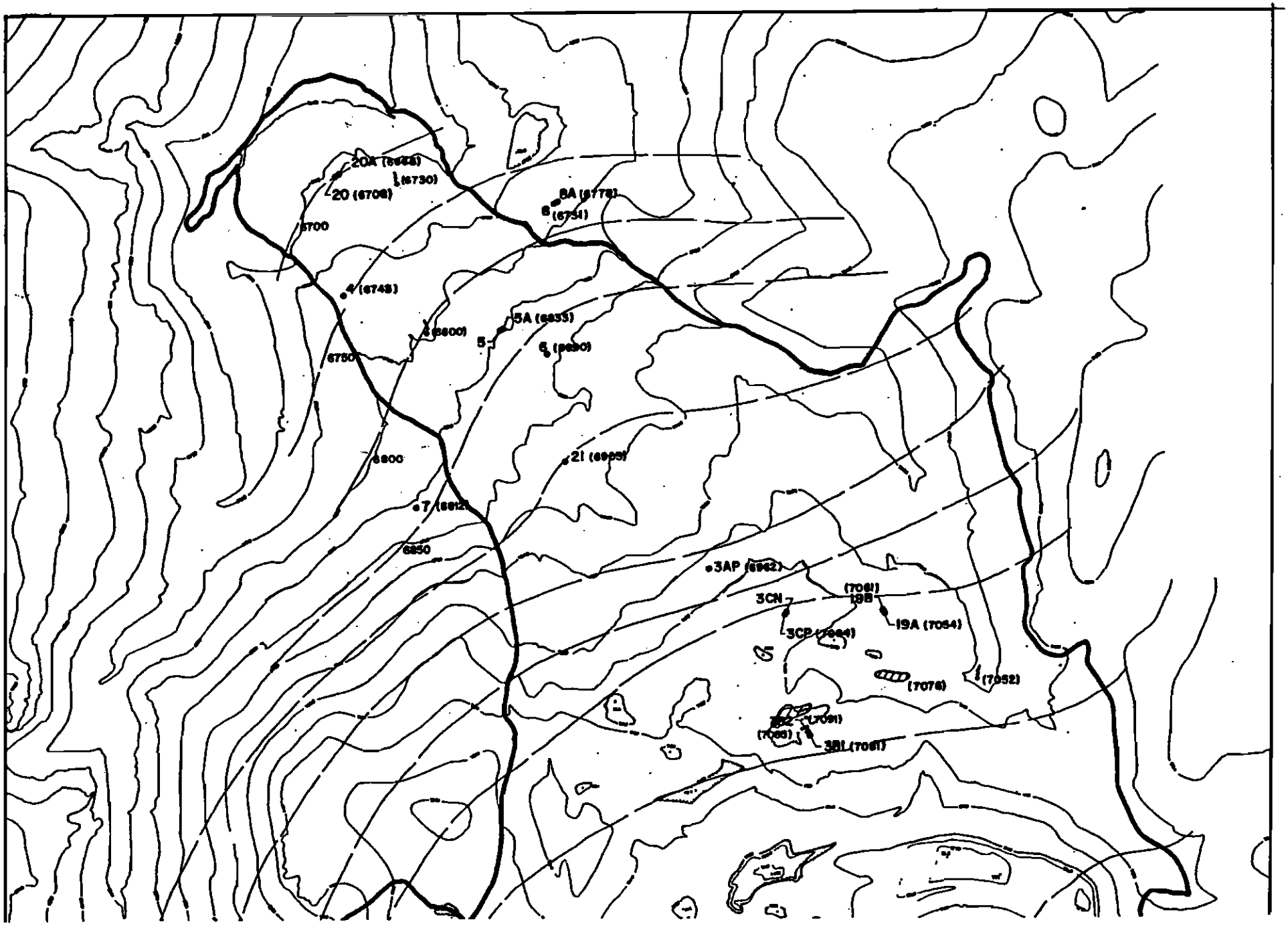
300 100 50 0 100 300

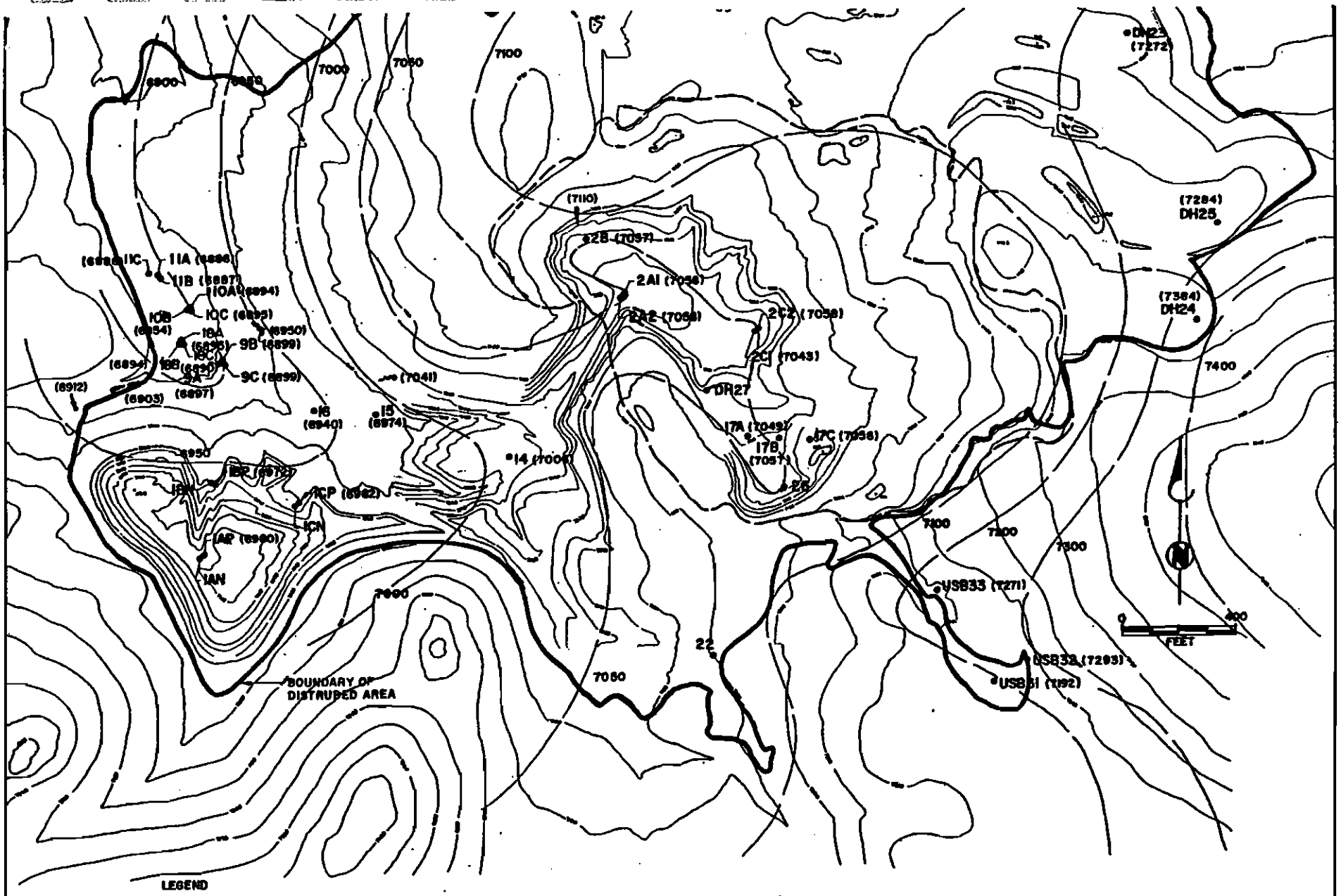
SCALE IN FEET

NOTE: For above diagrams

1. Ground water levels shown for Oct./Nov. 1982
2. See legend on Plate I

TURN PAGE FOR
NEXT FIGURE


20A (6728)
(6730)
20 (6708)
6700
8A (6778)
8 (6751)
4 (6748)
3 (6800)
5A (6833)
5
6 (6850)
6750
6800
21 (6895)
7 (6812)
6850
3AP (6962)
(7061)
3CN
19B
19A (7054)
3CP (7064)
(7076)
(7052)
(7091)
(7088)
3BL (7081)



LEGEND

17A
•(7049) LOCATION OF USGS GROUNDWATER MONITORING HOLE, SHOWING DRILL HOLE NUMBER. NUMBER IN ( ) IS APPROXIMATE ELEVATION OF STATIC WATER LEVEL, IN FEET

7100 ESTIMATED CONTOUR LINE OF EQUAL ELEVATION OF STATIC WATER LEVEL, IN FEET

(7041) LOCATION OF SPRING, SHOWING APPROXIMATE ELEVATION IN FEET

ESTIMATED AREAL EXTENT OF PONDED WATER, SHOWING APPROXIMATE ELEVATION IN FEET

BROWN AND CALDWELL CONSULTING ENGINEERS

FIGURE 2-25 MAP OF GROUNDWATER ELEVATION CONTOURS, OCT-NOV 1982

CHAPTER 3

PROBLEM ASSESSMENT AND CONTROL PRIORITY

As discussed in Chapter 2, mining activities have greatly affected the natural environment of the Leviathan Mine site. This chapter describes the resultant impact of mine seepage and surface discharges on water quality in Leviathan Creek and downstream waters, and quantifies the sources of these pollutants at the mine site. A summary of the water quality monitoring program conducted by the U.S. Geological Survey (USGS) to provide data for the problem assessment is presented at the end of this chapter.

BENEFICIAL USES AND WATER QUALITY CRITERIA

The historic and present beneficial uses of Leviathan and Bryant Creeks are discussed in this section. The beneficial use discussion is followed by a section on water quality criteria needed to protect the designated beneficial uses of these waters.

Beneficial Uses

The designated beneficial uses, the historic uses, and the current uses of Leviathan and Bryant Creeks are discussed in this section.

Designated Beneficial Uses. The California Regional Water Quality Control Board, Lahontan Region (Regional Board), has designated the potential beneficial uses of Leviathan and Bryant Creeks as water-contact recreation, nonwater-contact recreation, cold freshwater habitat, wildlife habitat, agricultural supply, and groundwater recharge. The actual uses of Leviathan and Bryant Creeks differ from the designated uses.

Beneficial Uses Prior to Mining. According to the Regional Board (1975), the uses of these creeks prior to mining activities were agricultural water supply and wildlife sustenance. Bryant Creek was diverted for irrigation of pasturelands at the River Ranch, a ranch near the confluence of Bryant Creek and the East Fork Carson River. Leviathan and Bryant Creeks have historically been a source of water to wildlife in the area. The creeks are believed to have supported a substantial trout population prior to mining operations.

Present Beneficial Uses. According to the Regional Board (1975), the present uses of Leviathan and Bryant Creeks are agricultural water supply, wildlife sustenance, and recreation. Bryant Creek is currently diverted for irrigation and livestock watering at the River Ranch. The water has resulted in poor crop growth and, in the opinion of the rancher, the death of some cattle. Leviathan Creek is used by wildlife upstream of the mine; however, downstream of the mine, it is poorly suited to this use. Some aquatic organisms are found in Leviathan and Bryant Creeks; however, below the mine, the cold freshwater fishery has been destroyed by the mine pollution. According to the Regional Board (1975), trout have, on occasions, been driven from a portion of the East Fork Carson River downstream from the confluence of Bryant Creek in response to periodic higher than usual concentrations of toxic materials from the mine. Leviathan Creek is aesthetically pleasing to sportsmen and campers upstream of the mine. Below the mine, Leviathan Creek is discolored, acidic, and toxic. The East Fork Carson River turns yellow and then milky below the confluence with Bryant Creek (Regional Board, 1975).

The objective of this project is to restore the water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity. The degree to which pre-mining water quality conditions will be attainable and to which desired beneficial uses can be restored will be strongly dictated by available financial resources.

Water Quality Criteria

Water quality criteria specify concentrations of water constituents which, if not exceeded, will protect the beneficial uses of the water body. Different criteria are established for different uses because different levels of quality are needed. For example, criteria for the protection of municipal water supplies are more stringent than criteria for the protection of livestock watering. The following documents were reviewed to determine appropriate water quality criteria to protect the designated beneficial uses of Leviathan and Bryant Creeks:

1. Environmental Protection Agency (EPA) Quality Criteria for Water

2. National Academy of Sciences (NAS) Water Quality Criteria

3. California State Water Resources Control Board (State Board) Water Quality Criteria (McKee and Wolf)

4. EPA Priority Pollutant Criteria

5. European Inland Fisheries Advisory Council (EIFAC) Water Quality Criteria for Freshwater Fish

6. Water Quality Control Plan for the North Lahontan Basin, East Fork Carson River Hydrologic Unit, October 1975

The criteria from each of these sources were compared for each beneficial use for each major water quality constituent and the criterion most appropriate for each beneficial use of Leviathan and Bryant Creeks was selected. These criteria are presented in Table 3-1. The current Basin Plan objectives are shown in this table for comparison to the recommended criteria. Most of the cold freshwater habitat criteria for metals are the EPA priority pollutant criteria. Both the chronic and acute toxicities values are presented. Acute toxicity criteria have not been published for barium, beryllium, selenium, and vanadium.

The essential difference between acute and chronic toxicity is that acute toxic levels of pollutants produce death with short-term exposure whereas chronic toxic levels produce susceptibility to disease, interference with reproduction, and other kinds of harm short of death.

EFFECTS OF MINE DISCHARGES ON RECEIVING WATERS

The effects of mine discharges on Leviathan and Bryant Creeks during operation of the mine and after mining operations ceased are presented in this section. Historical data and data collected by USGS during 1981 and 1982 are reviewed and compared to the recommended water quality criteria discussed in the previous section.

Historical Water Quality Conditions

The Regional Board (1975) presented a summary of water quality data collected from 1954 to 1962 when Anaconda Copper Company was operating Leviathan Mine. These data are presented in Table 3-2. The pH, turbidity, and sulfate concentrations above the mine were adequate for the protection of all beneficial uses. The pH values reported by the Regional Board below the mine site are consistently higher than the pH values reported by USGS during the current sampling program. It is not known if there have been actual changes in the pH or if the difference is due to different sampling methods used by the two agencies. The concentrations of these parameters in Leviathan Creek below the mine and in Bryant Creek down to the diversion at the River Ranch violated the water quality criteria and adversely affected the beneficial uses of these waters. Data were not collected on metals concentrations, with the exception

Table 3-1. Recommended Water Quality Criteria for Leviathan and Bryant Creeks

Parameter	Units	Criteria						
		Water contact recreation	Nonwater contact recreation	Cold freshwater habitat	Wildlife habitat	Agricultural supply	Groundwater recharge[a]	Basin Plan objectives
pH	S.U.			6.5-9.0	7.0-9.2	4.5-9.0	5.0-9.0	
Specific conductance	umhos/cm							200/286[b]
Dissolved oxygen	mg/l	Aerobic	Aerobic	5.0/2.0[c,f] 9.0/5.0[f]				
Acidity	mg/l as $CaCO_3$							10
Suspended solids	mg/l			25/80[d,f]				
Aluminum	ug/l					5,000/—[e]		100
Arsenic	ug/l			40/440[f]		100/200[e]		
Barium	ug/l			5,000/—[f]			1,000	
Beryllium	ug/l			11/—[f]		100		
Boron	ug/l					750/5,000[e]		
Cadmium	ug/l			0.012/1.5[f]		10/50[e]	10	
Chromium, hexavalent	ug/l			0.29/21[f]		100/1,000[e]	50	
Cobalt	ug/l					50/1,000[e]		
Copper	ug/l			5.6/12[f]		200/500	1,000	20
Iron	ug/l			—/1,000[f]		5,000/—[e]	300	500
Lead	ug/l			0.75/74[f]		5,000/100	50	
Lithium	ug/l					2,500/—[e]		
Manganese	ug/l					200/10,000	50	500
Nickel	ug/l			56/1,100[f]		200/—[e]	13.4	
Selenium	ug/l			0.01 (96-hr LC50)/—[f]		20/50	10	
Silver	ug/l			1.2			50	
Vanadium	ug/l					100		
Zinc	ug/l			47/180[f]		2,000/25,000[e]	5,000	
Total dissolved solids	mg/l			2,000		700/2,500[e]	1,000	
Sulfate	mg/l					200/500[e]	250	35/50[b]
Chloride	mg/l					100/1,500[e]	250	15/25[b]

[a]Criteria presented are for domestic water supplies.

[b]First number is annual mean; second number is 90 percentile.

[c]Moderately tolerant fish: 50% = 5 mg/l; 95% = 2 mg/l. Sensitive fish (salmonids): 50% = 9 mg/l; 95% = 5 mg/l.

[d]High level of protection = 25 mg/l; moderate protection = 80 mg/l.

[e]First number is criterion for irrigation; second number is criterion for stock watering.

[f]First number is chronic toxicity value expressed as a 24-hour average concentration of total recoverable metal. Second number is acute toxicity value expressed as a maximum allowable concentration of total recoverable metal.

of iron. The iron concentrations above the mine exceeded the recommended criterion of 1,000 ug/l at times, although the median concentration of 0.3 mg/l or 300 ug/l was lower than the criterion. The iron concentrations at Leviathan Creek below the mine exceeded the criterion of 1,000 ug/l. The Regional Board data collected at Bryant Creek below Mountaineer Creek and Bryant Creek at the diversion to the ranch are inconsistent. The data presented in Table 3-2 show that the median iron concentration was 0.02 mg/l at Mountaineer Creek and then increased to 0.58 mg/l at the diversion to the ranch. The maximum concentration at the diversion to the ranch is much greater than the concentration at Mountaineer Creek. This apparent anomaly in the data may be due to the fact that fewer samples were collected at the diversion to the ranch than at Mountaineer Creek.

Table 3-2. Summary of Water Quality Data During Mining Operations[a]

Parameter	Units	Measurement[b]	Sampling station			
			Leviathan Creek above mine	Leviathan Creek below mine	Bryant Creek below Mountaineer Creek	Bryant Creek at diversion to ranch
pH	Standard units	Maximum	8.2	6.8	8.8	9.1
		Median	7.7	3.4	5.7	6.9
		Minimum	7.2	2.2	3.4	3.2
		N	12	73	90	13
Sulfate	mg/l	Maximum	13	4,513	1,331	732
		Median	8.4	2,183	320	285
		Minimum	3.3	280	41	35
		N	13	60	76	13
Turbidity	Turbidity units	Maximum	16	770	350	108
		Median	6.5	115	60	53
		Minimum	3.4	4.5	7	1.7
		N	4	54	51	12
Total iron	mg/l	Maximum	2.0	470	0.2	22.3
		Median	0.3	0.12	0.02	0.58
		Minimum	0.08	0.01	0.01	0.01
		N	7	35	30	12

[a]Data source--Regional Board (1975).
[b]N = Number of samples analyzed.

Data collected by the Regional Board in 1968 and 1969, after the mining operations ceased, are presented in Table 3-3. The concentrations of all of these parameters above the mine were lower than the recommended water quality criteria indicating that the beneficial uses of Leviathan Creek were protected. The pH and the concentrations of sulfate, total dissolved solids, copper, and iron exceeded the recommended criteria for these parameters in both the Leviathan Mine discharges and at the two stations below the mine. The parameters have been ranked

Table 3-3. Summary of Water Quality Data During 1968-1969[a]

Parameter	Units	Measurement[b]	Sampling station: Leviathan Creek above mine	Leviathan Mine discharges	Leviathan Creek below mine	Bryant Creek at diversion to ranch
pH	Standard units	Maximum	7.9	3.3	3.8	7.2
		Median	7.6	2.0	3.4	4.5
		Minimum	7.2	1.3	2.8	3.2
		N	10	10	3	4
Sulfate	mg/l	Maximum	13	2,935	1,425	344
		Median	8.8	750	1,010	234
		Minimum	2.0	26	304	170
		N	14	8	6	7
Total dissolved solids	mg/l	Maximum	125	26,400	5,130	404
		Median	116	--	1,778	341
		Minimum	46	1,520	813	166
		N	3	--	3	3
Boron	mg/l	Maximum	0.2	73	3.5	2.4
		Median	<0.5	--	2.8	0.6
		Minimum	<0.5	<0.5	0.65	0.5
		N	3	--	3	3
Aluminum	mg/l	Maximum	0.7	300	38	6.7
		Median	0.43	--	6.6	3.4
		Minimum	<0.01	14.7	5.6	0.38
		N	3	--	3	3
Copper	mg/l	Maximum	0.04	64	2.0	0.11
		Median	0.02	--	1.8	0.09
		Minimum	<0.01	0.08	0.4	0.05
		N	3	--	3	3
Iron	mg/l	Maximum	0.28	1,720	342	92
		Median	0.26	--	115	34
		Minimum	0.20	95	112	32
		N	3	--	3	3
Manganese	mg/l	Maximum	<0.05	8.2	13	0.61
		Median	<0.01	--	4	0.1
		Minimum	<0.01	<0.5	<0.01	<0.01
		N	3	--	3	3
Arsenic	mg/l	Maximum	0.01	110	1.2	0.2
		Median	0.01	--	--	0.10
		Minimum	<0.01	0.02	0.76	0.09
		N	3	--	2	3

[a]Data source--Regional Board (1975).
[b]N = Number of samples analyzed.

in order of importance for control purposes based on the concentrations of the parameters observed in 1968 and 1969, the number of stations at which the criteria were exceeded, and the amount by which the criteria were exceeded. The order of control importance is:

1. Copper
2. Iron
3. Total dissolved solids
4. Sulfate

As shown in Table 3-3, this ranking is based on a few samples collected during 1968 and 1969. A more detailed analysis of the current data is needed to determine control priorities.

U.S. Geological Survey Creek Sampling Data

The USGS conducted a sampling program on Leviathan and Bryant Creeks during 1981 and 1982. The USGS program is briefly highlighted here with additional detail provided in a subsequent section of this chapter. A number of parameters, including heavy metals, were measured. Five stations along Leviathan and Bryant Creeks characterize the effects of mine drainage on the creeks. Station 1, Leviathan Creek above the mine, represents background conditions. No seepage from the mine or surface runoff from the site enters the creek above this sampling point. At Station 10, Leviathan Creek below the delta, most of the drainage from the mine site has entered the creek. Aspen Creek flows into Leviathan Creek above Station 17, Leviathan Creek below Aspen Creek. Station 25 is on Bryant Creek below Mountaineer Creek, and Station 26 is at the confluence of Bryant and Doud Creeks. This is just upstream of the East Fork Carson River. The locations of these five sampling stations are shown schematically on Figure 3-1.[a]

The data from these stations are summarized in Table 3-4. The average pH is 7.7 above the mine and 2.9 below the delta. The pH increases steadily to 4.8 at the confluence of Bryant and Doud Creeks. The concentrations of most of the heavy metals are low above the mine, extremely high below the delta, and steadily decrease downstream from the mine. The concentrations of barium, cadmium, chromium, and vanadium decrease to background levels at Station 26. The concentrations of other parameters

[a]Throughout this report, figures referenced in the text are included at the end of the chapter where first referenced. Plates referenced are included in a map pocket following the appendices.

Table 3-4. U.S. Geological Survey 1981-82 Surface Water Quality Data Summary

Parameter	Units	Sampling station: 1. Leviathan Creek above mine			10. Leviathan Creek below delta			17. Leviathan Creek below Aspen Creek		
		N[a]	Mean[b]	Range	N[a]	Mean[b]	Range	N[a]	Mean[b]	Range
pH (field)	S.U.	9	7.7	7.0-8.3	5	2.9	2.7-3.3	13	3.5	2.9-3.9
Specific conductance	umhos/cm	8	140	81-166	5	2,200	1,220-3,360	10	1,580	1,040-2,290
Acidity, as $CaCO_3$	mg/l	3	10	10	3	627	243-894	12	513	189-943
Hardness	mg/l	4	42	32-57	4	318	120-610	4	300	180-450
Dissolved aluminum	ug/l	6	803-838	<10-4,100	6	47,800	15,000-66,000	5	33,400	19,000-55,000
Dissolved arsenic	ug/l	5	4.6	2-9	5	802	38-1,700	5	281	64-600
Dissolved barium	ug/l	15	74	33-140	5	112	18-360	14	96	52-340
Dissolved beryllium	ug/l	15	0.1-1.1	<1-1	5	4.2-4.8	<3-9	14	2.4-2.6	<1-5
Dissolved cadmium	ug/l	15	1.1-2.1	<1-10	5	17	5-25	14	7.9	<1-14
Dissolved calcium	mg/l	15	13.2	10-16	5	112	33-215	14	113	49-180
Dissolved chloride	mg/l	5	1.0	0.8-1.2	5	1.5	0.9-2.2	5	1.4	1.1-1.7
Dissolved chromium	ug/l	5	0.2-8.2	1-<10	6	132	50-300	6	80	42-120
Dissolved cobalt	ug/l	15	0.2-3.4	<3-<9	5	578	270-740	13	395	220-660
Dissolved copper	ug/l	15	3.5-13.5	<10-40	5	744	390-1,400	14	332	40-880
Dissolved iron	ug/l	15	784	32-4,700	5	185,600	48,000-270,000	13	83,900	33,000-200,000
Dissolved lead	ug/l	15	5.9-15.9	<10-62	5	0-22	<10-<30	14	11.5-21.5	<10-100
Dissolved lithium	ug/l	15	3.4-6.6	<4-20	5	36	13-57	14	29	13-46
Dissolved magnesium	mg/l	15	4.0	1.7-5.4	5	29	8.3-48	14	32	13-55
Dissolved manganese	ug/l	15	30	5-97	5	5,620	1,200-9,900	14	4,980	1,500-8,700
Dissolved molybdenum	ug/l	15	1-12	<10-<30	5	0-22	<10-<30	14	0-11	<10-<30
Dissolved nickel	ug/l	3	33-100	<100-100	5	1,420	400-2,200	4	780	400-920
Dissolved silica	mg/l	15	39	24-46	5	47	33-70	14	41	34-85
Dissolved sodium	mg/l	15	7.9	4.1-10	5	11	6.2-17	14	15	7.8-19
Dissolved strontium	ug/l	15	202	110-250	5	960	290-1,700	14	830	410-1,200
Dissolved sulfate	mg/l	15	13-14	<5-58	5	1,280	320-1,800	15	680	200-1,500
Dissolved thallium	ug/l	4	0-1	<1	4	83	37-120	4	53	38-80
Dissolved vanadium	ug/l	15	1.2-6.7	<6-12	5	116	11-170	14	26-27	<6-83
Dissolved zinc	ug/l	15	23-24	<3-120	5	284	81-370	14	200	110-400

[a]N = Number of samples analyzed.

[b]In cases where one or more concentrations are reported as less than the detection limit, a range of mean values is shown. The lower number is calculated by assuming that all "less than" values are equal to zero. The upper value of the mean is calculated by assuming that all "less than" values are equal to the detection limit.

Table 3-4. U.S. Geological Survey 1981-82 Surface Water Quality Data Summary, continued

Parameter	Units	Station					
		25. Bryant Creek below Mountaineer Creek			26. Bryant Creek at USGS gage at Doud Creek		
		N[a]	Mean[b]	Range	N[a]	Mean[b]	Range
pH (field)	S.U.	5	4.6	4.3-5.7	4	4.8	4.5-7.6
Specific conductance	umhos/cm	6	757	470-987	5	496	374-594
Acidity, as $CaCO_3$	mg/l	4	134	40-194	3	101	84-129
Hardness	mg/l	3	160	130-210	2	150	120-180
Dissolved aluminum	ug/l	5	11,900	130-28,000	5	5,400	30-16,000
Dissolved arsenic	ug/l	4	99	2-170	5	50	2-130
Dissolved barium	ug/l	6	72	7-220	4	41	16-52
Dissolved beryllium	ug/l	4	0.8-1.8	<1-5	4	0.8-1.8	<1-<3
Dissolved cadmium	ug/l	6	2.8-3.2	<1-7	4	0.8-2.0	<1-3
Dissolved calcium	mg/l	6	59	36-86	4	45	31-51
Dissolved chloride	mg/l	5	1.3	1.1-1.5	5	1.4	1.1-1.7
Dissolved chromium	ug/l	4	25-28	<10-70	4	2.5-7.8	<1-10
Dissolved cobalt	ug/l	6	140	21-210	4	114	24-170
Dissolved copper	ug/l	6	236	30-470	4	198	10-300
Dissolved iron	ug/l	6	23,900	2,000-46,000	4	12,600	110-26,000
Dissolved lead	ug/l	6	0-13	<10-<30	4	.5-17.5	<10-<30
Dissolved lithium	ug/l	6	13	5-18	4	12	8-14
Dissolved magnesium	mg/l	6	17	9.9-27	4	13	9.1-16
Dissolved manganese	ug/l	6	1,480	450-3,200	4	1,070	440-1,800
Dissolved molybdenum	ug/l	6	0-13	<10-<30	4	0-15	<10-<30
Dissolved nickel	ug/l	3	330	300-400	4	280	100-500
Dissolved silica	mg/l	6	36	3.7-63	4	33	9.6-45
Dissolved sodium	mg/l	6	9.6	7.1-13	4	8.7	6.9-10
Dissolved strontium	ug/l	6	400	89-650	4	330	140-440
Dissolved sulfate	mg/l	5	270	2-440	5	230	160-300
Dissolved thallium	ug/l	4	23	9-37	4	17	5-23
Dissolved vanadium	ug/l	6	8-13	<6-46	4	0-7	<6-<10
Dissolved zinc	ug/l	6	121	14-380	4	53	14-88

[a]N = Number of samples analyzed.

[b]In cases where one or more concentrations are reported as less than the detection limit, a range of mean values is shown. The lower number is calculated by assuming that all "less than" values are equal to zero. The upper value of the mean is calculated by assuming that all "less than" values are equal to the detection limit.

such as aluminum, arsenic, cobalt, copper, iron, manganese, sulfate, and zinc are much higher than background levels at Station 26.

As discussed previously, there are different water quality criteria for the protection of different beneficial uses. In general, the criteria for cold freshwater habitat are more stringent than the criteria for other uses and provide a basis for a review of the Leviathan problem with respect to this more sensitive beneficial use. The concentrations of the parameters shown in Table 3-4 were compared to the cold freshwater habitat water quality criteria shown in Table 3-1. The water quality criteria for the metals are generally for total metal concentrations. The criteria for cold freshwater habitat are for total recoverable metal concentrations in some cases, as noted in Table 3-1. Only dissolved metal concentrations were routinely measured in the USGS sampling program. In comparing the dissolved metal concentrations to the freshwater habitat quality criteria, those cases where the dissolved concentration exceeds the criterion for a total or total recoverable metal concentration are a clear indication that the parameter is a problem. In cases where a dissolved metal concentration is less than the criterion, there is no way of knowing if the parameter is a problem because the total or total recoverable metal concentration may or may not exceed the criterion. The USGS measured total recoverable metals during April and August 1982. These data are summarized in Table 3-5. Since only two samples were collected, it is difficult to draw conclusions on the relationship between total recoverable and dissolved concentrations. In most cases, the total recoverable metals concentrations are considerably higher than the dissolved metals concentrations. This means that the water quality criteria are likely to be exceeded at stations where the dissolved metal concentrations are lower than the criteria. The following discussion of criteria and control priorities is based on the dissolved concentrations since there are not sufficient data on total recoverable concentrations.

The pH and the concentrations of dissolved metals shown in Table 3-6 violate the criteria at the stations indicated in the table. The concentrations of the metals, the number of stations at which the acute and chronic toxicity criteria for cold freshwater aquatic life were exceeded, and the amount by which the criteria were exceeded were evaluated to rank the metals in order of importance for control purposes. The metals are ranked in order of importance in Table 3-6.

Table 3-5. U.S. Geological Survey Total Recoverable Metals Data

Metal	Concentration range, ug/l				
	1. Leviathan Creek above mine	10. Leviathan Creek below delta	17. Leviathan Creek below Aspen Creek	25. Bryant Creek below Mountaineer Creek	26. Bryant Creek at USGS gage at Doud Creek
Aluminum	135	50,000	23,000	8,300	28,000
Barium	7.6 - 140	41 - 360	53 - 340	41 - 220	130 - 140
Beryllium	<0.5 - <3	3 - 6	2 - <3	<0.5 - <3	2 - <3
Cadmium	<3 - 9	14	9 - 10	6 - 11	5 - 37
Calcium	10 - 18	45 - 220	56 - 140	38 - 56	33 - 50
Chromium	<10	70	50	20	70
Cobalt	<3 - <9	620 - 740	330 - 340	120 - 210	120 - 170
Copper	26 - 38	48 - 780	98 - 640	48 - 380	320 - 460
Iron	300 - 3,700	150,000 - 220,000	76,000 - 92,000	22,000 - 46,000	28,000 - 46,000
Lead	13 - <30	<10 - <30	<10 - <30	<10 - <30	<10 - <30
Lithium	10 - <12	23 - 62	25 - 34	17	17 - 25
Magnesium	3.1 - 4.8	13 - 60	17 - 38	11 - 16	9.8 - 17
Manganese	27 - 97	2,100 - 13,000	2,100 - 6,000	1,000 - 1,900	800 - 1,900
Molybdenum	<10 - <30	<10 - <30	<10 - <30	<10 - <30	<10 - <30
Nickel	<100	2,200	1,000	400	500
Silica	41 - 44	<10 - 53	42 - 85	39 - 63	53 - 60
Sodium	5.5 - 8.5	7.4 - 19	9 - 16	7.6 - 10	7.6 - 10
Strontium	180 - 250	540 - 1,200	560 - 960	400 - 460	340 - 470
Vanadium	<6 - 12	86 - 111	33 - 83	13 - 46	28 - 30
Zinc	76 - 120	300 - 360	180 - 400	140 - 380	140 - 180

Table 3-6. Parameters that Violate Cold Freshwater Habitat Water Quality Criteria

Parameter	Stations
1. Iron	All
2. Copper	All
3. Cadmium	All
4. Chromium	10,17,25
5. Zinc	10,17,25
6. Arsenic	10,17
7. Nickel	10
8. Lead	17
pH	All

The average concentrations of these metals exceeded the chronic criteria at all four stations below the mine. The chronic criteria for many of these metals were also exceeded above the mine at Station 1. The maximum concentrations of iron, cadmium, and copper exceeded the acute criteria at all of the stations downstream from the mine. Chromium and zinc exceeded the acute criteria at Stations 10, 17, and 25; arsenic exceeded the acute criterion at Stations 10 and 17; and nickel and lead exceeded the acute criterion at Station 17.

Figures 3-2 and 3-3 compare the concentrations of the first six metals on the list to the recommended criteria for cold freshwater habitat. Although the pH of the water at the five stations was lower than the recommended criteria range of 6.5 to 9.0, pH is not included in the list because measures to control the metals loads entering the creek will also increase the pH of the creek water.

U.S. GEOLOGICAL SURVEY-MINE SITE MONITORING PROGRAM

The USGS conducted all surface and groundwater monitoring for the Leviathan Mine Restoration Project. The work began in February of 1981 and concluded in November 1982.

Sampling Stations

Monitoring consisted of establishment of approximately 50 surface water stations and 53 groundwater stations. Appendix D contains a map which shows the USGS surface water stations at the site. Table 3-7 presents a short description of each station. These stations were used to monitor the quality

Table 3-7. USGS Surface Water Sampling

Station number	USGS station number	Station location description
1	783	Leviathan Creek above Leviathan Mine
2	784	Adit No. 5 seep
3	785	Open pit flow
4		Leviathan Creek halfway between Sites 1 and 5
4.5		Intermittent seep entering Leviathan Creek below Site 4
5		Leviathan Creek just above Site 5.5
5.5		Seep 50 feet southeast of Site 6
6	787	Seep below crusher adjacent to Leviathan Creek
6.5		Leviathan Creek 50 feet below Site 6 confluence
6.6		Seep from base of waste dump
6.7		Ephemeral flow from gully on waste dump
7	786	Seasonal stream at west edge of waste dump
7.1		Intermittent stream from west above Site 7
7.2		Intermittent stream which flows along west side of waste dump
8		Leviathan Creek at north end of delta
9		Open pit and Adit No. 5 flow entering Leviathan Creek just above Site 10
9.1		Open pit and adit flow at culverts north of Brooks Park Diversion
10	788	Leviathan Creek just below delta and below Site 9
11		Stream (4-L) entering Leviathan Creek 200m below Site 10
12		Leviathan Creek at south end of slide and above Site 12.5
12.5		Ephemeral from east just north of Site 12. Adit and open pit flow diverted down this drainage after July 1, 1982
13		Seep from toe of slide opposite Site 14
14		Intermittent stream entering Leviathan Creek from west just south of slide toe
15		Leviathan Creek just above Aspen Creek confluence
16		Aspen Creek above Leviathan Creek confluence
17	790	Leviathan Creek below Aspen Creek confluence
18		Seep entering Aspen Creek from lower slide area
19		Seep entering Aspen Creek from middle of slide
19.11		North fork of seep flow on center of slide as it crosses jeep trail
19.12		North fork of seep flow on center of slide as it crosses jeep trail
19.2		Seep on upper portion of slide just below pond
20		Aspen Creek above culvert
20.5		Seep from overburden near its source to the west of Site 21.5
21		Seep from overburden below old town site
21.6		Aspen Creek just above Site 21.5
21.5		Seep entering Aspen Creek directly below old town site
22		Aspen Creek above culvert at water tank
23		Poison Creek entering Leviathan Creek from the east
24		Mountaineer Creek above Leviathan Creek confluence
25	794	Bryant Creek below Mountaineer Creek confluence
26	800	Bryant Creek at USGS gage above Doud Creek confluence
27		Doud Creek above Bryant Creek confluence
28		Irrigation diversion below Doud and Bryant Creek confluence
29		Bryant Creek just above East Fork Carson River confluence
30		East Fork Carson River below Bryant Creek confluence

at various points along Leviathan and Aspen Creeks as well as major seeps on the site. The surface water stations which provided key monitoring data were: Station 1--Leviathan Creek above the mine, Station 2--Seep from abandoned Adit No. 5, Station 10--Leviathan Creek below delta, Station 15--Leviathan Creek before confluence with Aspen Creek, Station 16--Aspen Creek before confluence with Leviathan Creek, Station 17--Leviathan Creek after confluence with Aspen Creek, Station 25--Where Leviathan Creek and Mountaineer Creek join to form Bryant Creek, and Station 26--Bryant Creek above confluence with Doud Springs. Numerous seeps were also monitored in the open pit, the waste dump, the landslide, Spoil Area A, and below the crusher.

A network of 53 groundwater wells covers the entire site. The drilling operations began in June 1982 and were completed in late October of the same year. Groundwater monitoring locations are shown on Figure 2-20 (Chapter 2).

A USGS subcontractor surveyed the observation wells to establish locations and well elevations. Table 3-8 presents coordinates and elevation data for each station.

Sampling Frequency

The USGS conducted flow and water quality monitoring at the site between March 1981 and November 1982. Two types of data were collected: (1) "Continuous" data from stations with automatic measurement and recording devices and (2) Grab samples collected during site surveys.

Continuous data were available at surface water Stations 1, 2, 3, 6, 10, 17, 25, and 26. The parameters measured at these stations were flow, specific conductance, and temperature reported as the mean daily value. Although the stations were continuously monitored, there are gaps in the data due to unavoidable problems with sampling equipment located at a remote site. The USGS carefully reviewed all of their data and eliminated data that appeared to be erroneous.

Surface Water Sampling

Grab sampling of surface waters at the site involved a larger number of stations. Field measurements included temperature, estimated discharge, pH, and specific conductance. Samples were sent to the USGS laboratory in Denver, Colorado, for complete chemical analysis. Although a large number of stations were sampled during the site surveys, on any particular sampling day, not all the stations were sampled. Appendix D includes a tabulation of the sampling dates and parameters measured during 1981 and 1982.

Table 3-8. Leviathan Mine--USGS Observation Well Locations

USGS number	Coordinates		
	North	East	Elevation
11A	387112.655	2667248.603	6889.51
11B	387117.887	2667248.052	6889.07
11C	387117.205	2667212.045	6889.48
10A	386989.599	2667351.441	6893.33
10B	386985.898	2667351.819	6894.51
10C	386981.791	2667352.803	6893.66
18A	386878.160	2667321.350	6895.00
18B	386874.842	2667319.501	6894.11
18C	386871.910	2667317.647	6895.03
9A	386796.279	2667454.105	6901.33
9B	386796.457	2667459.366	6900.35
9C	386796.789	2667464.368	6900.55
1BP	386366.660	2667433.713	7054.95
1BN	386366.508	2667424.504	7055.64
1AN	386113.572	2667393.225	7107.09
1AP	386114.081	2667387.667	7106.98
1CN	386285.361	2667715.709	7055.96
1CP	386285.048	2667722.547	7055.69
16	386621.402	2667792.160	6990.76
15	386598.262	2668007.534	6992.00
14	386440.360	2668472.652	7037.77
2B	387202.853	2668758.878	7067.37
2A1	386997.285	2668883.175	7057.61
2A2	387000.317	2668883.933	7058.08
2C1	386878.052	2669364.226	7065.63
2C2	386880.610	2669364.891	7065.08
17A	386491.650	2669326.669	7100.00
17B	386484.686	2669441.493	7102.84
17C	386477.488	2669547.423	7128.42
22	385726.000	2669197.070	7151.20
USB-33	385931.611	2669994.926	7298.65
USB-31	385609.787	2670196.177	7314.43
USB-32	385683.916	2670312.205	7333.25
H-24	386875.208	2670928.497	7434.68
H-25	387220.009	2671002.310	7382.40
B-23	387894.963	2670701.382	7322.71
3B1	388691.265	2669720.916	7105.11
3B2	388686.649	2669719.280	7105.43
19A	389140.055	2669996.863	7079.12
19B	389138.399	2669992.240	7080.35
3CP	389131.196	2669636.062	7121.86
3CN	389135.967	2669628.699	7119.98
4	390339.338	2667990.891	6794.03
6	390105.792	2668753.565	6897.10
3AP	389303.166	2669345.127	7062.55
21	389704.135	2668814.630	6941.97
5	390201.274	2668583.482	6853.90
5A	390197.165	2668579.687	6854.30
7	389546.829	2668260.202	6857.77
20A	390794.487	2667985.325	6710.02
20	390783.581	2667975.097	6710.68
8	390676.355	2668797.613	6799.05
8A	390670.910	2668800.116	6799.20

Note: Elevations are based on California Department of Water Resources survey point PP3C. Basis of bearings are points PP3C and PP4C.

Surface water in Leviathan Creek flows northerly from the upgradient sampling Station 1 through the waste dump and across the delta. Background surface water has lower concentrations of the select ions, a lower EC value, and a more neutral pH compared to the quality from the portal spring (Station 2). On one hand, Station 2 could be considered as a groundwater source because it originates as groundwater flow in the open pit intercepted by the adit. On the other hand, Station 2 could be considered as a surface water site because once reaching ground surface at the adit portal spring, it functions to help recharge the groundwater outside the pit by direct infiltration through the local porous aritificial fill).

Continued and similar degradation of surface water quality of Leviathan Creek is noted in Tables 3-4 and 3-5 by comparing the data from south to north along the creek. Qualities shown, for example, for Stations 6, 9, and 10 are essentially the same as those for nearby groundwater sites, DH-1BP, DH-1AP, and DH-9 (see Plates 2 and 3).

Representative upgradient quality for Aspen Creek is virtually identical to that for upstream Leviathan Creek Station 1.

In general, there is not much similarity in the concentration levels between the upgradient surface water sites and groundwater sites in the tailings at sites DH-24, -25, and -23A. This seems to suggest that the creek does not contribute significant recharge to the southeastern portion of Spoil Area A. However, farther northwest, there is more of a similarity between the surface and groundwater monitoring sites.

The conditions presented in the preceding paragraphs for the routine ions for surface flow also apply to surface water conditions represented by the heavy metals in the flows. Quality changes between upgradient and contaminated flows result in increases of a few orders of magnitude; however, arsenic and iron represent the most notable increases. Also, upgradient flow in Leviathan Creek (Station 1) appears to be more mineralized than upgradient flow in Aspen Creek for the heavy metals. Similarly, downgradient flow at proximal monitoring sites for heavy metals (Station 16 for Aspen Creek and Station 17 for Leviathan Creek) indicates more mineralization in Leviathan Creek even though the analyses are from two different dates and creek flows.

Also of note is the marked reduction in the heavy metals in Aspen Creek northeast of Spoil Area A and the landslide and the high concentrations of heavy metals in Leviathan Creek Stations 25 and 26 located several miles downstream of the mine.

Groundwater Sampling

Sampling of groundwater was conducted by USGS during November 1982. The parameters measured during groundwater sampling were depth to groundwater, pH, specific conductance, and temperature. The available groundwater data consists of two samples in November for approximately 50 percent of the monitoring wells at the site and one sample for the remainder. A few wells were never sampled. Appendix D contains a tabulation of the sampling dates for each of the monitoring wells.

To assess groundwater quality and the impact of acid mine drainage (AMD) from the mining activities on this quality, it is important to first consider what AMD is and how it forms. Although the details of AMD formation are beyond the scope of this study, it can be noted that AMD results from the oxidation or decomposition of sulfides and sulfosalts commonly found with mineralized ores such as those known to exist at the mine. Information available from the U.S. Environmental Protection Agency (EPA) (1975) and the Montana Department of Natural Resources and Conservation (1977), indicates that:

1. The diversity of chemical compositions of AMD is great as to the number of chemical elements and the complexity of compositions of sulfides and sulfosalts.
2. The most common sulfides of iron include pyrite, a mineral which has been reported to be abundant at the Leviathan Mine. [NOTE: Inspection of the site during this investigation did not disclose evidence of pyrite in spoil material or in rock outcrops. Because of its collapsed condition, the mine adit could not be inspected. Accordingly, there is no confirmation of the abundance of pyrite by those involved in this study.]
3. The oxidation of the sulfides in the presence of air and water creates AMD. The general formula indicates that pyrite plus water plus oxygen react to form sulfuric acid and ferrous sulfate.
4. Water acts to transport the oxidized material from the ore surfaces as accumulation of these products will affect the oxidation rate.
5. Acid produced by this oxidation lowers the pH of the drained water.
6. The numerous sulfides and sulfosalts which exist are oxidized or otherwise break down and produce a further release of metallic, non-metallic, and sulfate ions to the environment.

7. Copper, cobalt, manganese, zinc, and nickel all form soluble salts under AMD conditions, such as at Leviathan Mine. Lead, however, forms a relatively insoluble salt under similar conditions and is rarely found in high concentration in AMD discharges.

8. Certain bacteria are also capable of oxidizing sulfide minerals, including thiobacillus ferrooxidans, ferrobacillus ferrooxidans, and thiobacillus sulfooxidans.

Figures 3-4 through 3-6 and Plates 2 and 3 have been prepared to illustrate the interpretation of groundwater quality data provided in January 1983 by the USGS monitoring of observation holes during November 1982. Depicted on these figures are the drill hole sites actually monitored, and the respective data for each site monitored. The Stiff diagrams on Plates 2 and 3 were prepared by an adaptation of the method originally devised by H. Stiff (1951).

This method uses parallel horizontal axes extending on each side of a vertical central axis. Concentrations of the selected ions or constituents are plotted, one to each horizontal axis to the left of the central axis and another to the same horizontal axis but to the right of the central axis. The constituents are always plotted in the same sequence to permit comparison from one monitoring site to another. The concentrations are typically in units of milliequivalents per liter (equivalents per million, epm). These units recognize that ions of different species have different atomic weights and electrical charges.

To determine the appropriate milliequivalent per liter (or, epm) of a particular ion, that is, to determine its chemical equivalence with another ion, the respective ion charge and weight must be known. Hence, if the formula weight of an ion is divided by its charge, the result is the combining weight. When a concentration in milligrams per liter (mg/l) is divided by the combining weight of the ion concerned, the result is an equivalent concentration. Thus, the reported mg/l value can be converted to milliequivalents per liter (or, epm) by multiplying the given mg/l value by the reciprocal of the combining weight of the particular ion. With all ions then in units of epm, the unit concentrations of each ion are chemically equivalent. Units on these figures are thus in epm for the ionic constituents.

Although not generally shown on Stiff diagrams, the figures depict pH and specific conductance values as well. Standard units are used for the hydrogen ion values (pH), while specific conductance units are in micromhos. Because ionic concentrations often differ by several orders of magnitude across the mine property, it was necessary to provide all

units on a logarithmic scale on both figures, instead of the arithmetic scales normally used on Stiff diagrams. The exception is the hydrogen ion units which are plotted on an arithmetic scale.

Compared to the 59 borings drilled for the project, a total of 48 were completed with perforated casing to serve as monitoring holes. Of these 48 monitoring sites, 36 were sampled and tested by the USGS for their water quality. Reference can also be made to Appendix B to compare water quality monitoring sites to water level monitoring sites for total borings drilled. Casing perforation data for the monitoring holes are also presented in Appendix B.

To illustrate the November 1982 groundwater quality throughout the mine site and to permit spatial comparison of quality from one monitoring site to another, pattern diagrams have been prepared of select water quality constituents from the 36 sites monitored. The pattern diagrams on Plates 2 and 3 depict, for each monitored site, the ionic concentrations of select routine ions (calcium, magnesium, sodium, sulfate, but also including for this figure, specific conductance and pH) and of select heavy metals (arsenic, cobalt, copper, iron, manganese, and zinc), respectively.

These pattern diagrams, in the manner presented, also provide a comparison between the background upgradient (uncontaminated) water quality and the quality at each monitored site. This is accomplished by "shadowing in" the upgradient quality (in this case, that for USB-31) on each Stiff diagram prepared throughout the mine area. In the manner presented, the diagrams provide a three-dimensional comparison of groundwater at those sites having closely-spaced monitoring holes and different perforated intervals for these holes. This was performed for clsoely spaced holes in the delta (DH-9A, 9B, 9C, and DH-10A, 10B, 10C), in the open pit (DH-2A1, 2A2, DH-2C1, 2C2, and DH-17A, 17B, 17C), and near the landslide (DH-8, 8A) by stacking the respective Stiff diagrams for each site according to the perforation depth interval of the particular drill hole.

As indicated, uncontaminated regional groundwater quality for the Leviathan Creek area has been selected for purposes of this study as that at USB-31. This groundwater quality is very similar to that at uncontaminated upgradient surface water quality sampling Station 1, although concentrations of the constituents plotted are slightly higher in the groundwater. This reveals that the groundwater becomes more mineralized than the surface water as it flows through the volcanic rocks in the area which are known to be altered and weathered and to contain various amounts of sulfur throughout the entire watershed.

As revealed by Stiff diagrams, this uncontaminated groundwater in its northerwesterly flow onto the mine property, becomes immediately and grossly contaminated as it enters the open pit (refer to diagrams on Plate 2 for DH-26, 17A, 17B, 17C, 2C1, 2C2, 2A1, 2A2). Concentrations of the selected routine ions have increased by a few orders of magnitude; note particularly the specific conductance (EC) values, and sulfate. The pH has decreased from greater than 6 to 2 to 4 sandard units, indicating a change to strongly acidic conditions. Such changes are observed from south to north across the entire open pit.

Besides this lateral continuity of water quality across the open pit, data from DH-2A1 and 2A2 and from DH-2C1 and 2C2 reveal that the contamination effects have migrated vertically as well because these sites represent groupings of monitoring holes with different levels of perforations. Thus, at DH-2A1 and 2A2, near the pit breach, the contaminated water exists between depths of 7 and 21 feet (see perforation levels on Plate 2 and in Appendix B). Indeed, surface flow out of the pit as monitored at surface Station 3 is similarly degraded.

At DH-2C1 and 2C2 on the east side of the pit, contaminated groundwater exists between depths of 10 and 31 feet.

At DH-17A, 17B, and 17C which intersect Adit No. 5 from west to east across the mine pit, groundwater is contaminated but to slightly varying degrees. None of the three holes shows consistently anomalous concentrations for all constituents plotted.

The overall poorest quality of water in the mine pit, and for that matter, at the entire mine site, occurs at DH-26 in the southernmost part of the pit. Here, pH is less than 2.0, sulfate is three orders of magnitude higher than at the upgradient site, while EC is over two orders of magnitude greater than USB-31. Quality at DH-26 is degraded to this extent because its perforations likely intersect saturated bedrock containing sulfur-rich ore and abundant pyrite.

According to Figure 2-25 (Chapter 2), groundwater flows directly west from the mine pit toward Leviathan Creek, the waste dump, and the delta. This is clearly illustrated by noting the Stiff diagrams for DH-14, 15, and 16 on Plate 2. Also presented on Plate 2 is the quality for surface Station 2, the spring at the portal for Adit No. 5.

Thus, the quality at surface Station 2 is virtually identical in character but of slightly higher concentrations relative to that in DH-17A, 17B, and 17C which are located farther east, but still within the adit. Increased sulfate levels and decreased pH values are the notable changes in

quality as the water flows westerly along the adit to the portal spring. Undoubtedly sulfur and pyritic mineralization still exist in the westerly portions of the adit. Thus, because groundwater is flowing in the adit and atmospheric oxygen is available through rock fractures and other openings, the sulfur and pyrite can be altered through complex mechanisms to produce the AMD.

Because loose, porous artificial fill exists along the breach of the open pit and all around the spring at the adit portal, it is obvious that overland surface runoff from the pit (surface Station 3) and surface flow from the spring (Surface Station 2) both have ample opportunity to recharge local groundwater by direct infiltration. Such infiltrating waters are contaminated by AMD and flow westerly in conformance with the groundwater gradient.

As indicated, the effects of these migrating fluids are observed at DH-14 first, then later downgradient at DH-15 and DH-16. Comparison of the Stiff diagrams for these sites with that from surface Station 2 (the adit portal spring) reveals a gross similarity of contamination but a general reduction in individual ion concentrations. Note that Station 2 and DH-14 are virtually identical, but that farther downgradient at DH-15 and DH-16, concentrations are modified; sulfate has been reduced while pH has increased toward more neutral conditions. These changes have resulted from such processes as dilution by regional and stream underdrainage groundwater flows and likely by precipitation of dissolved mineralization as the contaminated low pH fluids encounter the higher pH waters near the stream (see also Figure 2-25 in Chapter 2).

Groundwater beneath the waste dump as monitored at DH-1AP, 1BP, and 1CP is likely affected by a combination of: deep percolation of precipitation on the waste dump; and by percolation of flow through these mineralized materials from Leviathan Creek and from the unnamed tributary which enters the dump from the south. Contaminated seeps of limited flow (as noted on Figure 2-21) and of unknown chemical composition exist along the toe of the slope on the north edge of the waste dump. The effect on quality beneath the waste dump by contaminated groundwater flowing from the open pit is considered minimal.

Groundwater in the delta sediments and underlying bedrock are depicted by Stiff diagrams for DH-9A, 9B, 9C,10A, 10B, and 10C. Perforations in these borings range between 10 and 52 feet below ground surface. For comparison, the deltaic sediments here were logged by the USGS to be approximately 40 feet thick on their geologic logs but, according to the elevation changes between pre-mine and post-mine topographic maps, the potential thickness is on the order of only 15 feet. Regardless of which, if either, thickness is correct, it is to be noted that

groundwater quality in this area is highly degraded compared to upgradient groundwater quality (USB-31) and to upgradient surface water quality (surface Station 1). The quality changes are apparent to at least the 52-foot depth level and, thus, the AMD degradation exists here in both the deltaic sediments and in the immediately underlying bedrock.

The background upgradient groundwater monitoring hole (USB-31) has also been used for this study to analyze groundwater quality along the Aspen Creek side of the property, that is, in Spoil Area A and in the main landslide; there are no monitoring holes completely upgradient from the mine on Aspen Creek. Stiff diagrams of data from Spoil Area A (DH-24, 25, and 23A from south to north, respectively) all indicate AMD contamination, although to varying degrees, and to generally slightly less levels than on the waste dump-delta-open pit side of the mine.

Farther north in Spoil Area A, the quality has degraded more as seen by concentration levels for Stiff diagrams at DH-3B1 and 3CP; key changes are values of sulfate and pH. Values here are more similar to those in the southwest corner of the property and reflect recharge through these tailings by Aspen Creek flow and direct infiltration of precipitation and of water ponded in the numerous surface depressions on these tailings (refer to Figure 2-21 for locations of these depressions).

Concentrations depicted for monitoring sites in the main landslide are more variable than for other comparably grouped holes in the remaining mine elements. This is likely caused by local variations in water levels and recharge sources, and by variations in rock types and the degree of rock weathering and alteration and mineralization here compared to other mine areas.

Shallow monitoring sites (such as DH-5A and 6) are likely above the landslide plane(s) and display similarly degraded water quality. In comparison, deeper monitoring sites (such as DH-4) are probably below the landslide plane(s) and more likely reflect ambient groundwater quality in the underlying, undistrubed bedrock.

By reviewing heavy metal concentrations on logarithmic scales as depicted on Stiff diagrams on Plate 3, the impact of AMD on groundwater is again quite noticeable. Here, the upgradient levels in USB-31 of arsenic, cobalt, copper, iron, manganese, and zinc increase by three to four orders of magnitude once the flowing groundwater intersects conditions within the open pit. Again, DH-26 contains the overall poorest quality (in terms of heavy metals) at the site.

Water flowing through the adit (from DH-17C toward DH-17A) picks up additional mineralization and the concentrations at DH-17A and at the portal spring (surface Station 2) are virtually identical. This, coincidentally, suggests there is little, if any, additional mineralization or oxidation of ore minerals occurring in the adit between DH-17A and Station 2.

The subsurface migration of percolating fluids from surface Stations 2 and 3 toward DH-14, 15, 16 is to be noted on Plate 3, also. Some reduction in the heavy metal concentrations are observed and related to the pH buffering and dilution factors discussed previously. Also to be noted is the vertical continuity of the heavy metal concentrations at DH-9A, 9B, 9C and at DH-10A, 10B, and 10C.

Heavy metal concentrations in the eastern part of tailings area A (DH-25, 24, and 23A) are not as high as those in the southwestern portion of the mine (for example, at DH-1BP), but still reflect contamination. Heavy metal concentrations in the main part of Spoil Area A (DH-3B1 and 3CP) are not as high (even though more recharge is occurring in this area) as those sites farther southeast in these tailings nor as high as those levels at the waste dump. This possibly occurs because these tailings deposits are not as highly mineralized as the waste dump materials. This is corroborated by the fact that the tailing piles contain more non-mineralized overburden materials and that the waste dump was created from more highly mineralized materials generated from nearer the main ore body.

Heavy metals concentrations in the main landslide are variable and result from local conditions discussed previously. The concentration levels are relatively low compared to values depicted for all other mine elements, except the upgradient area.

Relative to Basin Plan water quality criteria for groundwater recharge (see criteria in Table 3-1), upgradient groundwater quality at USB-31 is as follows: the field specific conductance of 295 micromhos slightly exceeds Basin Plan recharge objectives; the aluminum concentration meets the Basin Plan groundwater recharge objective of 0.1 mg/l; the barium value of 0.09 mg/l meets the groundwater recharge criterion; cadmium concentration is less than 0.001 mg/l and, thus, meets the criterion for groundwater recharge; chromium concentration is less than 0.01 mg/l and meets the criterion for groundwater recharge; copper concentration is less than 0.01 mg/l and meets the criteria for groundwater recharge; dissolved iron is 0.033 mg/l and meets criteria for groundwater recharge; lead is less than 0.001 mg/l and meets the criterion for groundwater recharge; manganese is 0.049 mg/l and meets groundwater recharge criteria; zinc is 0.01 mg/l and meets the groundwater recharge

objective; sulfate is 22 mg/l and meets established objectives; and chloride is 2.1 mg/l and meets the criterion of both objectives.

Criteria in Table 3-1 are also given for nickel, selenium, silver, and total dissolved solids, but data are not sufficient on the chemical analysis of USB-31 to provide comparison.

Though detailed comparison has not been made for each constituent on all groundwater monitoring sites relative to its particular quality criteria in Table 3-1, the general quality on the mine site is so poor that it likely violates all established criteria.

Of interest in Table 3-1 is the criterion of 0.44 mg/l established for arsenic concentrations for the beneficial use of cold freshwater habitat. Upgradient groundwater at USB-31 has an arsenic concentration of 0.08 mg/l and, thus, meets the criterion. However, virtually all other groundwater monitoring sites at the mine exceed the established criterion for arsenic for this beneficial use.

To depict our interpretation of the field values of specific conductance (EC) for groundwater monitored in the drill holes on the property, we have prepared Figure 3-4. As indicated, the contours of equal concentration of field EC values range from a low of approximately 500 micromhos in the upgradient area south of the site to a high of over 20,000 micromhos within a mineralized zone encountered by DH-26 in the mine pit. Typical EC values for the remainder of the mine pit are on the order of 3,000 to 10,000 micromhos, while in the Spoil Area A to the east and north, typical EC values are 1,000 to 1,500 micromhos.

For the main waste dump, typical concentrations are 1,000 to 2,000 micromhos, whereas slightly higher 2,000 to 3,000 micromho values occur in the delta just to the north. The main landslide displays 1,000 to 2,000 micromho values, but these values are not consistently grouped.

Also noteworthy on Figure 3-4 are the shapes of the contour patterns emanating westerly from the mine pit. Such shapes indicate recharge from that region, likely a result of infiltration of contaminants into underlying porous waste dump materials from mine pit runoff and adit spring flow.

Additional area-wide groundwater quality information has been contoured onto Figure 3-5 using the concentration of the sulfate ion. Contour lines of equal sulfate concentration range from less than 250 mg/l in the upgradient area to 10,000 mg/l at DH-26 in the mine pit. Typical values in the pit are approximately 3,000 to 5,000 mg/l.

Sulfate contours in the remainder of the property are 500 to 1,000 mg/l in Spoil Area A; 1,000 to 1,500 mg/l in the landslide; 500 to 1,000 mg/l in the main mass of the waste dump; and 1,500 to 4,500 mg/l in the delta.

The sulfate ion contour pattern reveals a similar recharge to the west as indicated by the EC values on Figure 3-4. The reduction in sulfate concentration westerly from the mine pit and the presence of high sulfates in this region result from infiltration and migration of contaminants from flow from pit runoff and the adit spring.

The final figure prepared to assess area-wide groundwater quality utilizes the arsenic ion concentration (see Figure 3-6). Contours on this figure suggest that upgradient arsenic values are undetectable (less than 10 ug/l) but that anomalously high values of 35 mg/l occur at DH-26 in the mine pit. Typical pit concentrations are approximately 1 to 20 mg/l.

For the remainder of the mine property, arsenic values on Figure 3-6 are less than 0.03 mg/l in Spoil Area A; near or slightly above this value in the main landslide; as much as 0.13 mg/l in the main waste dump and from less than 1 to nearly 5 mg/l in the delta.

As with EC and sulfate ion contours, the arsenic contours west of the mine pit reveal recharge from infiltrating pit runoff and adit spring flows and reduction in the arsenic concentrations westerly toward DH-14, 15, and 16 in the waste dump area.

PROBLEM SOURCE QUANTIFICATION

Leviathan Mine is made up of various elements which contribute individually to the overall degradation of Leviathan and Aspen Creeks. In an attempt to quantify this damage so that specific areas can be singled out, numerous methods have been evaluated. Based on the amount and nature of the data collected by the USGS during the surface water monitoring program, a mass balancing method was determined to be the most effective means for quantification of the relative contributions from each mine element. This procedure assumes that natural inputs above the mine plus inputs from the mine site equal the output in Leviathan Creek directly below the mine site.

Critical Water Quality Parameters

The USGS collected data on Leviathan and Aspen Creeks approximately monthly during 1982. Flow, specific conductance, acidity, and sulfate were measured at about 15 stations around

the mine site. Dissolved metals concentrations were measured less frequently at several of the 15 stations. Based on the criteria analysis presented previously in this chapter, many of the dissolved metals concentrations are significantly higher than the criteria and, therefore, represent the highest priority for control. The heavy metals which are causing the most damage to Leviathan and Bryant Creeks are iron, copper, cadmium chromium, zinc, arsenic, nickel, and lead.

Sufficient data were not collected on the metals concentrations to develop a mass balance for each metal. Specific conductance data were collected most extensively so relationships were develped between specific conductance and other chemical constituents. Figure 3-7 shows the relationship between specific conductance and total dissolved solids (TDS) concentration plotted from the data available for surface water Stations 1, 8, 10, 17, and 26. All of these stations except 26 are on Leviathan Creek. Station 26 is on Bryant Creek. The line representing the commonly used empirical equation,

TDS (mg/l) = specific conductance (umhos/um) x 0.64

is also shown. Figure 3-8 shows the relationship between specific conductance and TDS for Stations 2, 3, and 6. These stations represent pit and adit drainage and seepage from spoil materials. All have characteristic pH values below 3.5. The standard empirical formula does not accurately represent the specific conductance versus TDS relationship for these stations. There are three primary reasons for this:

1. Decreased ionic activity coefficients at the higher concentrations

2. Formation of ionic complexes at the higher concentrations

3. Higher solubilities associated with low pH

The data plotted on Figure 3-8 suggest the revised relationship,

TDS (mg/l) = 1.0 x specific conductance (umhos/cm)

for seepage flows and pit and adit drainage.

To establish a relationship between specific conductance and heavy metals, the concentrations of iron, copper, cadmium, and chromium were plotted against specific conductance. Figures 3-9 through 3-12 present the relationships between dissolved iron, copper, cadmium, and chromium and electrical conductivity. All show consistently good relationships between heavy metals and specific conductance. Based on these relationships, it

is safe to say that specific conductance is a good indicator of water quality. If specific conductance is high, it is almost certain that heavy metals will also be present in high concentrations. When specific conductance is less than 2,000 umhos/cm, the relationship is not as good. Since heavy metals data are quite limited, it is difficult to calculate mass balances on a site-wide basis. The relationship developed between specific conductance and heavy metals enables the use of specific conductance as a single parameter for site mass balancing and quantification of loading from the mine elements.

Total Dissolved Solids Load Calculations

The TDS load from various sources at the mine site was estimated by performing a mass balance along Leviathan and Aspen Creeks for dates on which sufficient flow and TDS data were collected. The recorded flows, specific conductances, and relationships between specific conductance and TDS concentration were used to calculate the TDS load at several points in the creeks. The sources of TDS load between points on the creeks were then found by difference. For specific dates and locations, there are inaccuracies in these mass balance calculations. The factors which produce the inaccuracies are:

1. Accuracy of flow and specific conductance measurements. If each of these measurements has an accuracy of ±10 percent, the resulting load has an accuracy of approximately ±20 percent.

2. When source loads are obtained by difference, their range of inaccuracy is approximately twice that of the calculated loads in the creeks. Therefore, a source load obtained by subtracting one calculated TDS load in the creek from another has an accuracy of approximately ±40 percent.

For these reasons, the load calculations were performed for as many dates as possible and the results averaged. For some sampling dates, values at certain stations had to be estimated. Although this results in some uncertainty, it produces a greater number of site mass balances and improved accuracy for the overall results. Rather than attempt to use the calculated numerical loads for comparison, the source loads were calculated as a percentage of the change in TDS load which occurs from the upstream to downstream side of the site on each sampling date. In this way, the percentage contribution from each source can be compared and averaged over several sampling dates.

Source Areas

The mine site was divided into three major elements which act as sources of pollutants to the creek. The three sources are:

1. Pit and Adit--These two sources are combined as they both flow into the same drainage ditch. Before July 1982, the combined flows entered Leviathan Creek above Station 10. In July, a diversion routed these flows down to Station 12.5 (slightly downstream of Station 12). There is pit flow only when the pond at the pit bottom overflows. This pond is typically dry during the summer. The adit flows all year long.

2. Spoil Areas B and C, Delta, and Waste Dump--The nature of the sampling sites makes it difficult to separate these four areas and the loading was thus calculated for the combination of the four areas. The major load appears to come from the delta and waste dump. Spoil Areas B and C do not appear to contribute significant loads to Leviathan Creek.

3. Spoil Area A and Landslide--Spoil Area A drains to Aspen Creek and contributes a major portion of the change in TDS load in Aspen Creek as it flows past the site. The landslide drains to both Aspen and Leviathan Creeks. The landslide provides the major TDS load input to Leviathan Creek from the mine site between water sampling. Stations 10 and 17, and a portion of the TDS load, change in Aspen Creek between Stations 22 and 16.

For each of eight sampling dates on which adequate flow and specific conductance data were available, the TDS loads from each of the source areas were calculated. To illustrate the procedure, the March 6, 1982, data will be used in the example calculation which follows. Figure 3-13 is a schematic of the site with the water sampling stations labeled and the flows and specific conductances at each shown. The calculated TDS load at each station is also shown. The difference in upstream and downstream TDS loads in the creeks can be found by subtracting the loads at Stations 1 and 22 from that at Station 17. The resulting total change in load is calculated as 23,963 pounds (25,006 - [164 + 879]). However, not all of the change in TDS load is attributable to the mine site. Drainage from natgural areas east of Aspen Creek and west of Leviathan Creek also contribute to the change in load. For example, Stations 7, 11, and 14 on Leviathan Creek monitor natural tributary flows to Leviathan Creek. Other unidentified or non-discrete sources of natural inputs are also present. In most cases, the contribution of natural inputs to TDS load is relatively small

due to low TDS concentrations in the natural flows. Estimation of unidentified natural sources therefore introduces only a small uncertainty in the magnitude of the mine site sources. For the March 6 data, the total mine site contribution to TDS load is taken as 23,400 pounds.

Figure 3-13 shows the three major mine elements as they relate to the TDS load schematic for Leviathan and Aspen Creeks. The contribution of each element is calculated either directly from data on source flows or by difference between two stations on the creek.

Pit and Adit Contribution. The pit and adit contribution might be calculated in two ways. Prior to July 1982, the combined Stations 2 and 3 flows were routed via a ditch into Leviathan Creek above Station 10. The TDS load at Station 9, which is located on the ditch, could be used as the input load from the pit and adit to the creek. However, the metered load at this station is generally lower than the combined loads at Stations 2 and 3. This is largely due to percolation and evaporation along the ditch. It is likely that percolated flow re-emerges through seeps that drain directly into the creek. After July, the pit and adit flows were rerouted to flow along an existing site road, and entered the creek downstream of Station 12 (at Station 12.5). In this case, the loads at Station 12.5 are much less than the combined Stations 2 and 3 loads. Because the eventual discharge to the creek of most or all of the combined flows at Stations 2 and 3 is likely, and because the seeps which result from percolated water in the diversion ditches cannot be accurately quantified, the combined load at Stations 2 and 3 has been used as the pit and adit contribution to Leviathan Creek. On March 6, the combined loads from Stations 2 and 3 produce a pit and adit contribution of 9,800 pounds (Figure 3-13).

Spoil Area A and Landslide Contribution. The contribution from Spoil Area A and the landslide is found by subtraction. The contribution to Aspen Creek is found by subtracting the load at Station 22 from that at Station 16. This results in a contribution of 2,905 pounds (3,069 minus 164 pounds) for March 6. The contribution to Leviathan Creek is found by subtracting Stations 12 and 14 from Station 15. This results in a load of 2,897 pounds (21,937 - [18,948 + 92]) for March 6. The total Spoil Area A and landslide load contribution is therefore 5,802 pounds (2,905 pounds plus 2,897 pounds).

Spoil Areas B and C, Delta, and Waste Dump Contribution. The load from Spoil Areas B and C, the delta, and the waste dump is calculated by subtracting all the known on-site and natural input loads from the total load at Station 17. This produces an estimated TDS load from Areas B and C, the delta, and the waste dump of about 7,800 lbs/day.

Total Site. The TDS load from the entire site for March 6, 1982, and the contribution from each of these three major sources is shown in Table 3-9. The percent contribution from each of these sources is also shown.

Table 3-9. Total Dissolved Solids Load Contributions, March 6, 1982

Area	Load, lbs/day	Percent contribution
Pit and adit	9,788	42
Spoil Areas B and C, waste dump, and delta	7,849	34
Spoil Area A and landslide	5,802	24
Total	23,439	100

Control Priorities

The area by area pollutant load calculation was made in accordance with the previously described methodology for each of the eight USGS sampling surveys. The results of these calculations in terms of each area's percentage of the total mine-related TDS contribution to Leviathan Creek are presented in Table 3-10 together with conclusions relative to the preferred order of priority for problem area correction.

Table 3-10. Average Total Dissolved Solids Loading to Leviathan Creek Based on Eight Samplings

Area	Average percent contribution	Correction priority
Pit and adit	35	2
Spoil Areas B and C, waste dump, and delta	39	1
Spoil Area A and landslide	26	3

The estimates in Table 3-10 show that almost 75 percent of the Leviathan Mine pollutant load originates from the pit, adit, waste dump, and delta. (Spoil Areas B and C are not considered major contributors.) The landslide and Spoil Area A are small pollutant load contributors when considered individually, but when combined prove to be significant. As stated before, Spoil Area A is believed to influence the landslide.

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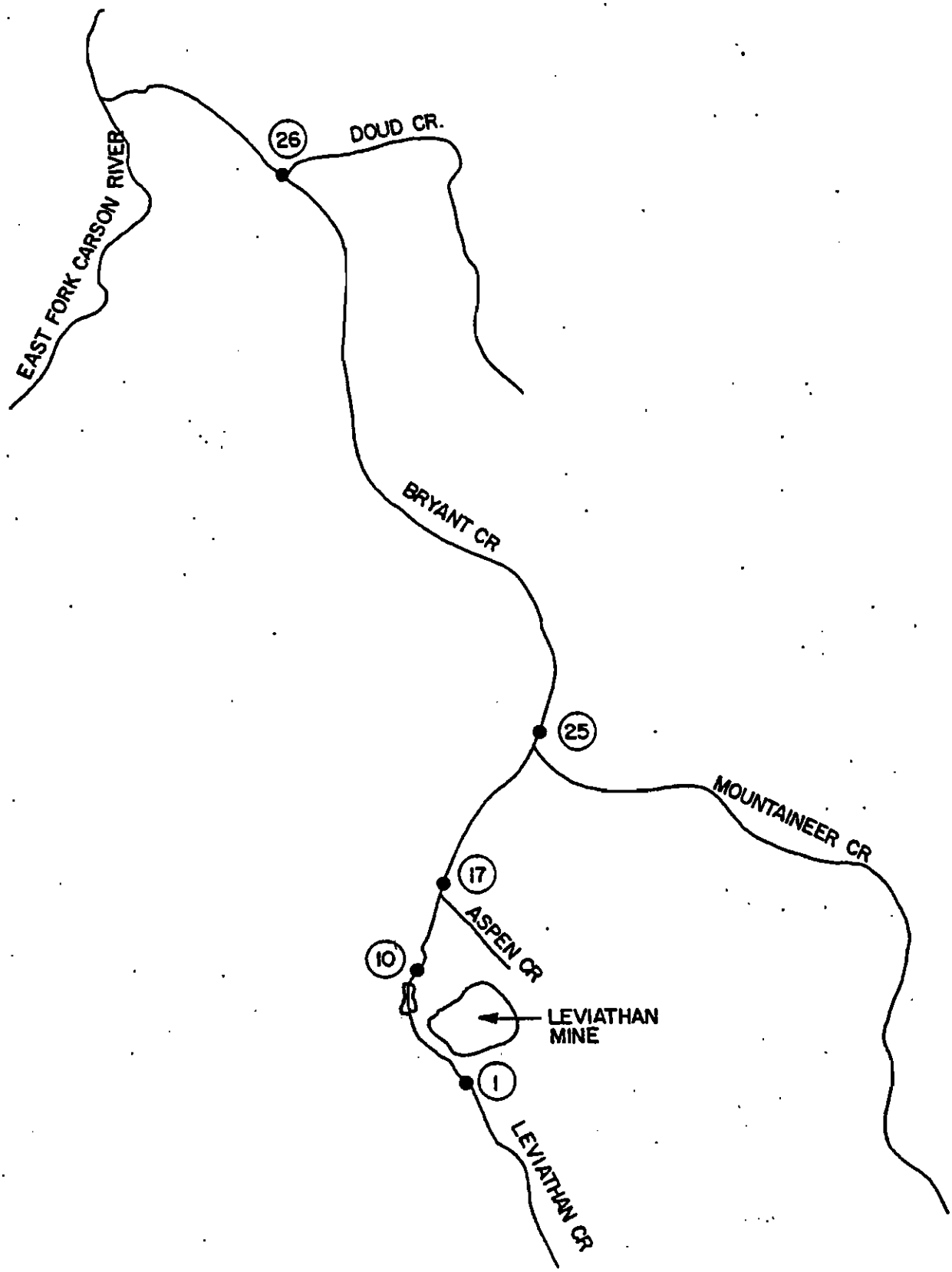


Figure 3-1 USGS Surface Water Sampling Station Locations

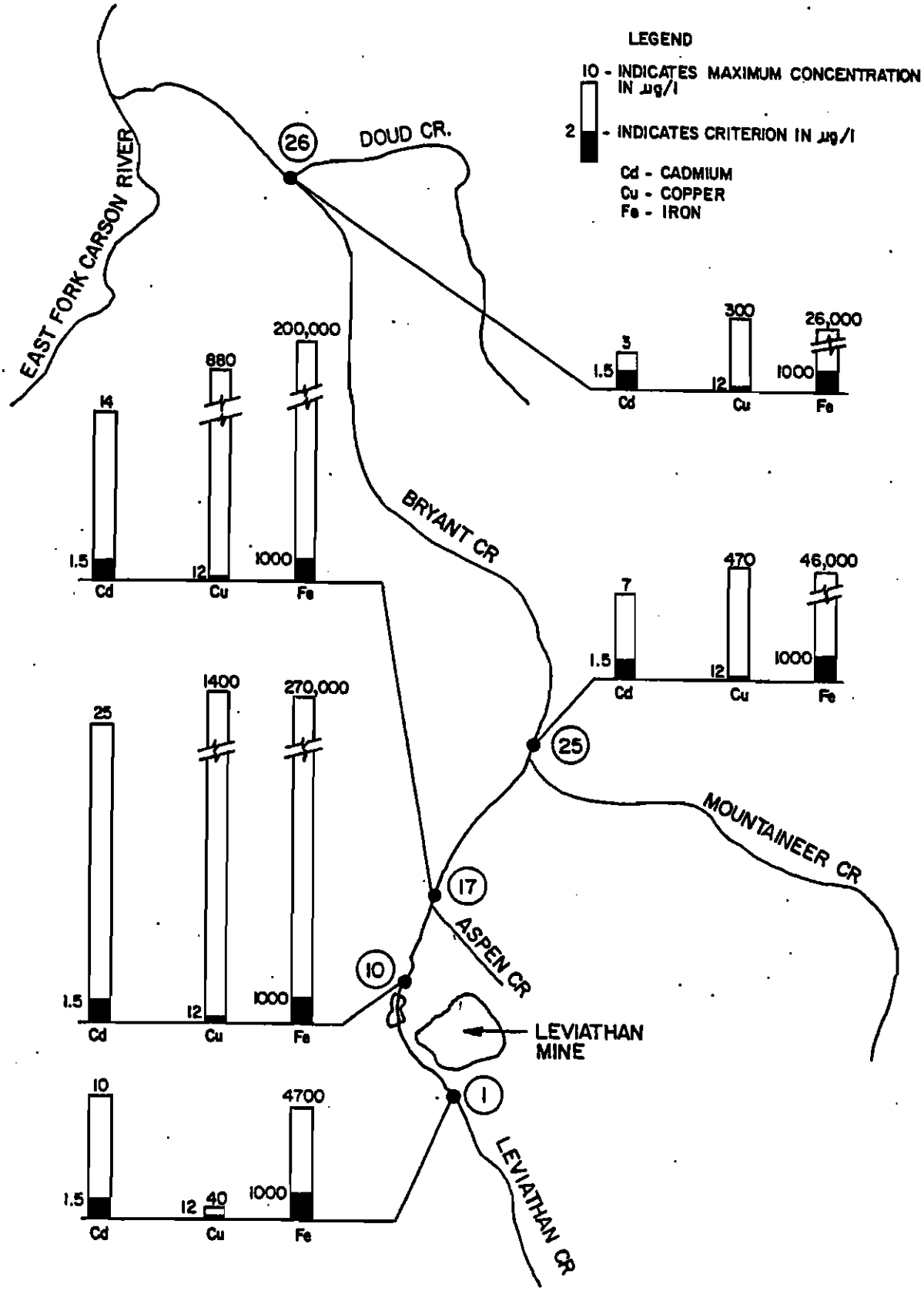


Figure 3-2 Comparison of Cadmium, Copper, and Iron Concentrations to Criteria for Cold Freshwater Habitat

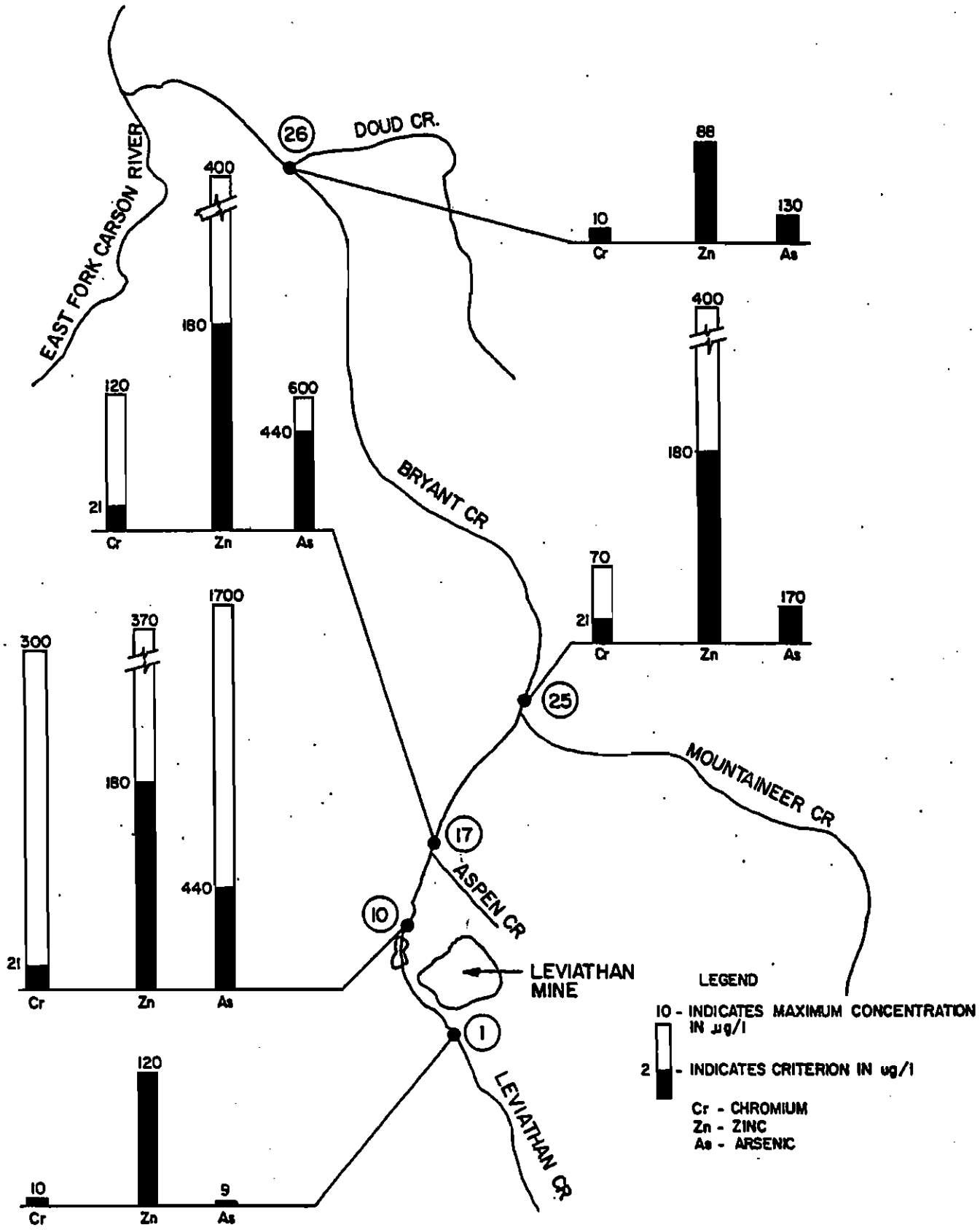
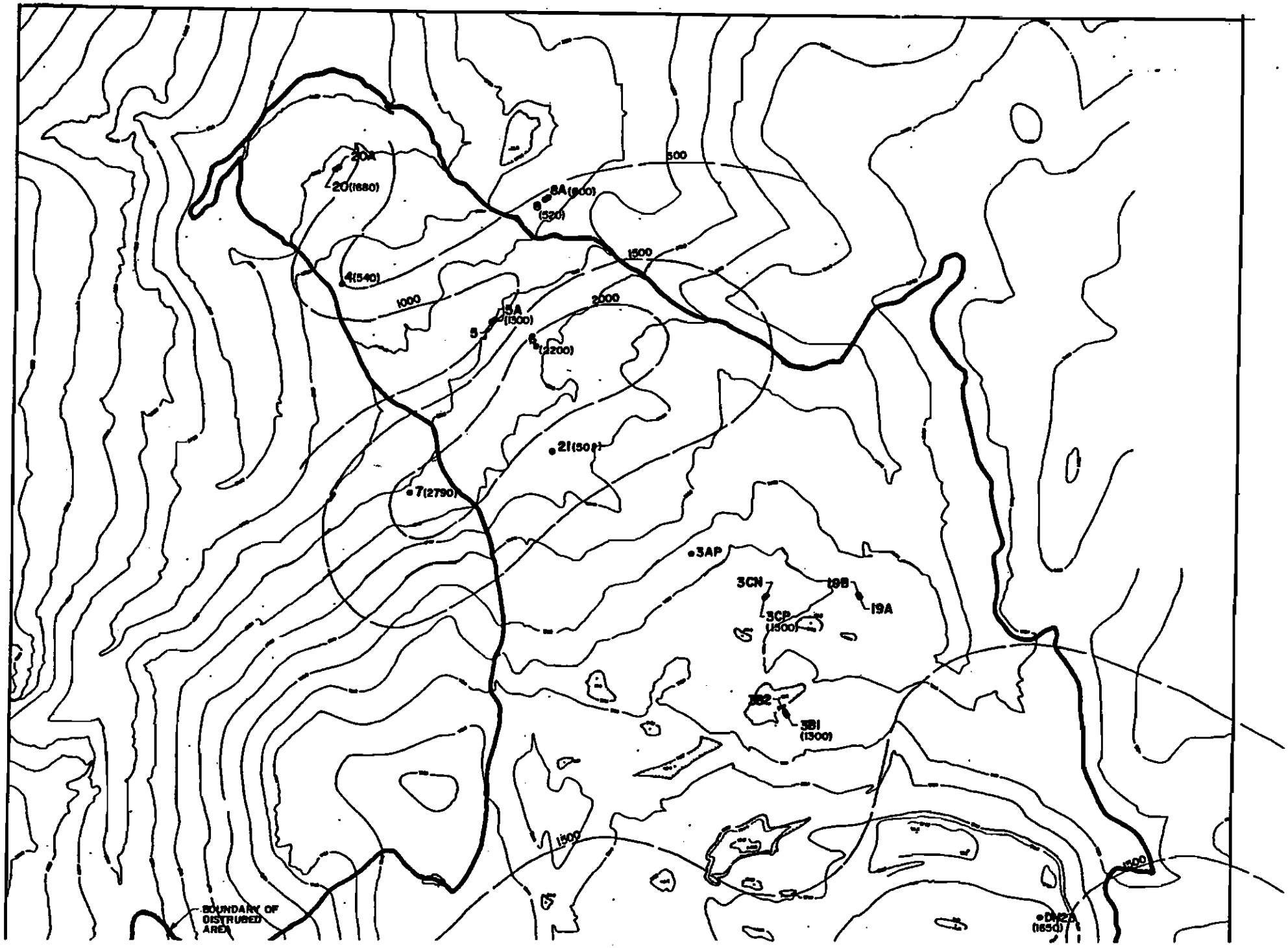
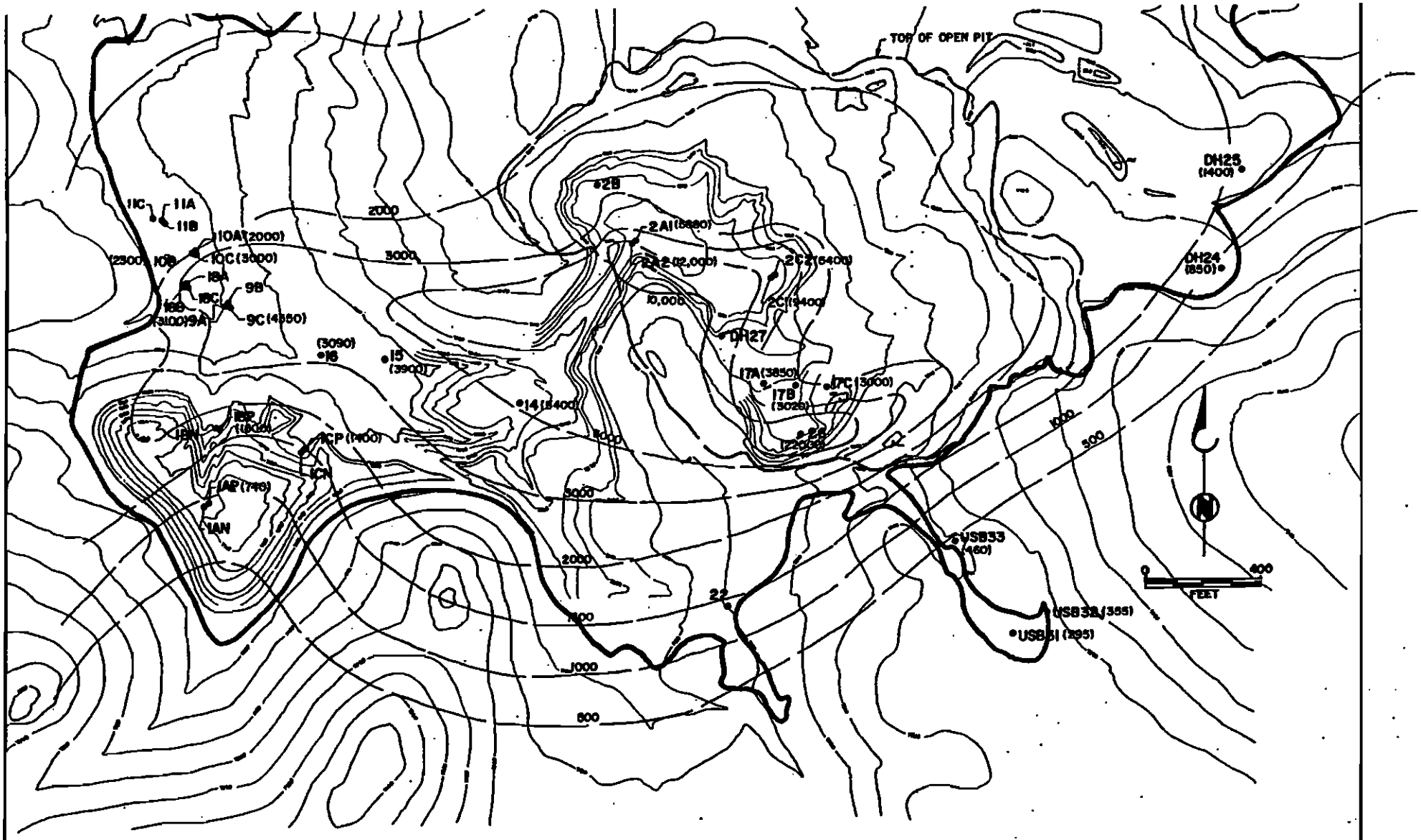


Figure 3-3 Comparison of Chromium, Zinc, and Arsenic Concentrations to Criteria for Cold Freshwater Habitat


500
1000
1500
2000
20A
20(1680)
8A(900)
8
(320)
4(540)
5A
(1300)
5
8
(2200)
21(50)
7(2790)
3AP
3CN
19B
19A
3CP
(1300)
3B2
3B1
(1300)
1500
1500
BOUNDARY OF
DISTRUBED
AREA
(1650)



LEGEND

(5400) LOCATION OF USGS GROUNDWATER MONITORING HOLE, SHOWING DRILL HOLE NUMBER. NUMBER IN ( ) IS FIELD VALUE OF SPECIFIC CONDUCTANCE IN MICROMHOS

1900 CONTOUR LINE OF EQUAL CONCENTRATION OF FIELD VALUE SPECIFIC CONDUCTANCE IN MICROMHOS

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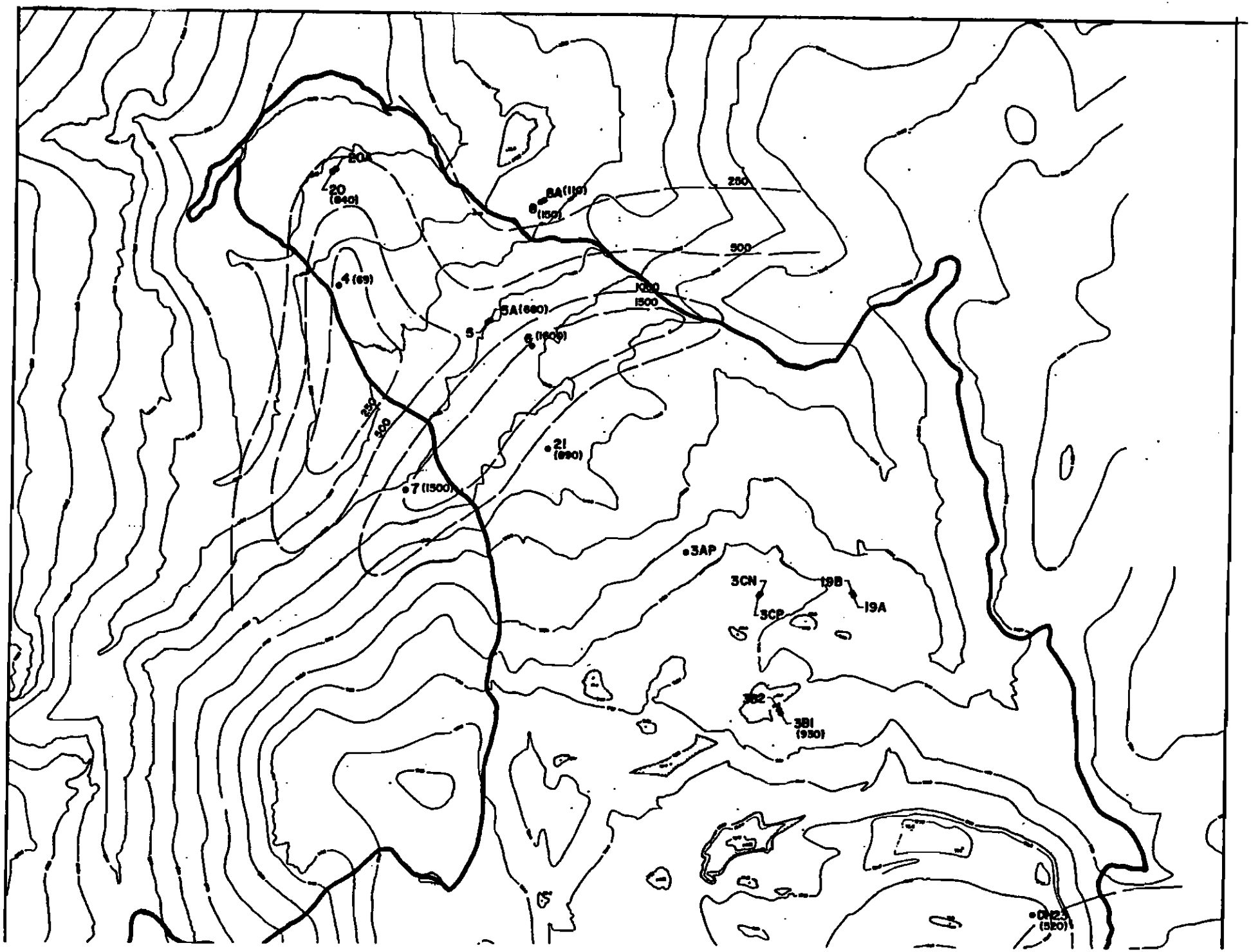
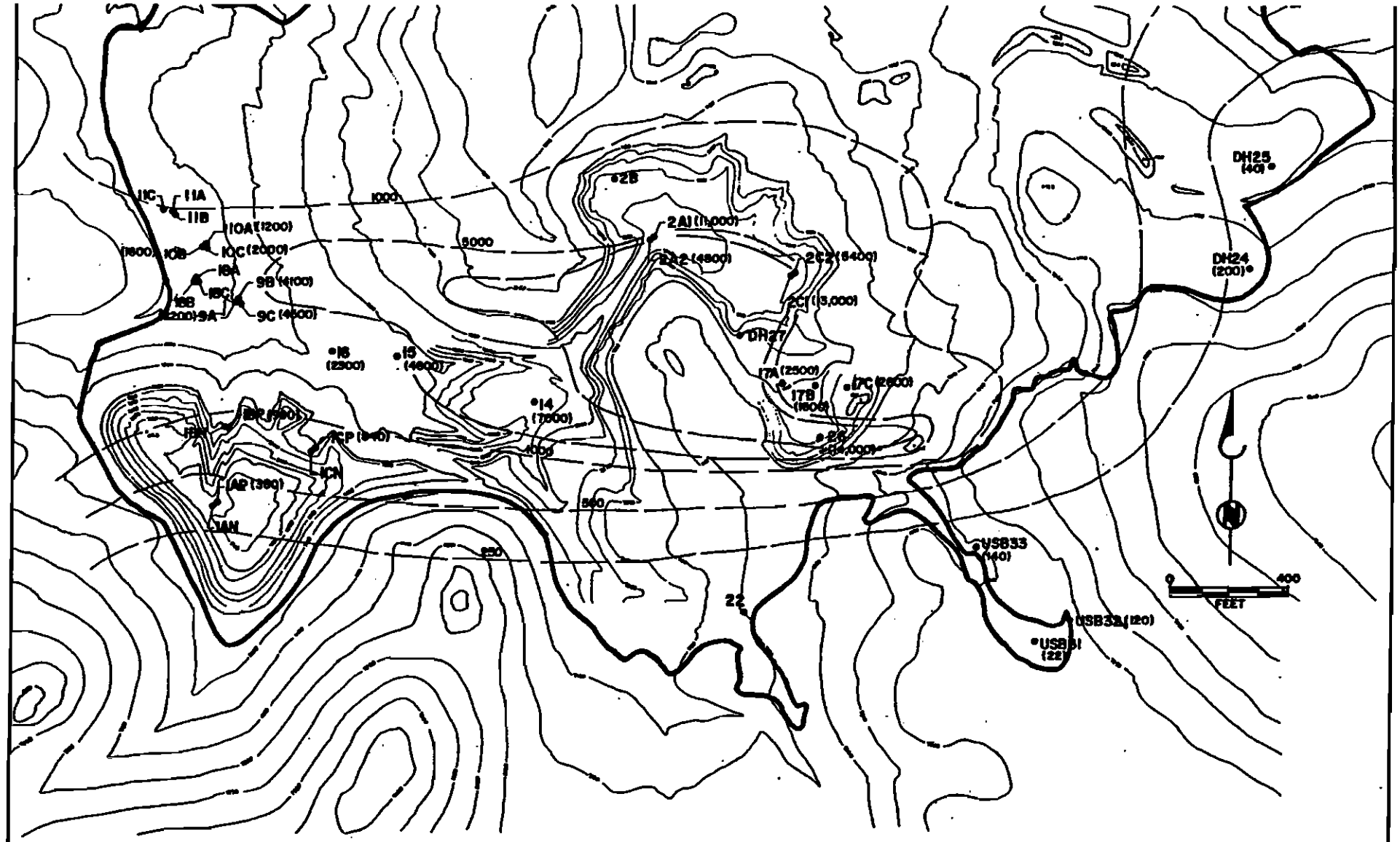
CONSULTING ENGINEERS

FIGURE 3-4 MAP OF GROUNDWATER QUALITY, SPECIFIC CONDUCTANCE CONCENTRATION NOV 1982


20A
20
(640)
4 (69)
8A (110)
8
(150)
250
500
1000
1500
5A (660)
5
6 (1600)
250
500
21
(690)
7 (1500)
3AP
3CN
19B
19A
3CP
3B2
3B1
(930)
(520)



LEGEND

14
•(7000) LOCATION OF USGS GROUNDWATER MONITORING HOLE, SHOWING DRILL HOLE NUMBER. NUMBER IN ( ) IS SULFATE ION CONCENTRATION IN MG/L

500 CONTOUR LINE OF EQUAL CONCENTRATION OF SULFATE ION IN MG/L

BROWN AND CALDWELL
CONSULTING ENGINEERS

FIGURE 3-5 MAP OF GROUNDWATER QUALITY, SULFATE ION CONCENTRATION NOV 1982

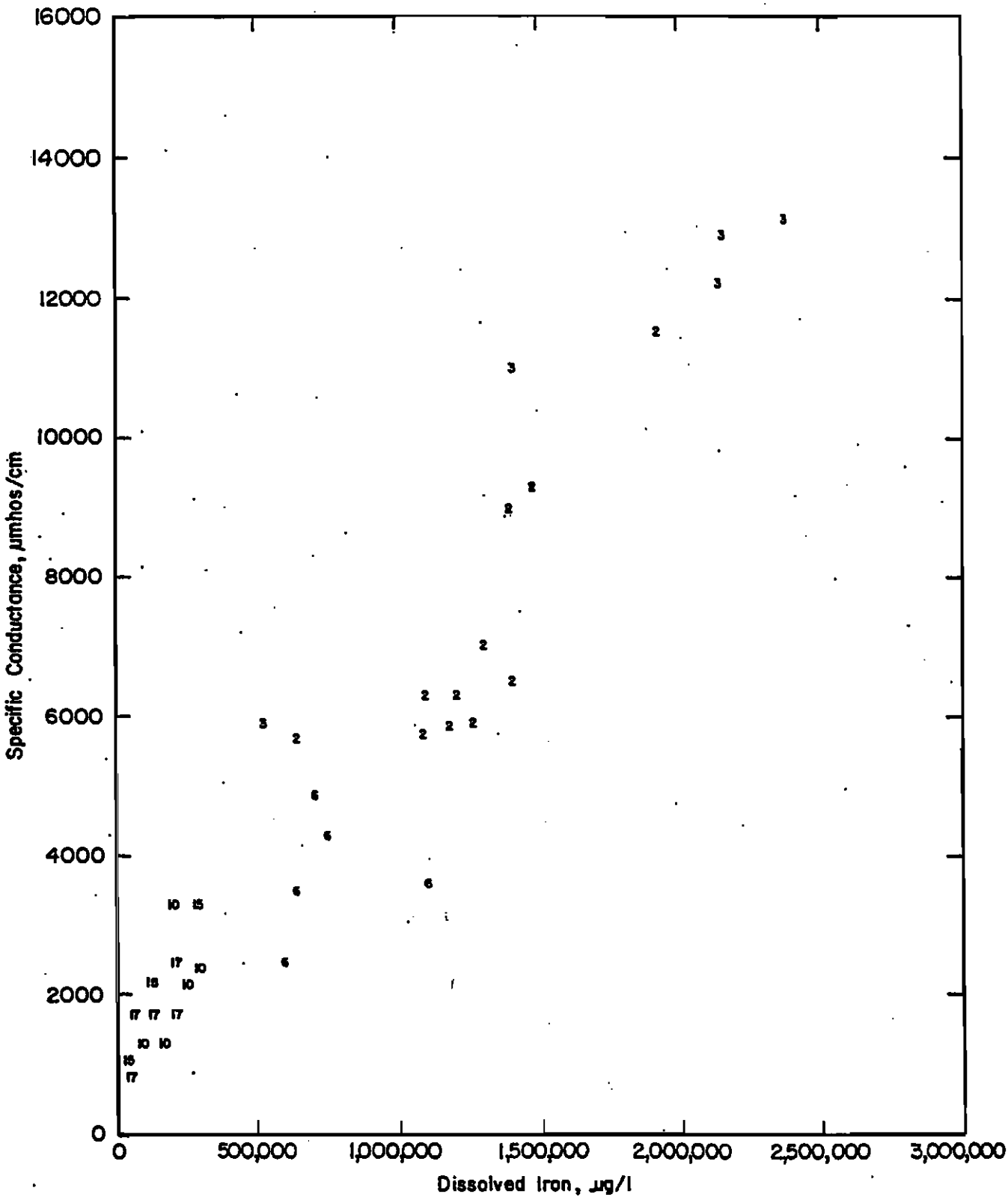


Figure 3-9 Specific Conductance versus Dissolved Iron

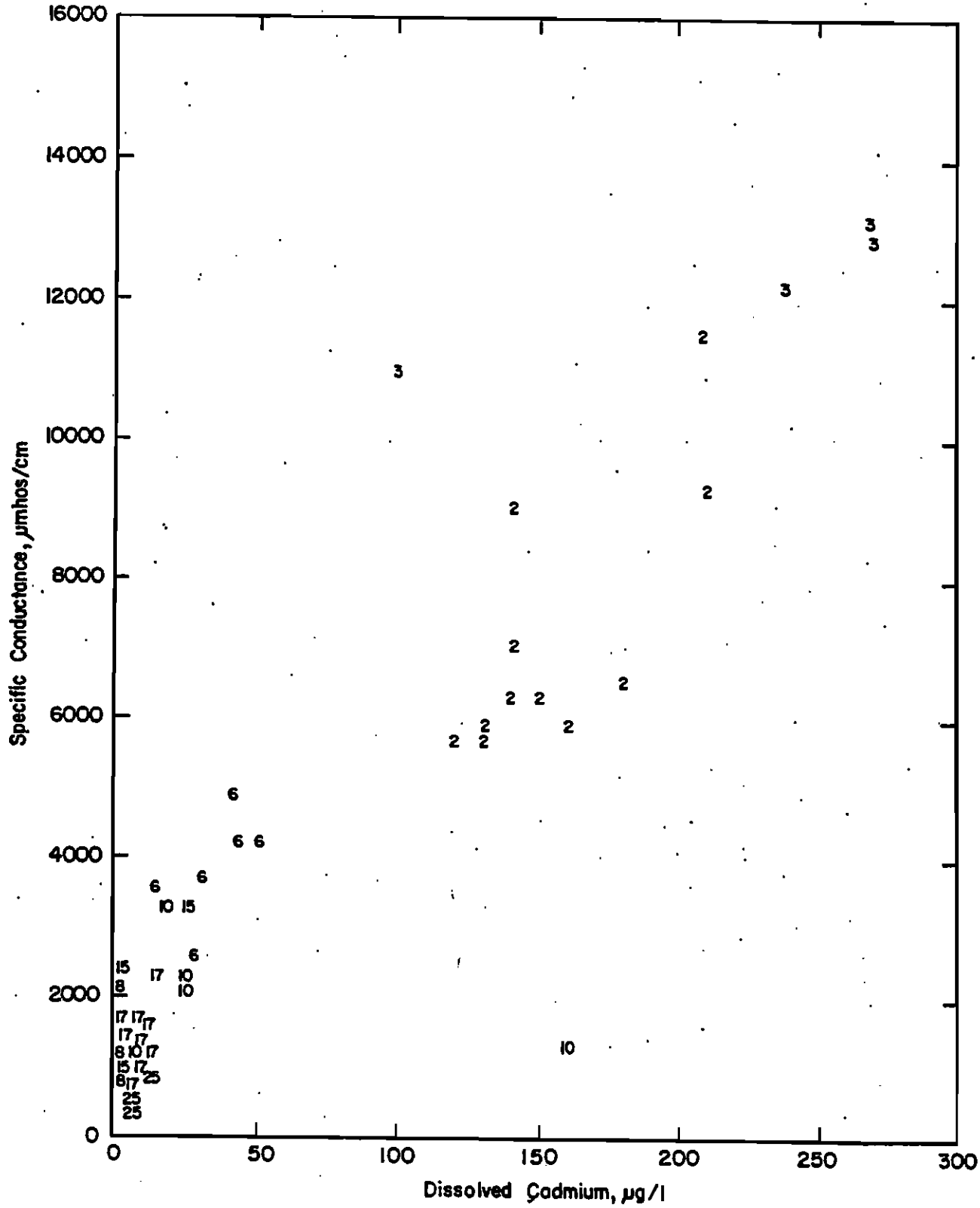


Figure 3-12 Specific Conductance versus Dissolved Cadmium

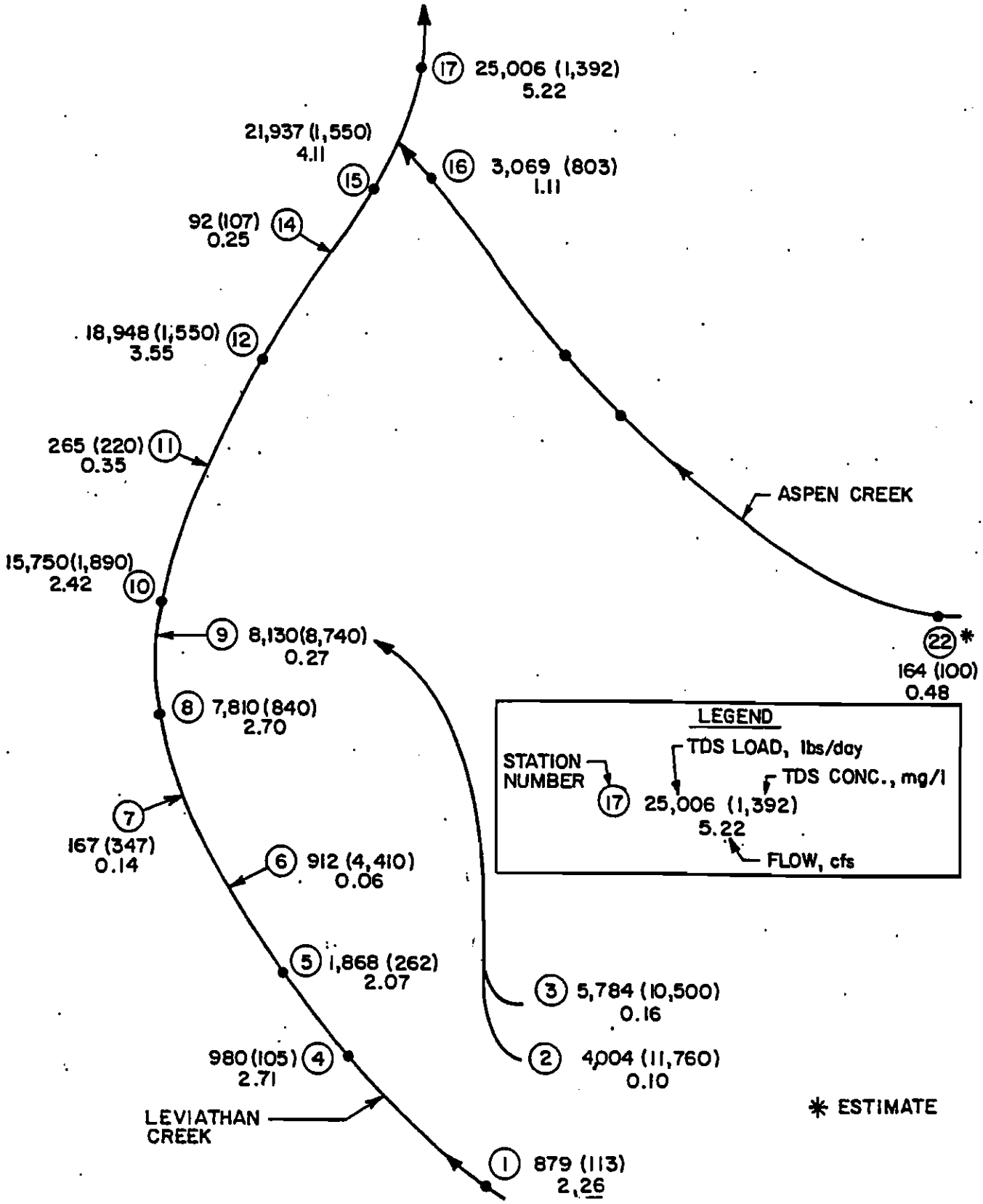


Figure 3-13 Schematic of TDS Loading Balance for March 6, 1982

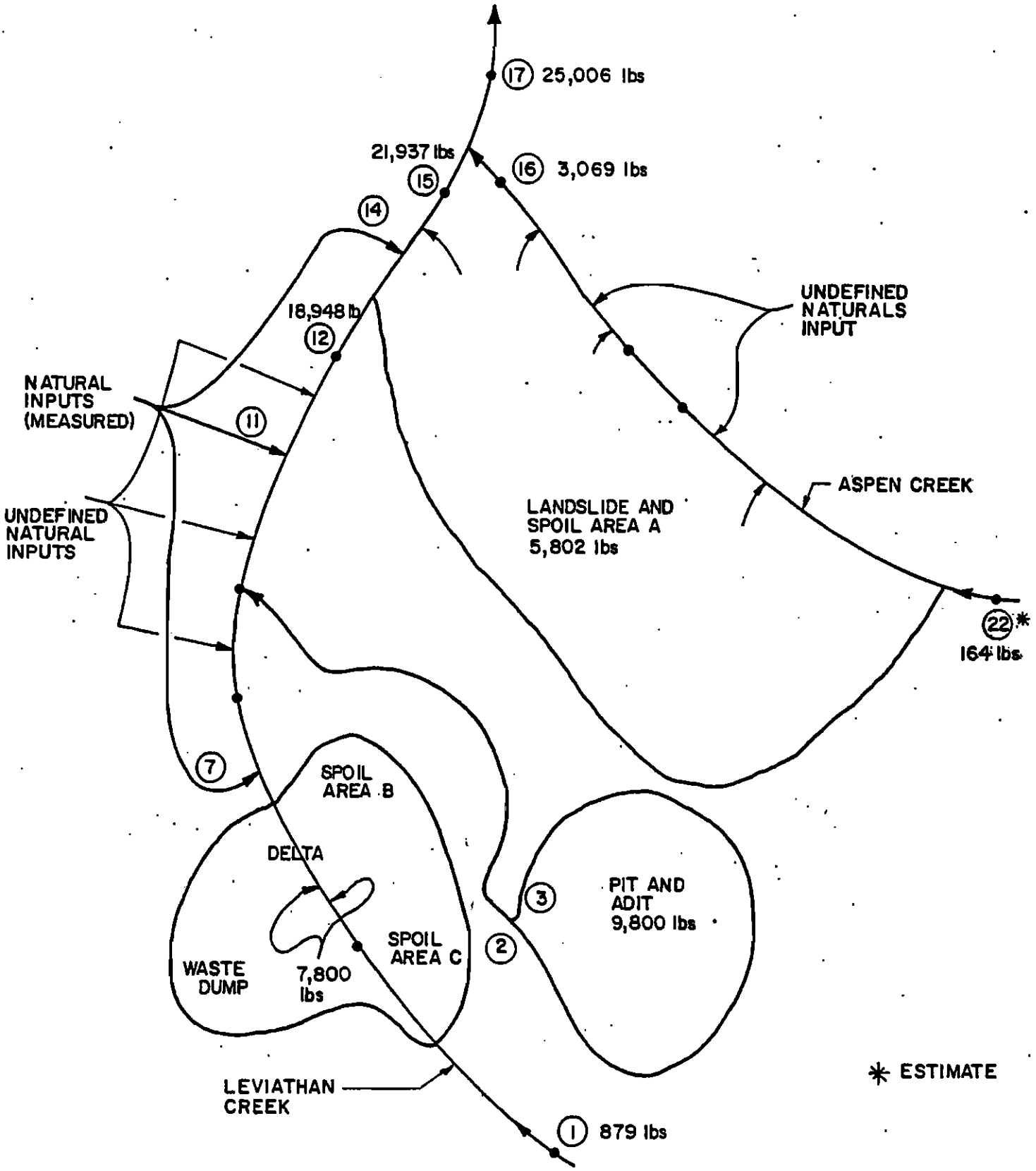


Figure 3-14 Schematic of TDS Loading Balance for March 6, 1982

CHAPTER 4

CONTROL METHODS SCREENING

This chapter describes the screening of a number of potential methods for control of pollution in Leviathan and Aspen Creeks at the mine site and for control of the landslide. The screening process used the results of work described in Chapter 3 (Problem Assessment and Control Priority) to evaluate the effectiveness of each potential control method. Control methods intended to improve water quality generally fall into two major categories--pollution source controls and pollution discharge controls. Source controls are intended to improve water quality by eliminating or reducing the problem source, e.g., regrading to reduce infiltration and the resulting contaminated flows from seeps. Discharge controls are intended to prevent discharge of contaminated flows to the creeks, e.g., collection and evaporation of flow out of the portal of Adit No. 5. In addition to the two major categories of water quality improvement control methods, several methods for control of the landslide were developed and evaluated.

SCREENING OF CONTROL METHODS

Factors to be considered in comparison of these control methods include:

1. The mountain area at the mine has rugged topography and is poorly accessible, particularly during winter and spring months. Any selected control method must be compatible with the hostile climate, poor logistics, and lack of on-site power.

2. Water in the creeks is not locally used for beneficial purposes, but becomes used for agricultural purposes several miles downstream of the mine. Creek flow is, however, polluted by acid mind drainage which is characterized by high acidity, high heavy metals concentration, and high solids content. Abatement of acid mine drainage would result in improved aquatic and wildlife habitats and a more aesthetically-pleasing stream course.

3. Intensely altered, and variably weathered and mineralized volcanic rocks exist throughout this watershed and adjoining ones. Pyrite is disseminated throughout the sulfur-bearing ore rocks and in the caprock at the mine.

Sulfur was mined locally, and pockets of the ore still exist within the open pit. Oxygen and water have access to these rocks through numerous rock fractures, prior drill holes, and existing adits. The condition of the adits, particularly No. 5, is not known, but likely is in a poor state of repair due to the nature of the rock and mining activities subsequent to tunneling. Any abatement method must consider the difficulty of sealing off the adit.

4. Acid mine drainage leaves the open pit by direct runoff during part of the year and by continual seepage from the adit portal at ground surface at a spring. These sources constitute the principal contamination problem at the mine. Subsequent infiltration of these contaminants back to the groundwater occurs outside the open pit as they flow along ground surface. Future abatement techniques must consider the volume and quality of these sources, particularly because there is a limited amount of suitable surface area at the proper locations and elevations on the site upon which to construct evaporation ponds.

5. Flow in Leviathan Creek fluctuates in volume and quality as it traverses the mine, but is considered unpolluted upgradient of the property. It flows through and along mineralized waste dump materials and leaches pollutants from them. In addition, it receives direct surface discharges from flow from the open pit and adit spring, and further receives local groundwater which has been contaminated by recharge from nearby percolating open pit and spring flows. It is impractical to treat the entire flow from this creek due to the large annual volumes involved.

6. Flow in Aspen Creek is less and of overall better quality than Leviathan Creek. Aspen Creek flows through and along partly mineralized spoil tailings and leaches relatively small amounts of contaminants; it also receives flow from polluted seeps along Spoil Area A. It flows adjacent to a major landslide and supplies some water to it. Control methods are not necessary to treat the entire flow because it is never highly mineralized.

7. The large landslide is historic in nature and involves several million cubic yards of materials. The slide is active, but because of its size and limited pollutant potential to local water quality, it is not feasible to remedy the entire situation. Control methods should consider remedial grading and other techniques to reduce movement-related problems.

8. The selected control method for each problem should be as cost-effective as possible in view of the limited funds available for construction. Another major consideration in selection is the need to minimize any operation and maintenance requirements.

Table 4-1 presents the list of potential control methods developed for the site and indicates the problem areas on the mine site where the method might be applied, or would be applicable to produce water quality improvement. Screening of the methods for use in each of the areas is described below.

Table 4-1. Potential Pollution Control Methods and Areas of Application

Control method	Adit 5 seep	Mine pit	Waste dump	Spoil Area A	Spoil Areas B and C	Landslide
S-1. Upgradient interception of groundwater:						
a. Well points southeast of site	x	x		x		
b. Groundwater cutoff barriers southeast of site	x	x		x		
c. Hydrauger holes southeast of site	x	x		x		
S-2. Interception of Adit No. 5 flow before contamination	x					
S-3. Sealing of streambeds, rerouting of streams			x	x		x
S-4. Clay or soil-cement seals, synthetic membrane	x	x	x	x	x	x
S-5. Regrading and compaction	x	x	x	x	x	x
S-6. Revegetation	x	x	x	x	x	x
S-7. Drainage facilities	x	x	x	x	x	x
S-8 Deoxygenation of upgradient groundwater	x	x		x		
D-1. Sealing of Adit No. 5	x					
D-2. Containment of contaminated flows	x	x				
D-3. Chemical treatment on site	x	x	x			
D-4 Collection and export for off-site disposal	x	x	x			

Note: The "S" and "D" prefixes on the control methods indicate whether the method is a source control (S) or discharge control (D) method.

SOURCE CONTROL METHODS

Source control methods are intended to prevent the contamination of natural surface and subsurface flows. In general, the control methods are designed to prevent contact of water with sulfur-bearing ore and spoil materials, or to inhibit the chemical processes which produce degradation of the quality of water passing over or through the materials. Each potential source control method is briefly described below.

Upgradient Interception of Groundwater

The purpose of this source control method is to intercept the flow of area groundwater toward and through the site prior to its contamination. Interception of the flow would prevent contaminated seepage from the adit, floor of the pit, and possibly Spoil Area A. The groundwater levels evaluation and water balance calculations performed in the study have led to the conclusion that the influence of area groundwater on surface flow and groundwater seepage from the pit and adit is extremely small. The total volume of flow from the pit and adit during 1982 was very close to the volume of precipitation which fell on the pit watershed. To have any value in reducing the pit and adit drainage problem, upgradient interception of uncontaminated groundwater would need to be extremely effective.

Three interception techniques were investigated: (1) deep wells or well points on the southeast side of the site, (2) physical groundwater cutoff barriers, and (3) hydrauger holes drilled to drain by gravity to the creeks.

Well Points. The use of deep wells is not considered feasible. Due to the depth to the water surface and the quantities that may need to be pumped, this method would have high power and operation and maintenance requirements. Because groundwater flow through many parts of the site is principally through rock fractures, the process of siting the wells and determining the required spacing would be complex and expensive.

Groundwater Cutoff Barriers. The use of physical groundwater cutoffs would involve construction of a slurry wall or grout curtain upgradient from the site. These techniques are not feasible because of the depth to the water surface and hardness of the bedrock.

Hydrauger Holes. Hydrauger holes, which are essentially horizontal wells, are also not practical. The topography near the site does not allow the holes to be spaced closely enough or to have outlets at low enough elevation to effectively lower the upgradient groundwater surface.

Because the need for upgradient groundwater interception is questionable, and because there appears to be no practical technique to accomplish it, this source control method has been eliminated from further consideration.

Interception of Adit Flow Before Contamination

This source control method is similar to the method discussed above, but would apply only to drainage in abandoned

Adit No. 5. The method would utilize a drilled horizontal well to intercept adit flow and bring it into the floor of the pit. However, the existing elevation of the bottom of the pit is at approximately 7,060 (USC&GS datum) and the level of the adit nearly 7,050 (USC&GS datum). Therefore, construction of the drain would require at least a 10-foot excavation into saturated soils in the bottom of the pit and the construction of a pipeline at this depth out to the mouth of the pit.

To be effective, the drain must intercept flow prior to contamination. The available groundwater elevation data from Wells 17A, 17B, and 17C along the adit alignment indicate that a very small positive gradient (and therefore flow) may exist from Well 17B towards Wells 17A and 17C. This suggests that there may indeed be no point within the adit where uncontaminated water may be found and gives further credibility to a conclusion that the source of adit seepage is the mine pit itself rather than the area groundwater. The water quality data, which indicate that water at Well 17B has a higher pH than that at Wells 17A and 17C, tend to support the concept that there is no through flow of water which becomes contaminated as it moves toward the adit portal. The fact that the water surfaces in the three wells are at different levels may be due to collapse of the adit. In this case, interception of some flow near Well 17B might not have a significant effect on the flow emerging at the adit portal. No data are available to indicate the flow rates through the adit at specific locations other than the portal. The quantity of flows which might be intercepted is therefore uncertain. This method might be combined with an attempt to seal the adit at a point within the pit in order to divert water to the drain. However, the nature of the rock in the adit and the adit structure itself make the outcome of plugging the adit uncertain. Sealing the adit, as a control method, is discussed in further detail in a later subsection as a discharge control method.

Because there is no indication of uncontaminated water in the adit which could be intercepted, this control method has been eliminated from further consideration.

Sealing of Streambeds, Rerouting Streams

This source control method prevents contamination of the creeks which occurs due to seepage of acid mine drainage from the site, contaminated surface runoff, and contact of the creek with mine spoil materials. The method is most applicable to Leviathan Creek from Spoil Area C to below the delta.

Aspen Creek. Although Aspen Creek runs along the edge of Spoil Area A, water quality data indicate that runoff and seepage from Spoil Area A either does not reach Aspen Creek, or reaches it in such small quantities that it does not seriously

degrade Aspen Creek's water quality. Rerouting Aspen Creek was considered as a means of preventing subsurface flow along the slippage plane of the landslide. However, seepage from Spoil Area A may be a more important source of lubricating moisture for the landslide. Because the rerouting of Aspen Creek would not be expected to result in any significant water quality improvement or landslide stabilization benefits, it has been dropped from further consideration.

Leviathan Creek. Leviathan Creek presently flows northerly along the east side of the waste dump where it is actively eroding a steep, unstable channel. Figure 2-21 (Chapter 2) shows the location of Leviathan Creek and several small tributaries in the area of the delta and waste dump. In the stream reach from just south of the waste dump to the north end of the delta, water quality in Leviathan Creek is severely degraded. Rerouting Leviathan Creek in this area would prevent active contact of the creek flows with erodible, sulfur-rich mine waste, intercept tributary flows prior to contamination in the waste dump area, and allow restoration of the delta. Although other control measures may reduce seepage from the waste dump and delta, this method provides the most effective means of preventing contact of the creek with sources of acidity and salts. It is therefore considered essential in the overall site restoration. Rerouting of the creek and design of the channel will be further discussed in the next chapter.

Clay or Soil-Cement Seals, Synthetic Membranes

This source control method has several potential applications in both source and discharge control. In general, its purpose is to prevent infiltration of either contaminated or uncontaminated water into the ground. As used for source control, sealing techniques involving clay, soil cement, or synthetic membranes may have applications in the spoil and mine dump areas.

Spoil Areas A, B, and C constitute a large percentage of the total surface area of the site. Rainfall infiltrates into the spoil immediately, and snowfall infiltrates during periods of snowmelt. The infiltrated water emerges in various seeps around the site which are highly contaminated. The possibility of sealing (or decreasing the permeability of) the spoil areas with a soil amendment or by compaction of a clay overlayer was considered. For several reasons, this approach does not appear cost-effective. First, the areas which the spoils cover are relatively large. Therefore, even minimal treatment would be expensive when done on such a large scale. Second, sealing of the surface would not be conducive to the establishment of vegetation. Third, the effects of the spoil areas on water quality in the creeks appears to be minimal. For these reasons,

large-scale sealing of the spoil surfaces or significantly reducing their permeability does not appear to be practical or cost-effective.

Clay or soil-cement or membrane seals may be applicable to specific locations in combination with other control methods. For example, transport of contaminated flows off site may require the construction of a stilling pond, which could be sealed using a clay, soil-cement, or synthetic membrane seal. Similar seals may be useful for construction of drainage swales and new creek channels. Specific applications, costs, and design criteria are discussed in detail in the next chapter.

Regrading and Compaction

This source control method has the same general purpose as the previous control method--maximizing surface runoff to prevent infiltration. The primary differences are the cost per unit area and the compatibility of the method with revegetation.

Many of the slopes on the mine site are extremely steep. The steep slopes are generally unstable and easily eroded by surface flow. The surfaces of most of the steeper slopes on Spoil Area A, for example, consist of loose, granular materials which are easily washed away and make the establishment of vegetation difficult. The slopes are therefore a potential source for high turbidities in the creek during runoff periods. Although some types of revegetation at the site would aid in stabilizing these steep slopes, regrading of the slopes provides a relatively inexpensive method to encourage natural revegetation, or to reduce the requirements for intensive revegetation.

The site also has areas where the slopes are very flat or where small impoundments are formed. These areas encourage infiltration and contamination of runoff. Specific examples include the intermittent ponds in the pit and on Spoil Area A. Elimination of these areas by grading would be relatively inexpensive. The regraded areas would have slopes which provide for runoff with significantly reduced erosion of the surface materials, and would be compacted to a density which would not inhibit vegetation.

Regrading and compaction work is applicable to Spoil Areas A, B, and C, the waste dump, and the pit. Because slope stability, erodibility, runoff/infiltration characteristics, and revegetation potential are not independent, regrading and revegetation plans for the site must be developed together. This ensures cost-effective measures are used in each area. Therefore, the use of regrading is discussed further in connection with control methods using revegetation and drainage facilities.

Pond in Pit. Placement of a pond in the bottom of the pit was considered but eliminated from further evaluation. Within the pit, there are several landslide areas which would be further destabilized by the pond excavation and which would in any event present an ongoing threat to the pond. This fact, coupled with the fact that only about 1.7 acres of pond surface area could be developed in the pit, led to elimination of the pit as a pond site.

Ponds on Delta and in Crusher Vicinity. Ponds could be located on the delta, or on a flat area of spoil materials south of the abandoned crusher. Both of these sites have the advantage of being considerably lower than the floor of the pit. Flow could therefore be routed from a collection system under the pit floor to the ponds by gravity. The collection system would consist of either one large rock-filled drainage trench or a series of smaller, but relatively deep rock-filled drains. The invert of the drain system would be below the bottom elevation of Adit No. 5. The collection system might be designed to lower the groundwater surface in the adit area and thus reduce or eliminate outflow at the portal. Alternatively, the collection system might simply collect the seep at the adit portal.

Near the crusher, a relatively level area approximately 1.7 acres in size currently exists. This area might be expanded by regrading work if necessary. A level area of approximately 3 acres exists on the delta. The delta is a low area below most of the disturbed area of the site which drains to Leviathan Creek. It could, therefore, serve as a collection pond for several site features and problems. The potential pond locations near the crusher or on the delta both appear more favorable than the one in the pit because of the elevation difference. The total area of ponds required will depend on the water quality improvement expected from different acreages of evaporation ponds in combination with source control methods. The total area of the existing sites near the crusher and on the delta is 4.7 acres, which would evaporate approximately 2.5 million gallons annually. As mentioned previously, the available acreage might be increased by regrading spoil materials between the crusher and the mouth of the pit.

Ponds on Regraded Waste Dump. With major regrading, the top of the waste dump could be leveled to receive 7 or more acres of ponds.

Chemical Treatment On Site

This control method involves the use of chemicals to treat contaminated mine drainage prior to release to the creeks. In general, this control method involves much higher operation and maintenance requirements than most others. Treatment of the

acid mine drainage would be focused on neutralization of the waste and precipitation of the less soluble heavy metals. The total dissolved solids (TDS) loading would probably not be significantly affected by treatment. Although several treatment methods have been used for acid mine drainage, the most common and most practical for remote sites are lime, limestone, and lime/limestone combination treatment processes.

Lime treatment involves addition and mixing of lime with the drainage flows, coagulation of the effluent, and disposal of the sludge. The advantages of lime treatment over limestone processes are:

1. Shorter detention times than limestone treatment (therefore less storage volume and smaller equipment).

2. Greater effectiveness in treating ferrous acid mine drainage than limestone processes.

The disadvantages are:

1. Lower density sludge than limestone processes, i.e., more volume for disposal.

2. Higher reagent cost than limestone.

3. High potential for accidental overtreatment (limestone is less reactive and therefore results in a less sensitive process).

4. Requires mechanical equipment and power supply whereas some limestone systems can be designed to work "passively".

5. Generally higher operation and maintenance requirements than limestone processes.

From these considerations, a limestone process appears most practical. A passive system requiring little operation and maintenance would be particularly attractive considering the remoteness of the site. However, the effectiveness of a passive limestone process in treating ferrous acid mine drainage would probably be poor (EPA 600/2-77-101).

A mechanical system might be used, but the long detention times would probably result in reaction and oxidation vessel sizes that would make the process economically unattractive compared to lime treatment.

A combination lime/limestone process using mechanical equipment would probably be most attractive economically. It offers the advantages of lower reagent cost, less sludge volume

produced, and potentially good effluent quality. However, the process is fairly complex and requires a high level of operation and maintenance, mechanical equipment, and power. Any mechanical equipment or storage vessels constructed on the site would require protection from vandalism. The most feasible method of supplying power to a treatment system appears to be diesel or gasoline generators. Sierra Pacific Power Company has roughly estimated the cost of extending service to the mine site at $1 million. Construction of a generator plant at the site is judged to be considerably less expensive.

Because of the extremely high operation and maintenance requirements, on-site treatment is not considered attractive as a control method and is eliminated from consideration.

Collection and Export Off Site

This discharge control method involves the use of a pipeline to export flows off site for containment and evaporation. The principal advantage of off-site export is that larger pond areas would be available, and more favorable weather conditions for evaporation would exist at lower elevations. The alternative applies principally to the contaminated subsurface drainage from the pit and adit, but might also include selected, small contaminated seeps elsewhere on the site.

Flows would be collected by underdrains in the pit and/or from the portal of the adit and transported in a pipeline after passing through a small sedimentation basin to reduce suspended sediment. A pipeline constructed in the mine access road which runs from U.S. Highway 395 in Nevada to Leviathan Mine could carry flows by gravity. Evaporation ponds would be located in the Double Springs Flat area near U.S. Highway 395.

To carry the present contaminated flows from the pit and adit, a 10-inch-diameter pipeline 10 miles in length would be required. Based on the 1982 flows from the pit and adit and a conservative estimate of evaporation in the area, approximately 30 acres of ponds would be required to evaporate the present flows. If combined with source control measures, the pipeline size and pond area required might be reduced substantially.

This control method also requires some degree of operation and maintenance. In particular, pipeline appurtenances such as monitoring gages and pressure-reducing valves would be required and would need routine attention. For reliability, the method would probably need to include a storage pond at the site in case of pipeline failure or blockage.

Although relatively expensive, the method has the advantage of providing certain control of the pit and adit drainage problem and can be modified to include other relatively discrete sources of contaminated flow.

LANDSLIDE CONTROL METHODS

This control method involves the potential use of construction techniques to mitigate the problems associated with the continued downslope movement mainly of the large, 35-acre, landslide north of the open pit. Indirectly, these techniques could apply to mitigating downslope movement of the landslides within the open pit, on the west flank of tailings Pile B, and along Leviathan Creek where it cuts through waste dump materials.

Large Landslide

Techniques for increasing the stability of the large landslide and, hence, for controlling its movement include: drainage; complete removal and recompaction; removal of the driving weight by reducing the slope height and slope inclination; placing a large mass of earth materials (soil or rock) at or near the toe of the slide to increase resisting forces; constructing a series of earth fills as shear keys; constructing a buttress fill with a shear key at the toe of the slide; constructing a retaining structure such as a retaining wall or a reinforced earth wall; and in situ soil improvement and densification. Of these alternatives, the construction of a buttress fill with a shear key at the toe appears to be the best option for the large landslide.

Placing a mass of fill near the toe to help resist downslope movement assumes that the strength of materials in the unstable mass derives solely from functional resistance and not cohesive strength and, also, that the angle of the slide plane in this area is less than the friction angle. This alternative should not be undertaken, however, without further detailed exploration of the slide mass, including definitive assessment of the location and strength of slide plane materials.

If these assumptions are not correct, then placement of the earth mass must be not only on but also in front of (north of) the toe of the slide. This implies that the earth mass must be placed within and across (north of) Leviathan Creek. This will require re-routing of the creek channel or providing a conduit to direct the flow below or through the earth mass. These methods are not considered as feasible as other methods.

Constructing a weighted mass near the toe of the large landslide using rock is not feasible due to the on-site paucity and nonaccessibility of a sufficient quantity of suitable rock.

Constructing a series of earth fills as shear keys in a series of parallel trenches across the toe of the slide is

another alternative to creating additional resistive forces to downslope movement. The chief problem with this method is that due to the width of the slide, a large number of long and deep shear keys would be required.

Significant reasons why most slope stabilization methods were deleted from further consideration involve: the large areal extent and mass of the failure; the unknown depth(s) to the shear plane(s); and the inability to cut off all sources of water to the sides and top of the unstable mass; and the large dollar cost of the methods relative both to the overall pollution problem caused solely by the slide and to the dollar cost of these methods compared with other possibilities.

The advantages of using a large buttress fill at the toe of the landslide include its relative ease of construction; the on-site availability of large volumes of earth materials; and its lack of future operation and maintenance requirements. For reliability, proper compaction of the keyway and buttress fill and surface drainage of the buttress are essential.

Constructing a buttress entails the use of locally available earth materials at the toe of the landslide to substantially increase the resisting forces on the unstable mass. Considerable volumes of material are available from both the waste dump and spoil piles. Use of the waste dump also has the advantage of removing mineralized material from continued leaching and contamination in that area. Once properly emplaced in a buttress, these materials would have a greatly reduced capacity of contributing to future water quality contamination. Placement of the buttress requires only standard grading equipment.

Initial operations necessary for the buttress fill include excavating a keyway below the landslide plane along the toe of the slide. Then, a subsurface drainage control in the keyway is provided with the use of gravel drains. Subsequently, the keyway and the buttress are constructed as a compacted fill.

Smaller Landslides

For the numerous failures in the open pit, a combination of grading to reduce slope heights and slope inclinations, and of loading the toes of the slopes appears to be the best option. To correct the failure on the west flank of Spoil Pile B, the best option appears to be constructing a buttress.

Control methods for the failures along Leviathan Creek at the waste dump include grading to reduce slope heights and inclinations, coupled with channelizing of Leviathan Creek.

CHAPTER 5

ANALYSIS OF APPLICABLE CONTROL METHODS

The control methods described previously which could feasibly be applied to each of the mine elements are described in this chapter in sufficient detail to allow development of reliable cost estimates and evaluation of control effectiveness.

BASIS FOR COST ESTIMATES

The facility construction cost estimates in this report are estimated construction bid prices. As such, they include: (1) material and labor costs to the contractor for performance of the work, (2) mobilization, bond, and insurance costs incurred by the contractor as he prepares to execute the work, and (3) an allowance for contractor overhead and profit on the work. The estimated construction costs also include an allowance for construction contingency which is applied to the cost estimates which are built up using the above three factors.

The construction cost estimates presented herein do not include: (1) office and field engineering during project design and construction and (2) the cost of construction contract administration to be incurred by the project owner.

Material and labor costs to perform the work associated with this project have been estimated based on discussions with contractors commonly engaged in this type of work and from the 1983 edition of the Richardson estimating manual. Because of several factors, including the shortness of the construction season, remoteness of the site, long transportation distances, and difficulty in moving materials and construction equipment in and out of the site, costs are expected to be slightly higher than for conducting the work under more suitable conditions. Discussed below are: (1) the basis for unit costs used in estimating major items of work associated with each control method and/or alternative and (2) other cost factors including: mobilization, bonds, and insurance; construction contingency; and contractor overhead and profit.

A brief discussion of the seismic criteria used in developing these control methods, and the basis for calculation of surface runoff and infiltration of precipitation on the site, is also contained in this section since both factors affect design and control costs.

Mobilization, Bonds, and Insurance

Mobilization includes costs incurred by the contractor at the onset of the project to set up, among other things, a field office, communication and sanitation facilities, and to

mobilize and transport equipment to the site of work. Bonds and insurance costs are costs incurred by the contractor in meeting the owners bonds and insurance requirements. Five percent of the total project costs has been assumed for mobilization, bonds, and insurance.

Construction Contingency

A 20 percent contingency has been included in the cost estimates to account for unknown factors which may arise during the course of project design and construction. The contingency amount accounts for unknown soil and groundwater conditions, variations in construction techniques and types of equipment used, and changed field conditions. As detailed design of the best alternative develops, the contingency factor will be gradually reduced to about 10 percent.

Construction Unit Costs

The following presentation of construction unit costs is divided into the major kinds of construction activity involved in the various control methods. As noted in the earlier discussion, these construction unit costs do not include contingency allowance.

A factor of 25 percent has been included in the unit costs to account for contractor overhead and profit. Recent experience with bidding on other projects indicates that contractors are currently willing to bid work on a significantly lower profit margin than that indicated by the use of a 25 percent factor. Because of the uncertainty as to whether and to what extent this phenomena of a weak construction economy will be reflected in bidding on the Leviathan project, the conservative 25 percent factor has been used.

Excavation, Cut, and Fill. This type of work is conducted in localized areas and involves regrading slopes, filling surface depressions, compacting soils, and constructing stream or drainage channels. The work is performed utilizing bulldozers and finish grading equipment. Drum-type soil compactors (sheepsfoot rollers) are usually pulled by bulldozer to satisfy compaction requirements. An estimate of $7.50 per cubic yard has been used for labor and equipment costs associated with this type of work.

Excavation, Grading, Filling, and Compaction. This type of work applies to large excavations where materials are transported over long distances and used for constructing levees, fill slopes, and benches. Equipment involved in this type of work has been assumed to include up to four, 21-cubic-yard capacity scrapers, one pushcat, one dozer-ripper, one roller-dozer, finish grader, water truck, and a foreman

with a pickup truck. Costs, including labor to operate the equipment, have been assumed to range from $1.60 to $1.85 per cubic yard for one-way haul distances of 1,000 feet and 2,000 feet, respectively.

Filling and Grading. Filling and grading is performed by a single bulldozer in localized areas where finish grading and compaction is not essential. The work includes filling surface depressions and generally regrading areas to enhance surface runoff. Costs for labor and equipment are estimated to be approximately $1,900 per acre based on haul distances less than 200 feet.

Riprap. Riprap is placed on the bottom and sides of streams or channels to minimize erosion. Costs for 6- to 10-inch-diameter cobbles delivered to the site are $10 per ton (based on discussions with local suppliers of riprap in the Gardnerville, Nevada, area) plus labor of $2.25 per ton for initial placement and $5.25 per ton for final placement.

Bentonite Liner. Bentonite is mixed at a rate of 6 pounds per square foot into soils placed on the bottom and sides of channels for leakage protection. The bentonite/soil mixture is placed 6 inches thick and subsequently rolled and compacted to finished grade. Material costs for the bentonite delivered to the site is $460 per ton plus $73 per ton for mixing, spreading, rolling, and compacting. This results in a total cost of $1.60 per square foot of channel liner.

Plastic Liner. Material and labor costs to install a plastic liner on the bottom and sides of storage/evaporation ponds to prevent leakage are estimated to be $0.70 per square foot. This includes first laying a fabric-felt base on the bottom on the pond followed by placement of a 36-mil-thick polyvinyl chloride (PVC) liner. For surface protection, the $0.70 per square foot cost includes placing 12 inches of fill material over the top of the liner.

Pipeline Installation. Costs for pipeline installation will vary depending on size of pipe, location, and type of soil conditions encountered. PVC pipe has been selected as the most suitable pipe material because of its excellent corrosion-resistant characteristics. Material costs for 6-, 8-, and 10-inch-diameter Class 200 (145 psi working pressure) PVC pipe are $4.75, $5.50, and $6.25 per foot, respectively. Installation costs, including excavation, backfill, bedding, and equipment range from a low of $9 per foot if the pipe is placed in fill material to $16 per foot if the pipe is placed in native mountainous soils containing about 20 percent rock.

Poured-in-Place Concrete. Costs for poured-in-place concrete are estimated to be $310 per yard for slab on grade construction and $435 per yard for wall or formed construction. Costs include materials, labor, formwork, curing, finishing, and application of a corrosion-resistant coating.

Revegetation. Unit costs for revegetation are presented in Appendix A. Costs are developed for various types and levels of revegetation for each area of the site.

Soil Cement. Soil cement will be applied to the bottom and sides of the drainage channels to prevent erosion and minimize deep percolation of surface flows. The soil cement will consist of a mixture of nonreactive soils and 12 percent by weight of Type V cement. The subgrade of the channel will be compacted to 90 percent relative compaction and covered with 2 feet of compacted nonreactive soils. For large channels such as Leviathan Creek, 9 inches of the soil cement lining will be placed on the bottom with 18 inches placed on the sides. Costs for excavation, compaction, and mixing and placing the soil cement is estimated to be $80 per foot. Costs are based on an 8-foot-wide trapezoidal channel approximately 4 feet deep with 2.5:1 side slopes.

Concrete Channel Lining. Concrete in lieu of soil cement will be used to reach areas such as the drainage ditches located on the benches. The concrete can be pumped from the pit floor directly onto prepared channel surfaces. Prior to concrete placement, the channel bottom will be compacted and then covered with about 6 inches of compacted nonreactive soils. A 4-inch layer of concrete will then be placed over a wire mesh reinforcement formed to the channel cross-section. Total costs for this method of lining is estimated to be $30 per foot based on a trapezoidal channel section approximately 3 feet wide and 3 feet deep.

Seismicity

This section briefly reviews the seismic conditions at the site which were earlier described in Chapter 2, and defines preliminary design criteria used in developing control methods and estimating control costs.

Greensfelder indicates that an unnamed fault located approximately five miles east of the site is capable of generating a maximum credible earthquake of Richter magnitude 6.5, which could generate a peak bedrock acceleration at the site of 0.46 gravity. The corresponding repeatable high bedrock acceleration would be on the order of 0.30 gravity. The duration of a 6.5 magnitude earthquake is estimated to be approximately 18 seconds, and its predominant period would be approximately 35 seconds. The occurrence of such

an event should have only a minimal effect on the site. Local shallow slumping will likely occur on the high 1.5:1 (horizontal:vertical) waste dump and spoil area slopes if left in their present condition. Similar slumping may also occur on the steep natural slopes above the proposed fill on the open pit. This maximum seismic occurrence could also trigger a temporary acceleration of the major landslide on the mine site.

The most significant effect of a maximum earthquake is the possibility of liquefaction of any proposed evaporation ponds or fills within the delta. The delta materials are soft and unsaturated, but significant data are not available to evaluate their liquefaction potential. Additional geotechnical data on the engineering properties of the earth materials should be obtained prior to the design and construction of any evaporation ponds in this area. Placement of fill materials that extend out into the delta, such as may be required on the waste dump to stabilize existing steep slopes, should be preceded by excavation of existing delta soil materials, followed by placement and compaction of fill.

Fill slopes that are constructed with a slope of 2:1 or flatter should perform satisfactorily during an earthquake magnitude of 6.5 or less.

Precipitation Runoff and Infiltration Estimates

Preliminary development of the control methods and subsequent assessment of their water quality benefits requires estimation of existing and expected infiltration and runoff. Although the instantaneous runoff coefficients will vary substantially depending on antecedent soil moisture conditions, precipitation intensity, and duration, average values were developed for use in estimating surface and subsurface drainage flows from precipitation on the site.

These average runoff coefficients were applied to mean annual or mean monthly precipitation levels to estimate quantities of surface and subsurface drainage after construction of the site improvements, and varied depending upon the level of regrading and compaction work performed for each control method.

Estimating soil surfaces over much of the site are extremely loose and permeable. In the uncompacted spoil areas and waste dump, average infiltration coefficients of approximately 90 percent have been used. Where precipitation presently collects in surface depressions and is contained, infiltration coefficients of nearly 100 percent are probable. In general, site improvements such as regrading, compaction, and construction of drainageways increase surface runoff and reduce percolation of water to subsurface drainage. For those control

methods where surface depressions are filled, but the surface of the overall area is not regraded to a controlled elevation to promote general drainage and there is no compaction of filled areas, an infiltration coefficient of 80 percent has been used.

For improvements where regrading of slopes is combined with filling of surface depressions with compaction limited to that resulting from equipment travel over the filled or regraded area, an infiltration coefficient of 60 percent has been used. General regrading of slopes, compaction of the insitu material, and construction of drainageways has been assumed to result in an average infiltration coefficient of 30 percent. In this case, the compaction effort is limited to just the surface materials. Where compaction is controlled and produced in fill by placement of fill material in lifts, the movement of water through the soil will be resisted by a greater thickness of compacted material. Therefore, where construction of drainageways on terraced slopes in fill material compacted in lifts to a 90 percent relative density, the infiltration has been estimated to be 10 percent. The infiltration coefficients which are applicable for each of the different levels of treatment for control methods on each of the major mine elements are described in the following sections for each of the control methods.

PIT AND ADIT CONTROL METHODS

In its present condition, the pit serves as a 50-acre catchment area for precipitation. Rainfall and snowmelt either runs off the unprotected surface area or infiltrates into the groundwater table underlying the pit. The resultant water quality problems are caused by contact of surface and groundwater with the highly mineralized materials in the pit. A large perennial seep surfaces at about elevation 7,050 feet where Adit No. 5 daylights. There is surface runoff discharged from the pit during heavy runoff periods when the depression in the pit fills with water and overflows the breach at the mouth of the pit.

Control Objectives and Applicable Control Methods

The basic objectives to control these two major water quality problems are:

1. Reduce infiltration of precipitation to underlying groundwater by improving surface drainage.

2. Convey surface runoff out of the pit in lined channels that will reduce infiltration and minimize contact with heavily mineralized spoils material.

3. Capture the heavily contaminated groundwater seepage and evaporate it to minimize discharge to Leviathan Creek.

Control of discharges from the open pit and the adit will require regrading of the pit to improve surface drainage characteristics and to minimize infiltration and subsequent recharging of the groundwater table underlying the pit. This can be accomplished by regrading the existing material in the pit or borrow of material from elsewhere on the mine site and construction of a series of fill slopes, benches, and runoff drainage channels. The areas of the pit that will not receive fill material will be regraded to eliminate surface depressions and improve runoff. The infiltration rate for these areas is estimated to be 30 percent. Infiltration rates on the fill slopes and benched areas are estimated to be 10 percent, with an infiltration rate on the remaining areas of 60 percent. Surface runoff from the pit will be discharged to Leviathan Creek. Contaminated groundwater, originating primarily from infiltration of direct precipitation on the open pit, will be collected in an underdrain system at the bottom of the pit and from the adit portal, and piped to evaporation ponds constructed either on or off the site. Depending on the availability of storage pond sites, groundwater collected in the underdrain system will either be evaporated or discharged to Leviathan Creek under controlled conditions.

Four alternative levels of treatment involving surface filling and regrading were analyzed for the pit. The treatment levels range from simple regrading with no filling to on-site borrow of up to 1.8 million cubic yards of material to resurface over 80 percent of the pit. For each level of treatment, an estimate has been made of the (1) total quantity of on-site borrow material to be placed in the pit, (2) percent of pit surface area treated, (3) pre- and post-treatment infiltration and runoff quantities, (4) evaporation pond requirements, (5) flow quantities evaporated and/or discharged to Leviathan Creek, and (6) construction and maintenance costs. Estimated construction costs for the work conducted within the pit include the costs for the ponds, control structures, pipelines, and drainage channels to convey the surface runoff and groundwater to the ponds and/or Leviathan Creek.

Common Features

Common elements associated with each alternative level of treatment considered for the pit include the construction

of (1) fill slopes, runoff collection benches, and drainage channels; (2) rock underdrain system; (3) underdrain control structure; and (4) evaporation/storage ponds.

Slopes, Benches, and Drainage Channels. The fill slopes and runoff collection benches will be constructed of material removed from the waste dump, spoil piles, or other areas that may receive surface regrading and excavation. The material will be placed on 3:1 to 8:1 fill slopes with drainage collection benches located at every 25-foot rise in elevation. Each collection bench will be 15 to 20 feet wide and sloped 2 percent to a drainage channel lined with concrete to collect the surface runoff and minimize infiltration within the pit. Figures 5-1[a] and 5-2 show typical fill slopes and runoff collection benches. The extent of slope and bench construction varies significantly among the four alternative levels of pit treatment. Pipelines constructed on the fill slopes will transport the runoff from the bench drainage channels to a collection header located at the bottom of the pit. The collection header will be constructed through the breach of the pit where the flows will be released into a drainage channel for discharge into Leviathan Creek.

Underdrain System. The underdrain system constructed beneath the bottom of the pit will consist of three trenches filled with drain rock and projecting radially out from a common point located just inside the breach of the pit. The rock-filled trenches will be lined and covered with a filter fabric (to prevent soil clogging) and ~~constructed approximately 20 feet~~ below existing grade (at elevation 7,040 feet). Figure 5-3 shows the configuration of the underdrain system and a typical cross-section through the rock-filled underdrain channel. Alternatively, a simpler and less costly groundwater collector system could be established at shallower depth at the pit mouth and at the portal of Adit No. 5. Functionally, the two configurations would be the same with the primary difference being that the deeper system, extending back into and under the pit, would produce the more rapid emergence of percolated water, thus allowing less time for contamination as the water moves through the mineralized formations. The less extensive system would simply collect the groundwater flows at existing points of emergence.

Underdrain Control Structure. Groundwater flows collected in the underdrain system and at the portal of Adit No. 5 will discharge to a control structure located just outside the

[a]Throughout this report, figures referenced in the text are included at the end of the chapter where first referenced. Plates referenced are included in a map pocket following the appendices.

breach of the pit. The control structure will be designed to regulate the flow of groundwater to the evaporation ponds and/or Leviathan Creek. Flows into the evaporation ponds will be regulated to match the surface acreage of ponds constructed and the net annual evaporation rate at the Leviathan Mine site. Groundwater flows in excess of the estimated evaporation rates from available ponds will be discharged to Leviathan Creek during periods of high flow in the creek. The quantity of surface runoff and groundwater collected in the underdrain system that must be discharged to the creek is directly related to the percentage of the pit area filled and/or regraded.

Evaporation Ponds. Evaporation ponds can be constructed at three locations on the site and off site near the Double Springs Flat area. Pond locations at the site include the top of the waste dump after it is regraded to obtain pit fill (Site 1), the area adjacent to the abandoned crusher structure (Site 2), and on the delta (Site 3). The Double Spring Flat area (Site 4) is located approximately 10 miles east of the mine. Site 1, which can provide a surface area of up to 7 acres would be created by a major excavation and flattening of the top of the waste dump for filling and regrading the pit. Site 2 (providing 1.5 acres) and Site 3 (1.8 acres) are generally flat areas requiring minimal regrading for pond construction. Site 4 can provide over 50 acres of ponds, but will require construction of approximately 10 miles of pipeline to convey collected drainage along the service road entering the mine site.

The evaporation ponds will be excavated to a depth of 2 to 6 feet with some of the excavated material used for constructing perimeter levees. The outside (dry side) of the perimeter levees will be constructed on 2:1 side slopes with the interior of the levees constructed with 3:1 side slopes. A 12-foot wide access/service road will be constructed on top of the perimeter levees around portions of the ponds. A barbed wire fence will also be constructed around the ponds. The ponds will be lined with a 36-mil-thickness reinforced polyvinyl chloride (PVC) liner protected on the bottom with a polypropylene filter fabric. The liner will be buried with 12 inches of earth cover for surface protection. Discussions with EPA staff involved in research for control of toxic and hazardous wastes indicate that:

1. If liners are properly selected, designed, and installed, they should last 50 to 100 years. The U.S. Bureau of Reclamation has lined ponds which have been in use for over 25 years with no known lining deterioration.

2. Key problem is construction. It is imperative to have good quality control during construction, and to have the work done by an experienced contractor.

One foot of storage will be provided in the ponds for accumulation of materials deposited on the pond bottom. To conservatively estimate the expected rate of deposition, it was assumed that:

1. Concentration of total dissolved solids in underdrain flow discharged to the ponds is 10,000 mg/l.

2. Gross evaporation from the pond surface is 34 inches per year. (Net evaporation is about 19 inches per year.) The density of bottom deposits is approximately equal to water.

Based on these assumptions, the deposition rate is estimated to be 0.3 inch per year. It would thus take about 35 years to use up the one foot of storage.

Figure 5-4 shows a typical cross-section through the pond and levees.

At Sites 1 and 4, the pond area will be divided by internal levees into two cells to permit bypassing of all or a portion of the pond. Flows will be distributed into the ponds from pipelines constructed in the levees with feed points piped into each cell. An overflow pipe will be constructed to transfer water from one pond to another in addition to limiting the maximum water level in the pond.

Level 1--Pit Regrading and Runoff Control

This level of treatment will include regrading the existing surface material within the pit to provide approximately 45 percent of the pit surface area with runoff collection benches and drainage channels. The remaining areas of the pit above the sloped and benched sections will be generally regraded to eliminate surface depressions and improve runoff. Pipelines will be constructed on the side slopes from the bench drainage channels to an open transport channel for discharge of collected surface runoff to Leviathan Creek. Contaminated groundwater flows will be collected from the underdrain channel and adit portal and piped to the flow control structure for regulated discharge to either on-site evaporation ponds (Sites 2 and 3) or Leviathan Creek.

The regraded areas of the pit will be constructed with slopes ranging from 8:1 to 16:1. Infiltration rates on the regraded/benched areas are estimated to be 30 percent with infiltration rates on the remaining areas estimated to be 60 percent. Based on these rates, the total quantity of contaminated groundwater that will infiltrate and be collected in the underdrain system and at the adit portal is estimated

to be 9.5 million gallons. Surface runoff from the pit that will be discharged into Leviathan Creek is estimated to be 10.9 million gallons.

Pond acreage required to evaporate the 9.5 million gallons is estimated to be 18.5 acres. Based on the availability of Sites 2 and 3 for pond construction, approximately 1.7 million gallons of the estimated 9.5 million gallons can be evaporated on site. The remaining 7.8 million gallons of contaminated groundwater must be discharged to the creek from the control structure.

Level 2--Filling Pit to Elevation 7,160 Feet

The pit will be filled with approximately 600,000 cubic yards of material excavated from the waste dump. A series of fill slopes and runoff collection benches will be constructed up to elevation 7,160 feet. This quantity of fill material will resurface approximately 37 percent of the pit surface area. Infiltration of precipitation on the fill slopes and benched area of the pit up to elevation 7,160 feet is estimated to be 10 percent.

Infiltration on the upper areas of the pit (above elevation 7,160 feet), that will be generally regraded to eliminate surface depressions and improve runoff, is estimated to be 60 percent. Contaminated groundwater flows will be collected from the underdrain channel and adit portal and piped to the flow control structure for regulated discharge to either on-site evaporation ponds (Sites 1, 2, and 3) or Leviathan Creek.

Because over one-third of the pit area will be resurfaced to reduce infiltration and improve runoff/collection, the total estimated quantity of infiltration collected in the underdrain system and at the adit portal will be approximately 8.5 million gallons annually. Surface runoff from the site that will be discharged to Leviathan Creek is estimated to average 11.9 million gallons annually. Pond requirements to evaporate the 8.5 million gallons of contaminated groundwater are estimated to be 16.5 acres.

Removing approximately 600,000 cubic yards of material from the waste dump will create about 7 acres of level surface area suitable for pond construction. The 7-acre pond site on the waste dump will be located at about elevation 7,030 feet. Based on constructing 10.3 acres of ponds on Sites 1, 2, and 3, approximately 5.3 million gallons of the estimated 8.5 million gallons can be evaporated on site. This requires that only 3.2 million gallons of contaminated groundwater will be discharged to Leviathan Creek from the control structure.

Level 3--Underdrain System and Export

Under this level of treatment, the pit surface will be left in its existing condition, except for the small area where the underdrain system is constructed. An underdrain system will be constructed to collect underground flow from the pit and groundwater seepage from the adit. Because large surface depressions and irregular drainage patterns exist in the pit, infiltration rates of 100 percent have been assumed for precipitation on the pit surface. Based on an average annual precipitation of 15 inches over the 50-acre site (see discussion of "Precipitation at Leviathan Mine" in Chapter 2) and ignoring precipitation losses to evaporation to be conservative, approximately 20.4 million gallons will infiltrate. Contaminated groundwater collected in the underdrain system and at the adit portal will be collected near the breach of the pit and piped to storage and evaporation ponds.

Pond requirements for evaporation of the 20.4 million gallons is estimated to be 40 acres. This is based on a net evaporation rate of 19 inches annually after accounting for the direct precipitation that falls on the ponds. Site 4, near the Double Springs Flat area, will be the only suitable site for constructing the required 40 acres of evaporation ponds. Construction of ponds on Sites 2 and 3, which total only 3.3 acres, will evaporate only 1.7 million gallons of the estimated 20.4 million gallons. Export of the flows to Site 4 will, therefore, require construction of a 10-mile-long pipeline. The pipeline will be installed in the existing service road that leads to the mine from U.S. Highway 395. The pipe will be routed around the landslide area across approximately 4,000 feet of fairly difficult terrain. Beyond the landslide area, the pipe will be installed in the roadway. The pipeline will drop in elevation approximately 1,200 feet requiring that pressure-reducing valves be installed to prevent pressures from exceeding the 145 pounds per square inch (psi) pressure capacity of the pipe. The pipe will be placed in a 24-inch-wide trench excavated to a depth of 4 feet. Pipe bedding materials will be obtained from the spoil areas or classified from the trench excavation to reduce costs associated with importing this material.

Level 4--Filling Pit to Elevation 7,300 Feet

Approximately 1.8 million cubic yards of material will be removed from the waste dump and spoil areas under this alternative to fill and regrade the pit up to elevation 7,300 feet.

Approximately 83 percent of the pit surface area will be sloped and regraded to reduce the infiltration rate to 10 percent. The remainder of the pit will have an infiltration rate of about 60 percent. Surface runoff from direct precipitation will be collected in the bench drainage channels, piped down the fill slopes, and discharged to Leviathan Creek. Contaminated groundwater flows will be collected from the underdrain channels and adit portal and piped directly to evaporation ponds constructed at Sites 1, 2, and 3. The flow control structure will not be required since all the groundwater can be evaporated on site.

Filling and regrading the pit will include initially filling the bottom of the pit to elevation 7,080 feet (20 feet above the existing grade) and constructing the fill slopes, benches, and drainage channels up to elevation 7,300 feet. An estimated 1.8 million yards of fill material will be placed on slopes ranging from 3:1 to 5:1. The area above elevation 7,300 feet will be regraded using existing material to eliminate surface depressions and improve runoff.

The quantity of contaminated groundwater collected in the underdrain system is estimated to be 3.8 million gallons. This quantity is substantially lower than the quantities estimated for the other levels of treatment analyzed primarily because of the larger surface area of the pit that is filled, graded, and provided with bench drainage channels. The pond surface area required to evaporate the estimated 3.8 million gallons and annual precipitation that falls on the ponds is estimated to be 7.4 acres. Based on constructing 8.5 acres of ponds at Sites 1 and 2, all the contaminated groundwater collected could be evaporated, leaving about 15 percent additional storage capacity.

Costs

The costs for construction and maintenance of these four treatment levels are described below.

Construction Costs. The costs for construction of improvements to the pit, and the piping and appurtenances required to convey and evaporate resultant surface and groundwater collected from the pit and Adit No. 5, are presented in Tables 5-1 through 5-4.

These costs are based upon the unit costs presented earlier in this chapter and quantities estimated from 1 inch equals 200 feet topographic maps of the mine site. The export pipeline is based upon estimates of distance and topography available from USGS 15-minute quadrangle maps.

Maintenance Costs. Requirements for maintenance of these alternative treatment levels will be similar and will generally include inspections of the evaporation ponds, adjusting control

Table 5-1. Pit and Adit--Estimated Construction Costs for Level 1

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum	—	45,000
Clean, strip, and level	10 acres	1,520/acre	15,200
Excavation, grading filling, and compaction	110,000 cu.yd.	1.60/cu.yd.	176,000
Bench drainage channels	2,800 feet	30/foot	84,000
Bench drain piping	2,000 feet	29/foot	58,000
Drainage collection header	300 feet	50/foot	15,000
Drainage channel	1,100 feet	60/foot	66,000
Limestone rock underdrain channel	850 feet	120/foot	102,000
Flow collection structures			
Pit breach	1 each	5,000 each	5,000
Adit portal	1 each	8,000 each	8,000
Control structure	1 each	9,500 each	9,500
Transport piping to ponds	1,600 feet	15/foot	24,000
Storage/evaporation ponds			
Site 2	Lump sum		75,800
Site 3	Lump sum		82,200
Subtotal			765,700
Contingency (20 percent)			153,300
Total			919,000

Table 5-2. Pit and Adit—Estimated Construction Costs for Level 2

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum	—	116,000
Clean, strip pit, and level	10 acres	1,520/acre	15,200
Waste dump excavation/ pit fill and regrade	600,000 cy.yd.	1.85/cu.yd.	1,110,000
Bench drainage channels	2,200 feet	30/foot	66,000
Bench drain piping	1,800 feet	29/foot	52,000
Drainage collection header	300 feet	50/foot	15,000
Drainage channel	1,100 feet	60/foot	66,000
Limestone rock underdrain channel	850 feet	120/foot	102,000
Flow collection structures			
Pit breach	1 each	5,000 each	5,000
Adit portal	1 each	8,000 each	8,000
Control structure	1 each	9,500 each	9,500
Transport piping	2,300 feet	15/foot	34,500
Storage/evaporation ponds			
Site 1	Lump sum		400,000
Site 2	Lump sum		75,800
Site 3	Lump sum		82,200[a]
Subtotal			2,157,200
Contingency (20 percent)			431,800
Total			2,589,000

[a]Pond excavation for Site 3 included in costs for waste dump excavation.

Table 5-3. Pit and Adit—Estimated Construction Costs for Level 3

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum		166,000
Limestone rock underdrain channel	850 feet	120/foot	102,000
Flow collection structures			
Pit breach	1 each	5,000 each	5,000
Adit portal	1 each	8,000 each	8,000
Pipeline (roadway installation)	51,000 feet	25/foot	1,275,000
Pipeline (landslide bypass)	4,000 feet	50/foot	200,000
Pressure-reducing stations	6 each	9,000 each	54,000
Evaporation ponds			
Site 4—40 acres	Lump sum		1,670,000
Subtotal			3,480,000
Contingency (20 percent)			696,000
Total			4,176,000

Table 5-4. Pit and Adit—Estimated Construction Costs for Level 4

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum	—	200,000
Clean and strip	10 acres	1,520/acre	15,200
Excavation/pit fill and regrade	1,800,000 cu.yd.	1.85/cu.yd.	3,330,000
Bench drainage channels	15,100 L.F.	30/L.F.	453,000
Bench drain piping	4,000 L.F.	29/L.F.	116,000
Drainage collection header	600 L.F.	50/L.F.	30,000
Drainage channel	1,100 feet	60/foot	66,000
Limestone rock underdrain channel	850 L.F.	120/L.F.	102,000
Flow collection structures			
Pit breach	1 each	5,000 each	5,000
Adit portal	1 each	8,000 each	8,000
Transport piping	1,200 feet	15/foot	18,000
Storage/evaporation ponds			
Site 1	Lump sum		400,000
Site 2	Lump sum		75,800
Subtotal			4,819,000
Contingency (20 percent)			964,000
Total			5,783,000

of discharge from the control structure to the evaporation ponds and Leviathan Creek, and cleanup of the paved bench drainage channels to remove rocks and debris. Routine inspections of the site would take about 4 hours and could be conducted by one person. Costs are based on $25 per hour or $100 per site inspection. During periods of high flows in the creek when water will most likely be released to the creek from the control structure, several inspections should probably be scheduled over about a three-month period.

Each year, the bench drainage channels should be cleaned of rocks and debris to assure good drainage. A three-man crew working full time for one to two weeks will be adequate to perform this task. Annual costs are estimated to be about $10,000 for labor, equipment, and disposal of debris. Total annual costs for maintenance of these treatment levels are estimated to be about $20,000.

The export pipeline will have much higher maintenance costs. Routine, regular inspections will be necessary to assure proper operation of pressure-regulating valves and all control valves. The life expectancy for this line is estimated to be about 50 years, so at the end of the 50-year project period it will have to be replaced.

WASTE DUMP, DELTA, AND SPOIL AREAS B AND C CONTROL METHODS

It was not possible to clearly separate the contribution of pollutant loading from these four sources so they have been evaluated together as a single source throughout this report. In this chapter, this grouping of problem areas will be referred to as the waste dump.

It appears that Spoil Areas B and C do not contribute significantly to pollution of Leviathan Creek. The major cause of polluted surface runoff and seepage is caused by Leviathan Creek and the other two major unnamed tributaries on the northwest and southwest corners of the waste dump. These large drainages contribute to the heavy total dissolved solids (TDS), metals, and acid loadings in Leviathan Creek because of:

1. The extremely heavy channel and bank erosion experienced along their alignments through the waste dump and delta.

2. The seepage through the waste dump and adjacent spoils which results from infiltration out of the bottom of the creek channels that have vertical alignments above the waste dump.

In addition, there are relatively flat areas and depressions on the waste dump which infiltrate incident precipitation and result in heavily contaminated seepage into Leviathan Creek. There are also several heavily eroding areas on the northeast side of the waste dump.

Control Objectives and
Applicable Control Methods

The objectives for controlling the waste dump problems are to eliminate erosion and infiltration of tributary creeks and infiltration of precipitation. Control of the water quality problems associated with the waste dump will depend on the following three applicable methods:

1. Channelization and lining of tributary creeks.

2. Regrading of surface depressions and flat areas to reduce infiltration.

3. Revegetation of regraded areas to further reduce percolation by encouraging transpiration of incident precipitation.

Two levels of application of these methods, referred to as Levels 1 and 2, are described below.

Level 1--Minimum Regrading

Surface regrading will be limited to only that required to eliminate surface depressions on the waste dump. The steep side slopes on the north side of the waste dump will remain in their present state.

The present alignment of Leviathan Creek will be filled and graded, and the creek will be rerouted along the south and west sides of the waste dump. The other two unnamed tributaries will also be intercepted and routed in this engineered channel, which will be lined to minimize infiltration losses past the waste dump and delta.

Creek Relocation and Channelization. The new channel will follow the general alignment of an existing channel that was formed around the western edge of the waste dump when the spoils were deposited in the natural creek channels. The new alignment will combine the flows in Leviathan Creek with the two tributary creeks located on the west side of the waste dump.

Based on expected methods of construction of the channel side slopes, and the size of equipment used, the channel section will be designed to convey 150 cubic feet per second

(cfs) at the design velocity generally under 5 feet per second. With this cross-section, it will have the capacity to convey 300 cfs without overtopping.

The channel will be approximately 8 feet wide and 3 to 4 feet deep with 2:1 side slopes where topography permits. Benches will be located where possible on one or both sides of the channel section to prevent runoff and erosion of native or waste dump material into the creek. Water depths will vary from 1 to 2 feet with velocities ranging from 3.5 to 8 feet per second (fps). The bottom and sides of the channel will be treated with soil cement to reduce infiltration losses. To install the soil cement and provide protection from the extremely active spoils material, the channel sections will first be graded with waste dump materials and then covered with 2 feet of nonreactive soils. A 9-inch bottom layer and 18-inch side layer, consisting of 12 percent by weight of cement mixed with native soil obtained from an undisturbed area of the site that is not contaminated with mining spoils, will then be placed, final graded, and compacted to 90 percent relative compaction. Riprap will be placed over the soil cement liner as required to prevent erosion in the steeper sections.

The steep topography in the final section of channel which drops down onto the delta will require that a concrete section be constructed. The channel will be designed approximately 4 feet wide and 2.5 feet deep and will carry the design flow with velocities approaching 40 fps.

In the delta, the bottom of the channel will be elevated to approximately match the grade level of the existing delta deposits to prevent the migration of contaminated water from the delta into the creek. The channel will be constructed on cut and fill material above the existing creek alignment.

Waste Dump Regrading. Excavation, filling, and regrading of the waste dump in Level 1 will be limited to about 50,000 cubic yards. This work will just include that required to reduce infiltration on the flat areas and depressions near the top of the waste dump, filling the existing creek channel and regrading it back to match adjacent topography and regrading of the two existing areas of heavy erosion on the north face of the waste dump.

Level 2--Regrading and Ponds

In addition to reducing water quality problems caused by the present creek alignments and reducing infiltration into the waste dump from precipitation, the objective of this alternative is to provide a site for additional evaporation ponds.

Regrading and Ponds. Approximately 600,000 cubic yards of material will be excavated from the waste dump and used for fill in the pit. The waste dump will be excavated down to about elevation 7,030 and 7 acres of ponds constructed on the resulting flat surface. This will leave a buffer of about 50 feet between the north and east faces of the waste dump and the pond. The pond will be separated into two cells and lined to prevent seepage through the bottom and sides.

The north and east faces of the waste dump will be regraded and benched with 2:1 side slopes. Benches and drainage conveyance ditches will be similar to those shown on Figure 5-2 for the pit regrading work. To maximize the area available for construction of ponds on the waste dump, fill will also be placed and compacted on the north face of the waste dump to extend it 50 to 60 feet out into the delta.

Creek Relocation and Channelization. Three major drainages must be conveyed around the waste dump. These are Leviathan Creek and its two tributaries on the northwest and southwest corners of the waste dump. Leviathan Creek will be rerouted in an engineered channel section that will be located just east of its present alignment. The southwest tributary will be rerouted across the south end of the waste dump in an engineered and sealed channel and combined with Leviathan Creek. A small unlined drainage channel will extend across the west side of the waste dump to collect and convey localized drainage. This will discharge into a large engineered and lined channel that will convey the northwest tributary across the north end of the waste dump and into Leviathan Creek. The channel alignment through the delta will be the same as Level 1.

Costs

The costs for construction and maintenance of the two levels of control for the waste dump are presented below.

Construction Costs. The costs for construction of Levels 1 and 2, based upon earthwork quantities estimated from profile cross-sections and the unit costs presented earlier in this chapter, are shown in Tables 5-5 and 5-6.

Maintenance Costs. Maintenance will be limited to periodic inspections of the site to verify proper operation of the pond inlets and overflows, inspect the creek channels, remove any logs or debris from the channels that could potentially cause erosion or flow blockages, and repair any erosion or drainage ditch problems on the regraded slopes. The costs will be about the same for either control level and are estimated to be about $10,000 annually. This will provide for several site inspections during the year and three people working at the site for about one week per year.

Table 5-5. Waste Dump--Estimated Construction Costs for Level 1

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum		15,000
Waste dump			
Cut, fill, and regrade	50,000 cu.yd.	1.70/cu.yd.	85,000
Fill and regrade present alignment of Leviathan Creek	6,000 cu.yd.	1.70/cu.yd.	10,000
Leviathan Creek relocation	3,400 feet	80/foot	272,000
Concrete channel	260 cu.yd.	375/cu.yd.	97,400
Riprap	4,700 tons	18.50/ton	87,000
Subtotal			566,400
Contingencies (20 percent)			113,600
Total			680,000

Table 5-6. Waste Dump--Estimated Construction Costs for Level 2

Item	Estimated quantity	Unit price, dollars	Total cost, dollars
Mobilization	Lump sum		80,000
Waste dump			
Excavation[a]	600,000 cu.yd.	1.85/cu.yd.	1,110,000
Evaporation ponds[a]	Lump sum		558,000
Fill and regrade north and east sides	31,000 cu.yd.	1.70/cu.yd.	53,000
Tributary flow channelization	1,300 feet	46/foot	59,800
Leviathan Creek relocation	2,000 feet	80/foot	160,000
Subtotal			2,020,800
Contingencies (20 percent)			404,160
Total			2,424,960

[a]Costs included in pit regrading and runoff control--Level 2.

SPOIL AREA A CONTROL METHODS

Spoil Area A is an area of approximately 104 acres on the northerly side of the open pit. Excess materials excavated during the initial construction of the open pit and during the mining of the pit were placed in this area without careful compaction. Aspen Creek runs generally along the northern boundary of the spoil pile and receives drainage from the area. The water quality problems associated with the spoil pile are therefore found both in Aspen Creek along the site and in Leviathan Creek below the site.

Because the surface of most of Spoil Area A is loose, granular material, little of the incident precipitation reaches Aspen Creek as direct runoff. Direct runoff probably occurs in significant amounts only during very intense rainfall, storms which last several days, or when snowmelt occurs over frozen ground. Infiltration on the spoil pile is increased by the presence of a large number of depressions and areas where runoff can be trapped in ponds behind dams formed from the construction of roads across the spoil materials. Infiltrating water comes in contact with sulfide-rich spoil materials and becomes contaminated. Perennial surface seeps apparently fed by infiltrated water exist on the spoil pile. Their locations, along with the locations and sizes of the surface depressions are shown on Figure 2-21. Water quality from these seeps is poor with characteristic pH of 3.5 to 4 and specific conductances of 1,500 to 3,000 umhos/cm. However, flow from the seeps does not normally reach Aspen Creek as surface flow, but infiltrates back into the spoil materials and into native materials at the top of the landslide.

In addition to decreasing the water quality of Aspen Creek, infiltration on Spoil Area A is apparently the source of moisture which lubricates the slippage plane of the landslide. Several depressions are in areas of obvious slippage or subsidence. These areas are likely near the head of the slide. Water which infiltrates on Spoil Area A may emerge at the surface of the landslide. Some of the Leviathan Creek water quality problems associated with the landslide may therefore have their source in Spoil Area A.

Control Objectives and Applicable Control Methods

Control of water quality problems associated with Spoil Area A depends on control of infiltration and percolation of water through the spoil materials. The control methods which are generally applicable to the area are regrading to improve surface runoff, stabilization of slopes, and revegetation.

Two levels of application have been developed to achieve separate sets of design criteria for the stability of slopes and enhancement of surface runoff. These levels of application will be referred to as Levels 1 and 2.

Level 1--Minimum Surface Drainage Improvements. The highest priority work on the spoil pile is the filling of surface depressions and regrading to allow for unimpeded surface runoff. This work is referred to as Level 1 treatment. In most cases, the topographic information indicates that drainage currently occurs or has occurred in the past along these same routes. Subsidence and slippage from the landslide and blockage created by road construction have interrupted these drainage patterns. As the depressions get larger and more water infiltrates, slippage and subsidence are more likely to occur, thus aggravating and accelerating the problem.

To promote surface drainage, slopes of 2 to 3 percent should be maintained in the drainageways. Regrading work should be done with suitable compaction and slight overfilling to provide positive drainage after some settling has occurred. Definite surface channels should be established, but they need not be lined or finely graded. A relatively large channel, constructed by bulldozer would be adequate to drastically improve runoff. Where slopes are steep enough to produce velocities greater than 2.5 feet per second (fps), some type of gully erosion control is required. The steeper sections of channel will be filled with 4-inch-diameter or larger rock, randomly placed in the channel. Velocities are calculated using the tributary area of the channel, assuming 100 percent runoff from a 20-year return frequency storm of 2 hours duration. Because hourly intensity-duration-frequency data exists for Markleeville but not for Leviathan Mine, the 20-year storm at the mine has been assumed to be of approximately the same duration and intensity as at Markleeville. Although Leviathan Mine receives less annual precipitation than Markleeville, this assumption is probably fairly accurate for short storms (2 hours duration).

Level 2--Drainage Improvement and Slope Stabilization. Level 2 treatment of Spoil Area A includes all of the drainageway measures discussed for Level 1 treatment. In addition, Level 2 includes measures designed to more permanently stabilize the slopes and drainageways on the spoil pile.

All spoil area slopes will be regraded 2:1 (horizontal: vertical) and terraces constructed to limit slope length to 50 feet. Provision for drainage off the terraces will be made in asphalt, clay, or soil cement-lined earth channels. Where design flow velocities exceed 7.5 fps, riprap and vegetative protection will be used to stabilize the channels. After regrading, terrace slopes will be revegetated to improve long-term stability. Revegetation density will vary with

slope steepness from no revegetation on slopes flatter than 4:1 to approximately 3,000 plants per acre on 2:1 slopes. Although Level 2 does not impact water quality problem sources as directly as Level 1, some additional improvement is probable. Higher vegetation densities will enhance evapotranspiration, thus limiting the volume of infiltrating water. Improved slope stability will make the constructed drainageways more permanent, and will reduce sediment load to the creek.

The landslide is likely to continue to cause some subsidence in this area, although this solution should help reduce slippage. It may be necessary to redo this work in the future if landslide slippage continues at the present rate. If the perceived water quality and landslide stabilization benefits do not appear significant at that time, no additional work will be warranted.

Costs

The estimated costs of construction and maintenance of the two Spoil Area A treatment levels are presented below.

Construction Costs. Costs for construction of the improvements to the two treatment levels have been developed using the unit cost and design criteria described in a previous section of this chapter. The earthwork quantities have been estimated from profile cross-sections for surface depressions, drainage channels, and slopes. Costs for rock protection of channels were estimated based on 1 foot of rockfill in a 10-foot-wide channel. Table 5-7 presents the total quantities required for each treatment level, their unit costs, and the total construction costs for the three levels.

Maintenance. Some need for maintenance exists with all of the Spoil Area A treatment alternatives. Occasional cleaning of drainageways may be required for Level 1 due to unstable slopes. Level 2 includes areas of fairly intensive revegetation. These areas will require maintenance during the first few years after planting as described in Appendix A. Estimated annual costs for maintenance are presented in Table 5-8.

CONTROL EFFECTIVENESS

For purposes of comparison, the effectiveness of each level of control was estimated in terms of the expected reduction in TDS loading to the creeks. Although this comparison does not lead directly to estimation of resulting water quality in Leviathan and Aspen Creeks, it does provide a means to compare the cost-effectiveness relationships between alternative levels of control for each of the mine elements. These comparisons

Table 5-7. Spoil Area A--Estimated Construction Costs for Alternative Treatment Levels

Description	Unit price, dollars	Estimated Quantity	Total cost, dollars
Level 1			
Regrading of surface depressions	1.25/cu.yd.	22,000 cu.yd.	27,500
Regrading of drainageways	1.55/cu.yd.	8,100 cu.yd.	12,600
Erosion protection for drainageways (rockfill)	18.50/ton	2,100 tons	38,900
Culvert installation, 18-inch-diameter	40/foot	300 feet	12,000
Subtotal			91,000
Contingency (20 percent)			18,200
Level 1 Total			109,200
Level 2			
Level 1 treatment	Lump sum		91,000
Regrading slopes to 2:1	1.60/yard	120,000 cu.yd.	192,000
Revegetation on slopes	3,500/acre	15 acres	52,500
Subtotal			335,500
Contingency (20 percent)			67,100
Level 2 Total			402,600

Table 5-8. Spoil Area A--Estimated Maintenance Costs for Alternative Treatment Levels

Alternative Treatment	Description	Annual cost, dollars	Five-year total cost, dollars
Level 1	Cleaning of drainageways	2,000	10,000
Level 2	Revegetation monitoring/ replanting program; cleaning of drainageways	7,000[a]	25,000

[a]First three years only. Cost is $2,000 per year thereafter.

are useful in determining what type or level of work is most effective for control on each mine element and in refining and combining control levels into alternative projects for the entire site.

To estimate the amount of correction obtained from each level of treatment, the average annual load prior to improvements must be calculated. This load was estimated as follows:

1. The total TDS load during water year 1982 from the site was calculated using electrical conductivity and flow data for Stations 1, 17, and 22 on Leviathan and Aspen Creeks. The calculated load was 2,550 tons per year of TDS.

2. The total annual load in 1982 was multiplied by the ratio of mean annual precipitation at Woodfords to the 1982 annual precipitation at Woodfords. This resulted in a mean annual load of 1,680 tons per year of TDS from the site.

3. The results of the mass balances described in Chapter 3 were used to find the annual TDS loads from specific areas of the site. The resultant contribution of TDS load from each of the three major problem areas on an annual mean basis was estimated to be as follows: pit and adit--35 percent or about 600 tons; waste dump, delta, Spoil Areas B and C--39 percent or about 655 tons; and landslide and Spoil Area A--26 percent or about 436 tons.

Pit and Adit

The TDS loading from the pit and adit has two sources--surface runoff and subsurface drainage. For the purposes of these loading calculations, the concentrations were taken as 500 mg/l TDS for surface runoff and 7,200 mg/l TDS for subsurface drainage. The value for subsurface drainage was obtained from the electrical conductivity data for flows from the adit during 1981 and 1982. Surface runoff was not directly sampled at the site for conditions comparable to those expected after pit regrading, and the concentration of surface runoff can therefore not be directly estimated. The value of 500 mg/l was chosen by reviewing the available data and selecting sites where subsurface drainage was exposed to spoils material for a limited time. The TDS concentration in these sources was about 400 to 500 mg/l. Since the future surface runoff will also be exposed to spoils material for a very limited time, it was felt that the data from these sites was representative of future surface runoff quality. The control methods that involve regrading and benching to improve surface drainage also include lined drainage

ditches. The intent is to minimize the time when surface runoff is in direct contact with spoils materials, so travel distances are limited. The water quality of surface runoff should thus be substantially better than subsurface flow.

A water balance for water years 1981 and 1982 was developed for the pit and adit to determine whether regional groundwater was contributing to the flows and associated TDS loads discharged from the pit and adit. This balance was based on the following:

1. Precipitation levels at Woodfords adjusted down by a factor of 0.7 to represent Leviathan precipitation.

2. Precipitation loss to evaporation of 10 percent.

3. Pit surface discharge (Station 3) and adit seep discharge (Station 2) reported as daily mean flow by the USGS from their continuous recording stations.

This analysis showed that for water year 1981 the combined surface and subsurface discharges from the pit and adit were slightly greater than the estimated precipitation adjusted for evaporation. For water year 1982, the opposite was true (i.e., outflows were less than precipitation). Water years 1980 and 1982 were above normal precipitation and water year 1981 was below normal. Based on the description of mine pit hydrogeology presented in Chapter 2, subsurface discharges would be expected to substantially lag precipitation, and this comparison shows this lag could be as much as a year.

This analysis shows that on a mean annual basis, pit and adit outflows approximately match annual precipitation.

The calculations of TDS load therefore assume that the total annual precipitation is equal to the total annual outflow (sum of surface and subsurface flows). The calculations are made for a year in which the mean annual precipitation occurs. The ratio of surface runoff and subsurface drainage to total outflow are found by using the estimates of runoff/infiltration coefficients for specific regrading work, and the areas to which the regrading work applies.

Level 1. Roughly 45 percent of the pit's watershed area will be regraded, benched, and provided with drainage ditches. The regraded and benched areas will be constructed using existing materials in the pit; no fill material from outside the pit will be used. An infiltration coefficient of 30 percent is used for the regraded areas and 60 percent for the ungraded areas. This results in annual TDS loads of 301 tons per year from the subsurface drainage and 24 tons per year from the

surface runoff for a total of 325 tons/year from the pit and adit. Approximately 3.3 acres of evaporation ponds will be constructed in conjunction with the pit grading work in this level. This provides a total net annual evaporation of 5.2 acre-feet, which reduces the TDS load from the subsurface drainage system by an additional 50 tons per year. The annual TDS load to the creek for Level 1 treatment is therefore 275 tons per year (600 tons minus 325 tons).

Level 2. Roughly 45 percent of the pit watershed is regraded with fill material. An infiltration rate of 10 percent on the filled area and 60 percent on the remainder of the pit yields TDS loads of 244 tons per year from the subsurface drainage and 28 tons per year from the surface runoff for a total of 272 tons per year. In this level, 10.3 acres of evaporation ponds are constructed, removing 159 tons per year of TDS load. The total TDS load to the creek for Level 2 is therefore 272 tons per year minus 159 tons per year or 113 tons per year.

Level 3. This treatment of the pit includes construction of a subsurface drainage collection system and an export pipeline. There is no surface runoff from the pit to the creek. Because the entire subsurface drainage flow is exported off site, the resulting TDS load to the creek is zero for Level 3.

Level 4. Roughly 83 percent of the pit area will be filled and regraded. Again, using infiltration coefficients of 10 and 60 percent on the filled and ungraded areas, respectively, the TDS loads are calculated as 121 tons per year from the subsurface drainage and 37 tons per year from the surface runoff for a total load of 158 tons per year. The pond area constructed in this level is 8.5 acres, which would allow evaporation of the entire subsurface drainage flow. The total annual TDS load to the creek for Level 4 is therefore 37 tons per year.

Waste Dump, Delta, Spoil Areas B and C

The procedure for comparing the effectiveness of treatment level for the waste dump is similar to that for the pit and adit. In this case, however, the mass balance figures apply to the combined loads from the waste dump, delta, and Spoil Areas B and C. The procedure therefore includes the creek channelization work with two levels of treatment for the waste dump and estimates the total reduction in TDS load.

After improvements, the sources of TDS load to the creek are seepage through the waste dump and spoil materials caused by infiltration of incident precipitation and lack of complete control of the combined loads by the creek channelization work.

Infiltration through the waste dump can be estimated for each of the two levels of treatment using infiltration rate estimates in a manner similar to that used in the pit. The quality of surface runoff is estimated to be similar to that from the pit, with a TDS concentration of 500 mg/l. Seepage from the waste dump will have higher concentrations. Using data for seeps from spoil materials at other locations on the site, the TDS concentration of waste dump seepage resulting from infiltration was estimated at 3,000 mg/l. As in the calculations for the pit, the TDS loads are calculated by estimating infiltration coefficients for areas which receive specific types of regrading or other improvement work.

In Level 1 treatment of the waste dump, only very minor regrading work (filling surface depressions) is required. Therefore, an infiltration coefficient of 80 percent is applied to the area. Assuming that all of the incident precipitation on the waste dump eventually reaches the creek as surface runoff or seepage, an annual TDS load of 106 tons per year is produced by this source.

To estimate the total combined load from the waste dump, delta, and Spoil Areas B and C, the control effectiveness of the creek channelization must also be analyzed. First, the load which currently comes from incident precipitation on the waste dump must be estimated. Using an infiltration coefficient of 90 percent, this load is calculated at 117 tons per year. Based on the estimated average annual load of 655 tons per year from the waste dump, delta, and spoil areas combined, the load without the contribution from precipitation on the waste dump is calculated as 538 tons per year (655 minus 117 tons per year). This remaining load is assumed to be nearly completely eliminated by channelization of the creeks. The resulting TDS load to the creek is calculated at 10 percent of 538 tons per year (54 tons per year) plus the 106 tons per year which come from precipitation at the waste dump. The total TDS load after improvements is therefore 160 tons per year (106 plus 54 tons per year). The total average annual TDS load reduction for Level 1 is thus calculated to be 495 tons per year (655 minus 160 tons per year).

In Level 2, approximately 7.0 acres of the waste dump area are used for ponds. Approximately 50 percent of the remaining waste dump area is regraded with benches and drainage improvements, and 50 percent receives only very minor regrading. Infiltration coefficients of 30 percent for regraded and benched areas, no infiltration for ponds, and 80 percent for areas which receive minor regrading are used. The TDS load from incident precipitation on the waste dump for this level of treatment is calculated as 66 tons per year. The load reduction from channelization of the creek is taken as the same as for Level 1.

The resulting average annual TDS load to the creek is therefore 120 tons per year (66 plus 54 tons per year), and the TDS load reduction is 535 tons per year (655 minus 120 tons per year).

Spoil Area A and Landslide

Evaluation of control effectiveness on Spoil Area A is similar to that for other site areas. TDS concentrations of 500 mg/l for the surface runoff and 3,000 mg/l for the subsurface seepage are again used to estimate loads after improvement. The existing problem is assumed to be the result of high infiltration and resulting seepage on the spoil pile.

Level 1 work primarily eliminates surface depressions. Because the total catchment area for the depressions is nearly 60 percent of the total spoil pile area, 80 percent of the infiltration problem is assumed eliminated by regrading of the surface depression. This yields a 67 percent reduction in TDS load after the surface runoff is included. The existing average annual TDS load is estimated at 235 tons per year. Therefore, the TDS load after improvements is estimated at 78 tons per year and the TDS load reduction is 157 tons per year.

Level 2 treatment of Spoil Area A further reduces infiltration and includes revegetation to stabilize slopes and increase evapotranspiration. The load reduction for this level of treatment is estimated at 75 percent for a load reduction of 176 tons per year. The remaining load discharged to the creek is 59 tons per year.

Although no work is envisioned on the landslide, improvement of Spoil Area A drainage is expected to have a positive effect on drying out the slippage plane of the landslide and reducing the flow of seepage from the landslide to the creek. Conservatively, the load reduction resulting on the landslide from regrading on Spoil Area A is estimated at 20 percent. This reduction is the same for both Levels 1 and 2 treatment on Spoil Area A. The existing load is estimated at 201 tons per year from the mass balance work. The load reduction is therefore 40 tons per year, and the resultant load discharged to the creek is 161 tons per year.

The total TDS load discharged to the creek from Spoil Area A and the landslide under Level 1 treatment is thus 239 tons per year (78 plus 161), and is 220 tons per year (59 plus 161) for Level 2.

Level 3 treatment of Spoil Area A involves removal of approximately 1.2 million cubic yards of material for placement in the pit. This level of work allows further reduction of slope steepness from that obtained in Level 2. Major regrading

will increase the percentage of runoff from the spoil area and increase the estimated reduction in TDS load. The resulting load reduction is estimated at 80 percent for a load reduction of 188 tons per year. The remaining TDS load discharged to the creek is 47 tons per year. The load reduction from the landslide can be expected to increase slightly to about 25 percent, and the resultant load discharged to the creek is thus 151 tons per year. The total load discharged from Spoil Area A and the landslide is thus 198 tons per year.

Cost-Effectiveness

The total TDS load removed by each level on an annual basis is calculated by subtracting the calculated loads to the creek from the estimated average annual load. Table 5-9 presents the results of the TDS load calculations for each of the levels of treatment for each mine element. The estimated construction cost was used to compute unit removal costs ($/ton TDS load removed/year), which is also shown in the table for each treatment level.

Table 5-9. Control Method Cost-Effectiveness

Control level	Estimated construction cost, million dollars	Estimated average annual TDS load to creek		TDS load removed, tons/year	Unit removal cost, dollars/ton removed/year
		Existing tons/year	After improvements, tons/year		
Pit and Adit					
Level 1	0.92	600	275	325	2,830
Level 2	2.59	600	113	487	5,320
Level 3	4.18	600	0	600	6,970
Level 4	5.78	600	37	563	10,270
Waste Dump, Delta, and Spoil Areas B and C					
Level 1	0.68	655	160	495	1,300
Level 2	2.42	655	120	535	4,520
Spoil Area A and Landslide					
Level 1	0.11	436	239	197	560
Level 2	0.40	436	220	216	1,850
Level 3	--[a]	436	198	238	--[a]

[a]Cost included in costs for Level 4 of the pit and adit.

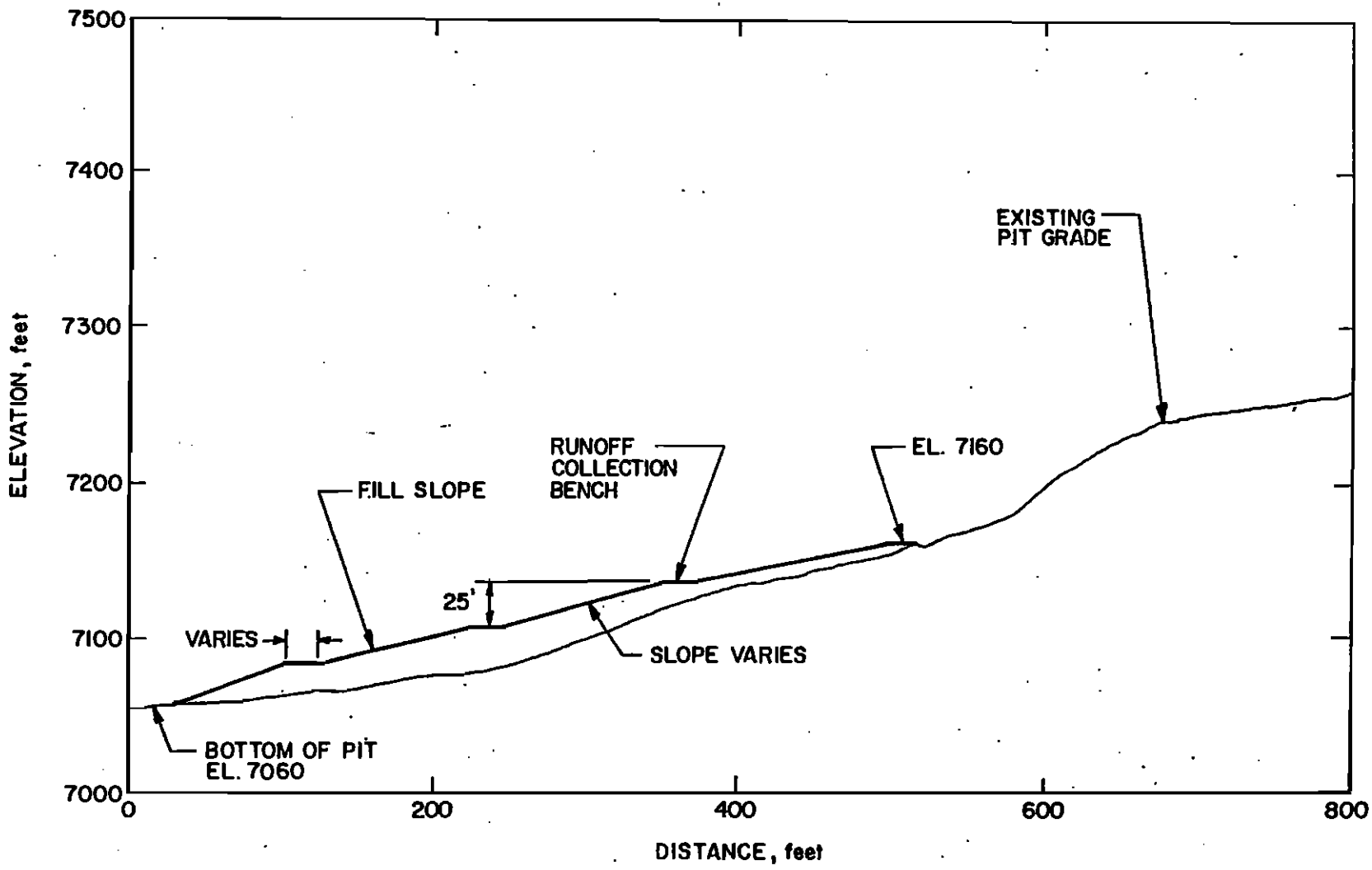


Figure 5-1 Typical Pit Fill Slopes and Runoff Collection Benches

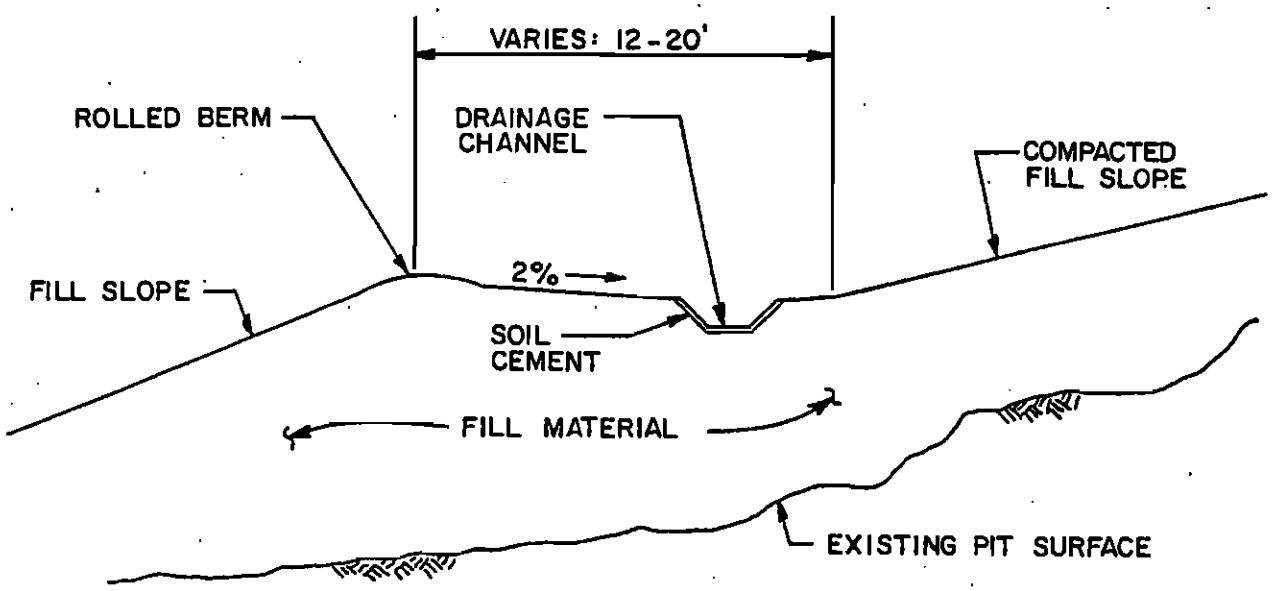
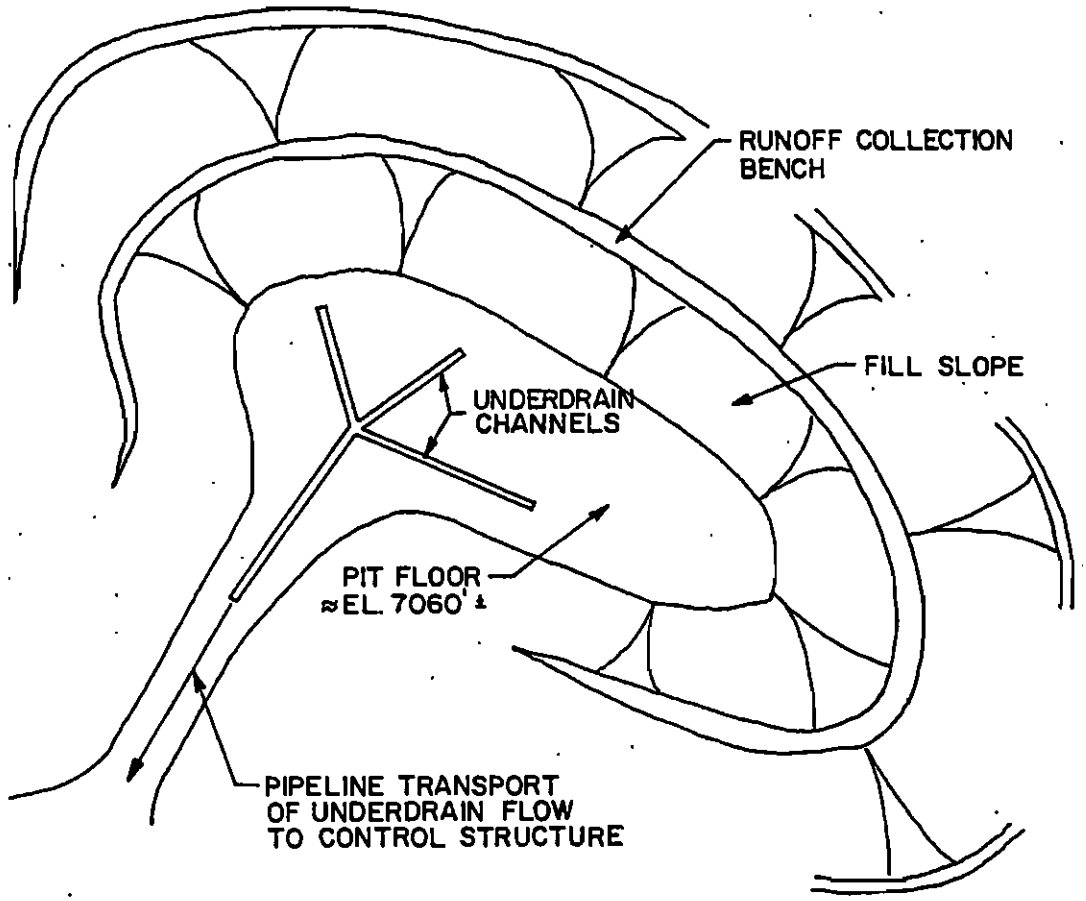
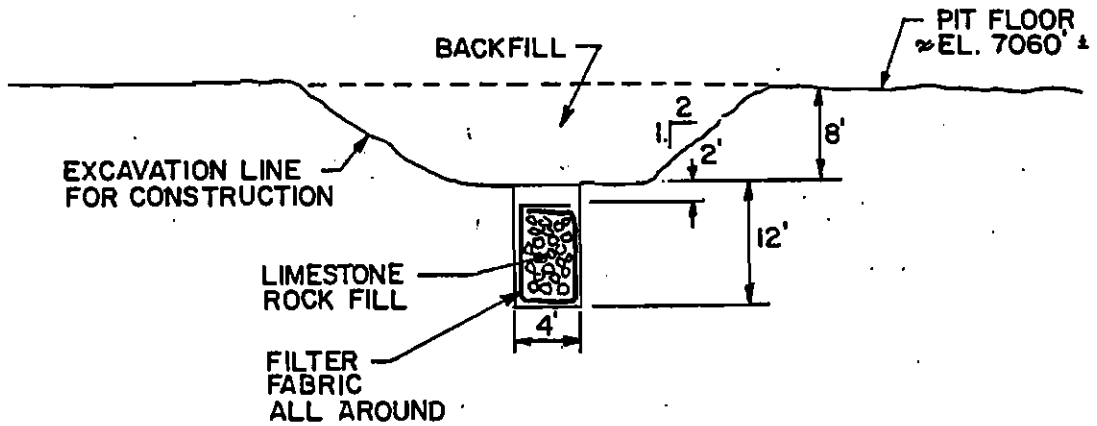


Figure 5-2 Typical Runoff Collection Bench With Drainage Channel



PLAN



SECTION THROUGH CHANNEL

Figure 5-3 Limestone Rock Underdrain System

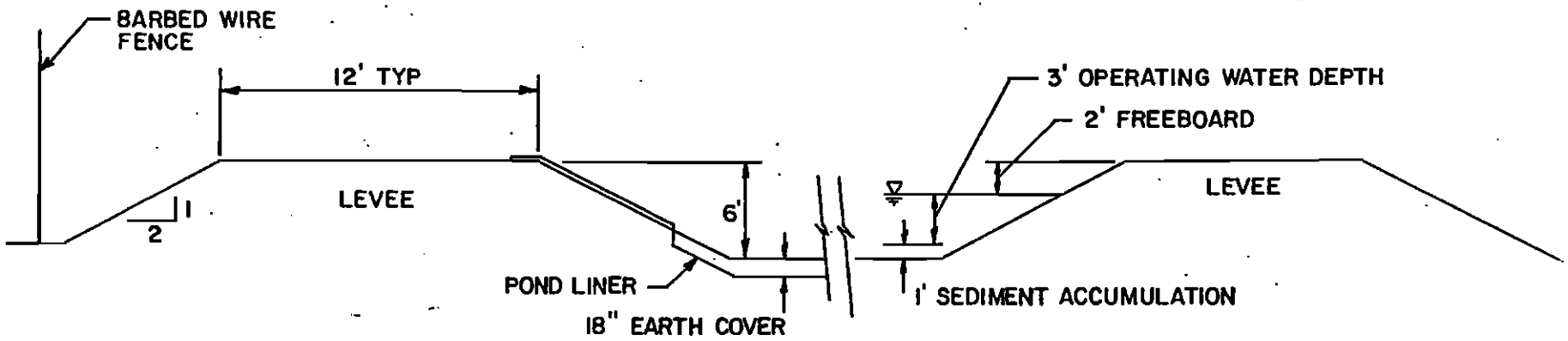


Figure 5-4 Typical Section Through Evaporation Pond

CHAPTER 6

ALTERNATIVE PROJECTS EVALUATION

The control methods which were developed in sufficient detail in the preceding chapter to allow an estimate of probable construction costs are combined in this chapter into seven alternative projects varying in cost from about $2 million to $6 million. These alternatives are then analyzed for their cost-effectiveness, both in terms of reduction of pollutant loading at the mine site and protection levels for the beneficial uses of Leviathan Creek.

To evaluate the impacts of the alternatives on the water quality of Aspen and Leviathan Creeks, it is important to consider not only the total dissolved solids (TDS) load reduction but also the resultant concentration of TDS and other important parameters in the creeks. The procedures used in this section to analyze water quality benefits are developed from simple mass balances based upon flows and characteristic concentrations of each source before and after project implementation. This approach ignores the more complex chemical reactions that will result from mixing of water of varying pH, and probably underestimates the control effectiveness. This is particularly true for the metals whose solubility is dictated by pH. The mass-balance comparison in this section is, however, adequate for comparison of the alternatives. In Chapter 7, a more sophisticated analysis technique is used to refine the evaluation for the recommended and maximum feasible pollution abatement projects.

Revegetation could also be added to the alternatives to enhance their control effectiveness. The effectiveness of revegetation in controlling pollutant loading from the site is tied primarily to the potential for reducing surface runoff and infiltration of precipitation by evapotranspiration. Until the pilot revegetation study is completed, however, it will be difficult to estimate the benefits of site revegetation. Such an analysis has not been completed for the alternatives, but the added benefits to be derived from revegetation and the probable costs are described in Chapter 7 for the recommended project and the maximum feasible pollution abatement project.

DESCRIPTION OF ALTERNATIVES

Chapter 5 describes methods to control water quality problems on the three major mine elements that contribute about 85 percent of the salt loading to Leviathan Creek.

These are the pit/adit, waste dump, and Spoil Area A. Project alternatives to control both the pit/adit and waste dump problems include only certain logical combinations of control methods on the individual areas. Spoil Area A, however, is somewhat independent of the solutions for control of the pit/adit and waste dump, and the treatment levels for Spoil Area A are, thus, carried as alternates for each of the alternatives discussed in this chapter.

The project alternatives that result from combination of individual control solutions are shown on Figures 6-1[a] through 6-4. Alternatives are presented in these figures in ascending order of construction cost. The construction costs shown in the tables on these figures represent costs for combining the various treatment levels for controls on each individual mine element. To arrive at the costs for each alternative, the individual construction costs from Chapter 5 cannot be simply added together. For example, with the pit/adit and waste dump control solutions, excavation fill costs shown in Chapter 5 for both of these elements include costs for excavation of material off the waste dump and transfer, grading, and compaction of that material in the pit. The cost for an alternative that combines these individual solutions, therefore, only includes this excavation/fill cost once to avoid double counting.

AVERAGE ANNUAL COST-EFFECTIVENESS

The seven alternatives are compared in Table 6-1 to show their cost-effectiveness based upon average annual reduction in total dissolved solids (TDS) load. Because maintenance costs will be very similar for all the alternatives, the unit control costs are compared only on the basis of estimated costs for construction. As the table shows, the reduction in TDS load for Alternative A costs about $1,800/ton; for Alternative B about $2,700/ton; for Alternative C about $4,000/ton; and for Alternative D about $5,000/ton. For these costs, Alternative A reduces the present TDS load from the entire mine site, estimated to be 1,680 tons in an average annual precipitation year, by about 61 percent, Alternative B about 73 percent, Alternative C about 78 percent, and Alternative D about 79 percent.

[a]Throughout this report, figures referenced in the text are included at the end of the chapter where first referenced. Plates referenced are included in a map pocket following the appendices.

Table 6-1. Comparison of Average Annual Cost-Effectiveness for Alternative Projects

Alternative	Construction cost, million dollars	Average annual TDS load reduction, tons				Percent reduction in TDS load[a]	Unit control costs, dollars/ton/year
		Pit/adit	Waste dump	Spoil Area A and landslide	Total		
A—Creek relocation and minimum site regrading							
1—Spoil Pile A drainage	1.71	325	495	197	1,017	60	1,680
2—Spoil Pile A regrading	2.00	325	495	216	1,036	62	1,930
B—Creek relocation and 0.6 mcy excavation/fill							
1—Spoil Pile A drainage	3.12	487	535	197	1,219	72	2,560
2—Spoil Pile A regrading	3.41	487	535	216	1,238	74	2,750
C—Creek relocation, minimum waste dump regrading, and export line							
1—Spoil Pile A drainage	4.96	600	495	197	1,292	77	3,840
2—Spoil Pile A regrading	5.26	600	495	216	1,311	78	4,010
D—Creek relocation and 1.8 mcy excavation/fill	6.21	563	535	236	1,334	79	4,660

[a]The estimated total annual TDS load from the mine site in an average year is 1,680 tons.

Figure 6-5 graphically compares the alternatives for cost-effectiveness in reduction of the average annual TDS load from the entire mine site estimate. Alternatives C and D appear to be at the point on the curve where the incremental effectiveness of expending more money for construction begins to taper off. The incremental cost per percent of reduction in TDS load increases rapidly beyond Alternative B. Alternatives A and B appear to be the most cost-effective projects.

WATER QUALITY CONTROL EFFECTIVENESS

The control effectiveness of each alternative must be evaluated not only on the basis of average annual reduction in TDS load, but ultimately based upon the concentrations of pollutants which it produces in Leviathan and Aspen Creeks. Because runoff and drainage from the site and flow rates in the creeks vary occasionally, the impacts of alternative projects can be expected to vary with the time of year. Control of the subsurface drainage from the open pit allows some flexibility in the manner in which flow is discharged to Leviathan Creek, and, therefore, some control over creek water quality. This

section describes the work done to evaluate the impacts of the alternatives on the creeks in terms of expected pollutant concentrations and their variation seasonally.

Hydrology

Estimation of chemical concentrations in the creeks which result from alternative improvement projects requires estimation of typical flow rates and concentration in the creek and for each of the major sources of pollutants. Mean monthly flow rates in Leviathan and Aspen Creeks were developed by regression for Stations 1, 10, 16, and 17, as described in Chapter 2. Typical natural concentrations in the creeks can be found by analysis of the continuous and instantaneous water quality data from the U.S. Geological Survey (USGS) sampling program. Flow rates and concentrations for the sources of pollutants are more difficult to estimate. The method using flow patterns in the creeks and from Station 2 (adit drainage) flow data to estimate the pattern of flow from each of the sources is described below.

Pit and Adit. In all of the alternatives, flow from the pit has two components: (1) surface runoff and (2) subsurface drainage. Surface runoff is allowed to flow directly to the creek, while subsurface drainage is controlled to varying degrees by evaporation in ponds on-site exported to off-site ponds. The existing pattern of flow from the adit can be used to estimate the flow pattern after improvements are constructed. Figure 6-6 shows a plot of the available adit flow data for Station 2 for water years 1981 and 1982. Although the annual precipitation for the two years differed by a factor of 2.5 (8.9 inches in water year 1981 versus 22.0 inches in water year 1982), and the time of occurrence of precipitation differed for the two years, patterns of outflow from the adit are very similar. For this reason, the flow pattern recorded in water year 1982 was taken as typical, and the alternatives compared on the basis of this pattern for subsurface drainage.

To develop a hydrograph for outflow from the subsurface drainage system for a specific alternative, the total annual volume of subsurface flow is calculated from the volume of precipitation and the infiltration coefficients which apply to the specific levels of grading, benching, and runoff control in the open pit. For the purposes of this evaluation, mean annual precipitation at Leviathan Mine was used to estimate volumes. The total annual volume is divided into mean monthly flows according to the relative magnitudes of monthly flows from the 1982 record. Figure 6-7 shows an example of the development of the hydrograph for Alternative A. The subsurface drainage outflow hydrographs for other alternatives were developed in the same manner. Figures 6-8 through 6-11 show the hydrographs for Alternatives A, B, C, and D.

The pattern of surface flow from the pit was estimated in a manner similar to that used for the subsurface drainage. In this case, the pattern of flow in Leviathan Creek was considered representative of the annual pattern of surface runoff from the open pit. The same procedure was used to determine monthly flows from the total annual volume of runoff expected, and then the relative magnitudes of mean monthly flows were used to calculate mean monthly flows in the outflow hydrograph for pit runoff. The mean monthly flow rates at Station 1 on Leviathan Creek and the mean annual precipitation were used for hydrograph development. Figures 6-12 through 6-14 show the resulting surface runoff outflow hydrographs from the pit.

Waste Dump, Delta, and Spoil Areas. The potential sources of pollutants from this area are surface runoff and seepage from the waste dump and spoil materials. The annual flow pattern was estimated using the same procedure as used for surface flow from the pit. Total flow volumes were estimated from infiltration calculations and the volumes divided among months according to the ratios for flows at Station 1. Figure 6-15 shows the resulting hydrographs for Levels 1 and 2 treatment of the waste dump, delta, and spoil pile area.

Spoil Area A. Hydrographs for outflows from Spoil Area A were developed from the calculated TDS load reduction expected for the two levels of treatment, and typical concentrations of outflow. Although the TDS load to Aspen Creek is strongly influenced by infiltration rates, no direct relationship was found between precipitation volumes and TDS load. Therefore, the outflow hydrograph was developed from the total annual TDS load expected rather than from annual precipitation volumes and infiltration coefficients.

Spoil Area A is expected to contribute 78 tons/year TDS after Level 1 treatment and 59 tons/year after Level 2 treatment. Since both surface and subsurface runoff contribute to the TDS load, the average concentration of runoff was taken to be 1,700 mg/l. This value was chosen based upon measurements of existing concentrations of Spoil Area A runoff. It should be noted that the choice of a typical concentration is not a particularly important parameter in the calculation of concentrations in Aspen Creek, because the flow rate from Spoil Area A is small relative to the flow rate of the creek.

The outflow hydrographs for Spoil Area A, shown in Figure 6-16 were developed from the total annual TDS load and typical TDS concentration in a manner similar to that used for open pit and waste dump flows. The expected annual loads were divided among the months according to the relative magnitudes of monthly flows at Station 1.

Landslide. Although the landslide is not directly affected by work in any of the alternatives, some improvement in water quality is expected in association with work done on Spoil Area A. An outflow hydrograph for the landslide was, therefore, developed exactly as described above for Spoil Area A. A typical concentration of 1,500 mg/l was chosen based upon evaluation of available water quality data for surface seepage on the landslide. The resulting hydrograph is shown in Figure 6-17.

Calculation of TDS Concentrations

Expected TDS concentrations were calculated for Leviathan Creek below the waste dump and at Station 17 below the mine site. The calculations are based on simple mass balances using the mean monthly flows and characteristic concentrations for each of the sources, and the mean monthly flows developed for Leviathan Creek as described in Chapter 2. The chemical data of Station 1 were used to establish characteristic concentrations for natural flows. Actual mean monthly values are expected to be equal to or lower than the calculated values, due to chemical reactions during mixing of natural flows with more concentrated flows from the mine. Higher pH values in the creek are expected to produce some precipitation of materials, such as iron, which have highly pH-dependent solubilities.

The TDS concentration calculations were performed by first summing the effects of all sources except the subsurface drainage from the open pit and computing the resulting TDS concentrations below the waste dump (landslide and Spoil Area A contributions are not included for this calculation) and at Station 17. The resulting flow and TDS values were then used to determine optimum operational strategies for diverting the pit subsurface drainage to evaporation ponds or the creek. Two control strategies were considered: (1) constant discharge rate to the creek for a preselected number of months and (2) an overflow system which would provide constant flow to the evaporation ponds and automatically vary discharge to the creek according to the flow rate coming out of the pit subsurface drainage system. For each alternative, the control strategy which resulted in the lowest maximum concentration in the creek was chosen. Table 6-2 lists the mean monthly TDS concentrations expected in the creek below the waste dump and Table 6-3 lists the concentrations at Station 17. Concentrations at Station 17 are generally lower because of dilution by Aspen Creek and the relatively lower magnitudes of TDS loads from Spoil Area A and the landslide.

Table 6-2. Comparison of Projected TDS Concentration Just Below the Waste Dump

Alternative	Annual mean TDS concentration, mg/l	Maximum monthly mean TDS concentration, mg/l
A	343	741
B	312	493
C	246	263
D	321	525

Table 6-3. Comparison of Projected TDS Concentration at Station 17

Alternative	Annual mean TDS concentration, mg/l	Maximum monthly mean TDS concentration, mg/l
A	469	693
B	379	497
C	365	567
D	400	510

The TDS concentrations presented in Tables 6-2 and 6-3 represent upper limits for expected mean monthly values during a year in which average rainfall occurs. Short-term variations in creek flow may substantially affect the actual daily concentrations after improvement. Variation in monthly and annual precipitation will also affect the concentrations. Figures were presented in Chapter 2 which show mean monthly precipitation and annual precipitation for 20, 50, and 80 percent exceedence frequency levels. These figures show that the variation in annual precipitation between 20 and 30 percent exceedence frequency levels is about 60 percent, while the mean monthly values vary by over 400 percent in the wet months to 1,400 percent in the dry months. Variation in the creek is principally in the wet months, as shown in the figures for Stations 1 and 17. In April and May, the difference in flows for the 20 and 80 percent exceedence frequency levels is between 500 and 700 percent. The magnitudes of these variations illustrate the potential for higher and lower TDS concentrations in the creek than those presented in this evaluation. However, variation in the concentrations will be resisted by several factors. First, high runoff from the mine site will likely

occur during periods of high flow in the creek and in roughly the same proportion to changes in creek flow. The mean monthly concentration will, therefore, be affected very little. Second, the open pit subsurface drainage system will react relatively slowly to hydrologic changes due to the nature of the collection system. Third, the highest variations in precipitation occur during the dry months when the site soils are likely to be dry, and able to provide storage capacity for precipitation. This will attenuate the effects of specific precipitation events.

The alternatives can be compared directly on the basis of the TDS concentrations which result in the creek. Table 6-3 lists the alternatives and their maximum mean monthly and mean annual TDS concentrations at Station 17. The figures presented in the tables show that the relative ranking of effectiveness of the alternatives in terms of reduction in TDS concentration in Leviathan Creek, in order of best to worst, is Alternative C, Alternative B, Alternative D, and Alternative A. In terms of annual mean concentration, the alternatives provide roughly the same benefits. When considered on the basis of maximum monthly mean concentration, Alternative A provides substantially less than Alternatives B, C, and D, which are roughly equivalent.

WATER QUALITY BENEFITS

The TDS loads and concentrations in Leviathan Creek resulting from each of the four alternatives were presented in the previous section. The mean annual TDS concentrations below the mine site range from about 370 mg/l to about 470 mg/l. All of the beneficial uses of Leviathan and Bryant Creeks would be achieved at these TDS concentrations if the TDS was composed of nontoxic anions and cations. The dissolved metals constitute a large portion of the TDS of Leviathan and Bryant Creeks, however, and as explained earlier in this chapter, their soluble fraction is significantly affected by pH. To simplify this analysis and yet provide a method of comparison of the water quality benefits which is quite adequate for screening down alternatives to the apparent best project, the metals concentrations at Stations 17, 25, and 26 were estimated based on the reductions in TDS concentrations.

The first step in the calculation procedure was to determine the amount of dilution occurring between Stations 17 and 25 and between Stations 17 and 26 for TDS and for the eight metals that are primarily responsible for noncompliance with the water quality criteria in Leviathan and Bryant Creeks. The reduction factors were calculated from the mean concentrations at these stations presented earlier in Table 3-4. Table 6-4 presents the reduction factors.

Table 6-4. Reductions in TDS and Metals Concentrations

Parameter	Units	Station 17		Station 25		Station 26	
		Mean concentration	Percent reduction	Mean concentration	Percent reduction	Mean concentration	Percent reduction
TDS	mg/l	1,011	0	484	52	317	69
Iron	ug/l	83,900	0	23,900	72	12,600	85
Copper	ug/l	332	0	236	29	198	40
Cadmium	ug/l	7.9	0	3.0	62	1.4	82
Chromium	ug/l	80	0	27	66	5.2	93
Zinc	ug/l	200	0	121	39	53	73
Arsenic	ug/l	281	0	99	65	50	82
Nickel	ug/l	780	0	330	58	280	64
Lead	ug/l	17	0	6.5	62	11	35

The percent reduction in TDS at Station 17 was calculated for each of the alternatives. These data are presented in Table 6-5.

Table 6-5. Reductions in TDS Concentration at Station 17 with Each Alternative

Alternative	TDS concentration, mg/l		Percent reduction
	Existing	After project	
A	1,011	469	54
B	1,011	379	63
C	1,011	365	64
D	1,011	400	60

The percent reduction factors presented in Tables 6-4 and 6-5 were combined to estimate the TDS and metals concentrations at Stations 17, 25, and 26 with each alternative. For example, under Alternative A, there will be a 54 percent reduction in TDS at Station 17. Using the TDS reduction factors of 52 and 69 percent at Stations 25 and 26, respectively, the TDS concentration at these stations can be calculated as follows:

Station 25 TDS = 1,011 mg/l x (1-0.54) x (1-0.52) = 223 mg/l
Station 26 TDS = 1,011 mg/l x (1-0.54) x (1-0.69) = 244 mg/l

The same procedure was used for each of the parameters listed in Table 6-4. The resultant concentrations are presented in Table 6-6. The metals concentrations are rough estimates based on reductions in TDS concentrations. The pH associated with each alternative will increase by some amount. When the pH increases, the solubility of metals will decrease so that the resultant metals concentrations may be lower than the values presented in Table 6-6.

Table 6-6. Estimated TDS and Metals Concentrations with each Alternative

Parameter	Units	Concentration											
		Alternative A			Alternative B			Alternative C			Alternative D		
		Station			Station			Station			Station		
		17	25	26	17	25	26	17	25	26	17	25	26
TDS	mg/l	469	223	144	379	180	116	365	175	113	400	194	125
Iron	ug/l	38,600	10,800	5,800	31,000	8,700	4,700	30,200	8,500	4,500	33,600	9,400	5,000
Copper	ug/l	153	108	92	123	87	74	120	85	72	133	94	80
Cadmium	ug/l	3.6	1.4	0.7	2.9	1.1	0.5	2.8	1.1	0.5	3.2	1.2	0.6
Chromium	ug/l	37	12.5	2.6	30	10.1	2.1	29	9.8	2.0	32	10.9	2.2
Zinc	ug/l	92	56	25	74	45	20	72	44	19	80	49	22
Arsenic	ug/l	129	45	23	104	36	19	101	35	18	112	39	20
Nickel	ug/l	359	151	129	289	121	104	281	118	101	312	131	112
Lead	ug/l	7.8	3.0	5.1	6.3	2.4	4.1	6.1	2.3	4.0	6.8	2.6	4.4

The concentrations presented in Table 6-6 were compared to the water quality criteria presented in Table 3-1 for a rough comparison which of the designated beneficial uses would be achieved with each alternative. Tables 6-7 through 6-10 present the results of this analysis. Table 6-7 shows which of the three stations (17, 25, 26) would meet the acute and chronic water quality criteria for cold freshwater habitat with each of the four alternatives. Most of the metals concentrations will be too high under all four alternatives to allow a thriving trout population in Leviathan and Bryant Creeks. Many of the metals will not be acutely toxic at Stations 25 and 26 in Bryant Creek but the concentrations will be sufficiently high to cause chronic toxicity problems in trout. Less sensitive fish may be able to inhabit Bryant Creek without any adverse effects. Tables 6-8 and 6-9 indicate that irrigation and stock watering criteria will be met under all four alternatives. Table 6-10 indicates that most of the criteria for groundwater recharge and domestic water supplies will be met.

APPARENT BEST PROJECT

The objective of this project is to restore the water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity, within the available financial resources, which for the Regional Board total about $2.5 million. In Table 6-11, all the alternatives are compared for cost, control effectiveness, and water quality benefits. Alternative B clearly appears to come the closest to meeting the above objective, and is the apparent best project. If the effectiveness of Alternative B is maintained, and its cost reduced somewhat, it would clearly be the recommended project. Possible modifications to Alternative B which can reduce its cost and maintain or increase its effectiveness include:

Table 6-7. Stations Which Meet the Criteria for Cold Freshwater Habitat

Parameter	Alternative A		Alternative B		Alternative C		Alternative D	
	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute
TDS	All	--	All	--	All	--	All	--
Iron	--	None	--	None	--	None	--	None
Copper	None	None	None	None	None	None	None	None
Cadmium	None	25,26	None	25,26	None	25,26	None	25,26
Chromium	None	25,26	None	25,26	None	25,26	None	25,26
Zinc	26	All	25,26	All	25,26	All	26	All
Arsenic	26	All	25,26	All	25,26	All	25,26	All
Nickel	None	All	None	All	None	All	None	All
Lead	None	All	None	All	None	All	None	All

Table 6-8. Stations Which Meet the Criteria for Irrigation

Parameter	Alternative			
	A	B	C	D
TDS	All	All	All	All
Iron	None	26	26	26
Copper	All	All	All	All
Cadmium	All	All	All	All
Chromium	All	All	All	All
Zinc	All	All	All	All
Arsenic	25,26	25,26	25,26	25,26
Nickel	25,26	25,26	25,26	25,26
Lead	All	All	All	All

Table 6-9. Stations Which Meet the Criteria for Stockwatering

Parameter	Alternative[a]			
	A	B	C	D
TDS	All	All	All	All
Iron	--	--	--	--
Copper	All	All	All	All
Cadmium	All	All	All	All
Chromium	All	All	All	All
Zinc	All	All	All	All
Arsenic	All	All	All	All
Nickel	--	--	--	--
Lead	All	All	All	All

[a]Dash (--) indicates there is not a criterion for stockwatering.

Table 6-10. Stations Which Meet the Criteria for Groundwater Recharge and Domestic Water Supplies

Parameter	Alternative[a]			
	A	B	C	D
TDS	All	All	All	All
Iron	None	None	None	None
Copper	All	All	All	All
Cadmium	All	All	All	All
Chromium	All	All	All	All
Zinc	All	All	All	All
Arsenic	--	--	--	--
Nickel	None	None	None	None
Lead	All	All	All	All

[a]Dash (--) indicates there is not a criterion for groundwater recharge and domestic water supplies.

1. Reduction in excavation of the waste dump while maintaining the maximum area for pond construction.

2. Simplification of the underdrain system.

3. More efficient use of materials excavated off the waste dump.

4. Incorporation of revegetation on regraded areas of the waste dump, pit, and Spoil Area A, and in the area of the delta where pond construction will not occur.

Table 6-11. Comparison of Alternatives

Comparison factor	Relative ranking			
	1	2	3	4
Construction cost, million dollars	A-1.71	B-3.12	C-4.96	D-6.21
Unit cost for TDS load reduction, dollars/ton/year	A-1,800	B-2,700	C-3,900	D-4,700
Percent reduction in total mine TDS load	D-79	C-78	B-73	A-61
Annual mean TDS concentration in creek at bottom of mine site, mg/l	C-365	B-379	D-400	A-469
Maximum monthly mean TDS concentration in creek at bottom of mine site, mg/l	C-567	B-497	D-510	A-693
Compliance with water quality criteria in Leviathan Creek at bottom of mine site	B and C are virtually the same, and only slightly better than A and D.			

Chapter 7 incorporates these modifications to Alternative B to develop the recommended project.

TURN PAGE FOR
NEXT FIGURE

DESCRIPTION

Pit

Level 1--Regrade 45 percent of area into stable slopes with benches and drainage ditches; discharge 10.9 million gallons of surface runoff to Leviathan Creek; construct underdrain system to convey 1.7 million gallons to 3.3 acres of ponds for evaporation and 7.8 million gallons to Leviathan Creek.

Waste Dump

Level 1--Regrade surface depressions, flat areas, and erosion gullies; relocate Leviathan Creek and tributaries in lined channel around waste dump and elevated above delta.

Spoil Area A

Alternative A-1 (Level 1)--Drain surface depressions.
Alternative A-2 (Level 2)--Drain surface depressions and regrade slopes.

CONSTRUCTION COSTS

ALTERNATIVE A-1

Description of work	Cost, dollars
Pit/Adit Work	
Mobilization, grubbing, and leveling	60,200
Excavation, grading, filling, and compaction	176,000
Drainage channels and piping	223,000
Underdrain system and piping	148,500
Evaporation ponds	158,000
Subtotal	765,700
Waste Dump	
Mobilization	15,000
Excavation, filling, and grading	95,000
Creek relocation	456,400
Subtotal	566,400
Spoil Area A	
Drainage work	91,000
Subtotal	1,423,100
Contingencies (20 percent)	284,600
Total	1,707,700

ALTERNATIVE A-2

Alternative A-1 Cost	1,423,100
Spoil Area A regrading	192,000
Revegetation	52,500
Subtotal	1,667,600
Contingencies (20 percent)	333,500
Total	2,001,100

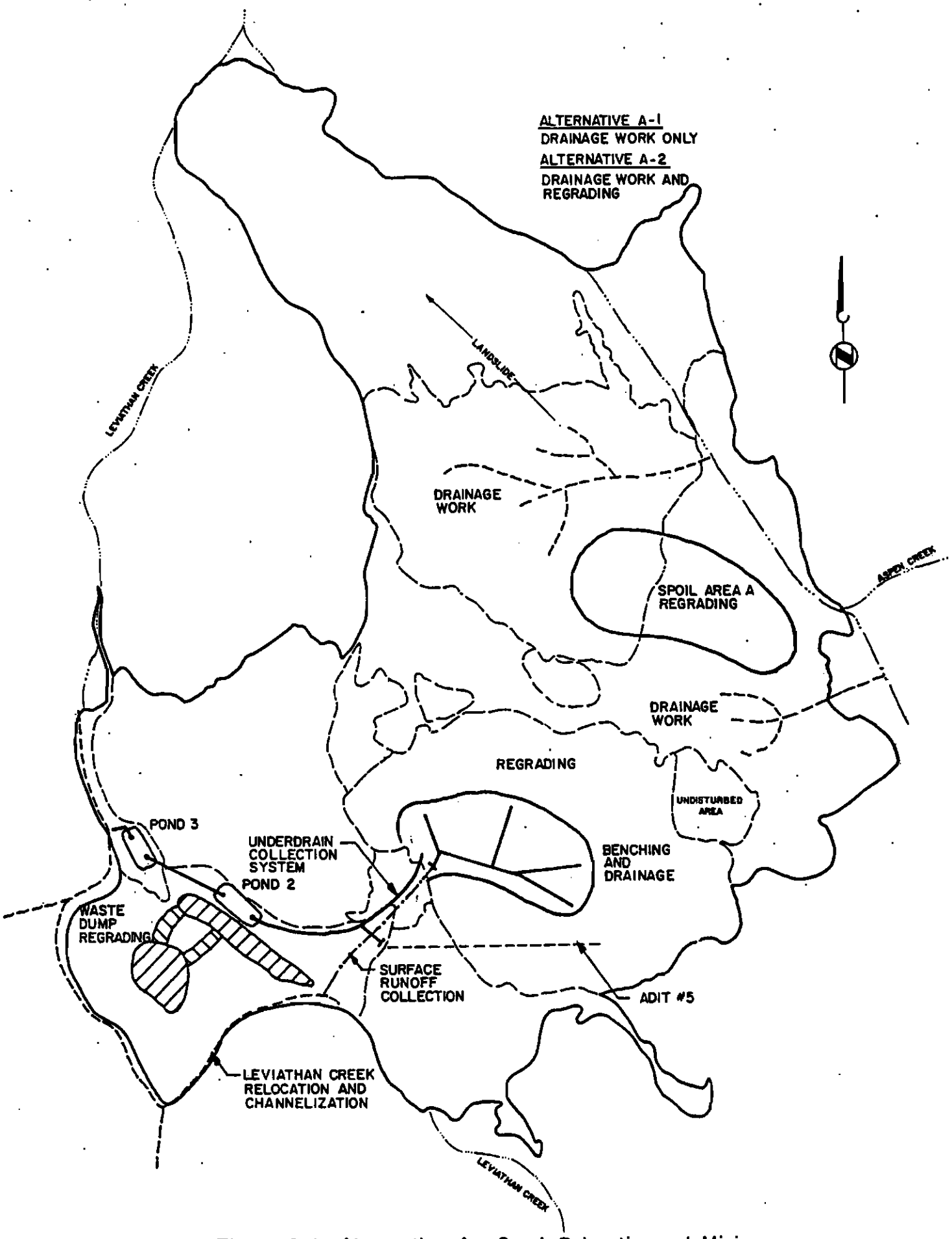


Figure 6-1 Alternative A - Creek Relocation and Minimum Site Regrading

DESCRIPTION

Pit

Level 2--Fill with 0.6 mcy from waste dump; construct stable slopes, benches, and lined drainage ditches up to elevation 7,160 feet (about 37 percent surface area); regrade remaining area to improve surface runoff; discharge 11.9 million gallons of surface runoff to Leviathan Creek; evaporate 5.3 million gallons of underdrain flow in 10.3 acres of ponds; discharge 3.2 million gallons of underdrain flow to Leviathan Creek.

Waste Dump

Level 2--Excavate 0.6 mcy to elevation 7,030 feet; construct 7 acres of lined ponds; relocate Leviathan Creek and tributaries in lined channel across waste dump and elevated above delta; regrade north and east faces, and construct stable slopes, benches, and lined drainage ditches on regraded areas.

Spoil Area A

Alternative B-1 (Level 1)—Drain surface depressions.
Alternative B-2 (Level 2)—Drain surface depressions and regrade slopes.

CONSTRUCTION COSTS

ALTERNATIVE B-1

Description of work	Cost, dollars
Pit/Adit Work	
Mobilization, grubbing, and leveling	131,200
Excavation, filling, and regrading	1,110,000
Drainage channels and piping	199,000
Underdrain system and piping	159,000
Evaporation ponds	558,000
Subtotal	2,157,000
Waste Dump	
Mobilization	80,000
Regrading	53,000
Tributary creek channel and liner	59,800
Leviathan Creek channel and liner	160,000
Subtotal	352,800
Spoil Area A	
Drainage work	91,000
Subtotal	2,600,800
Contingencies (20 percent)	520,200
Total	3,121,000
ALTERNATIVE B-2	
Alternative B-1 Cost	2,600,800
Spoil Area A regrading	192,000
Revegetation	52,500
Subtotal	2,845,300
Contingencies (20 percent)	569,100
Total	3,414,400

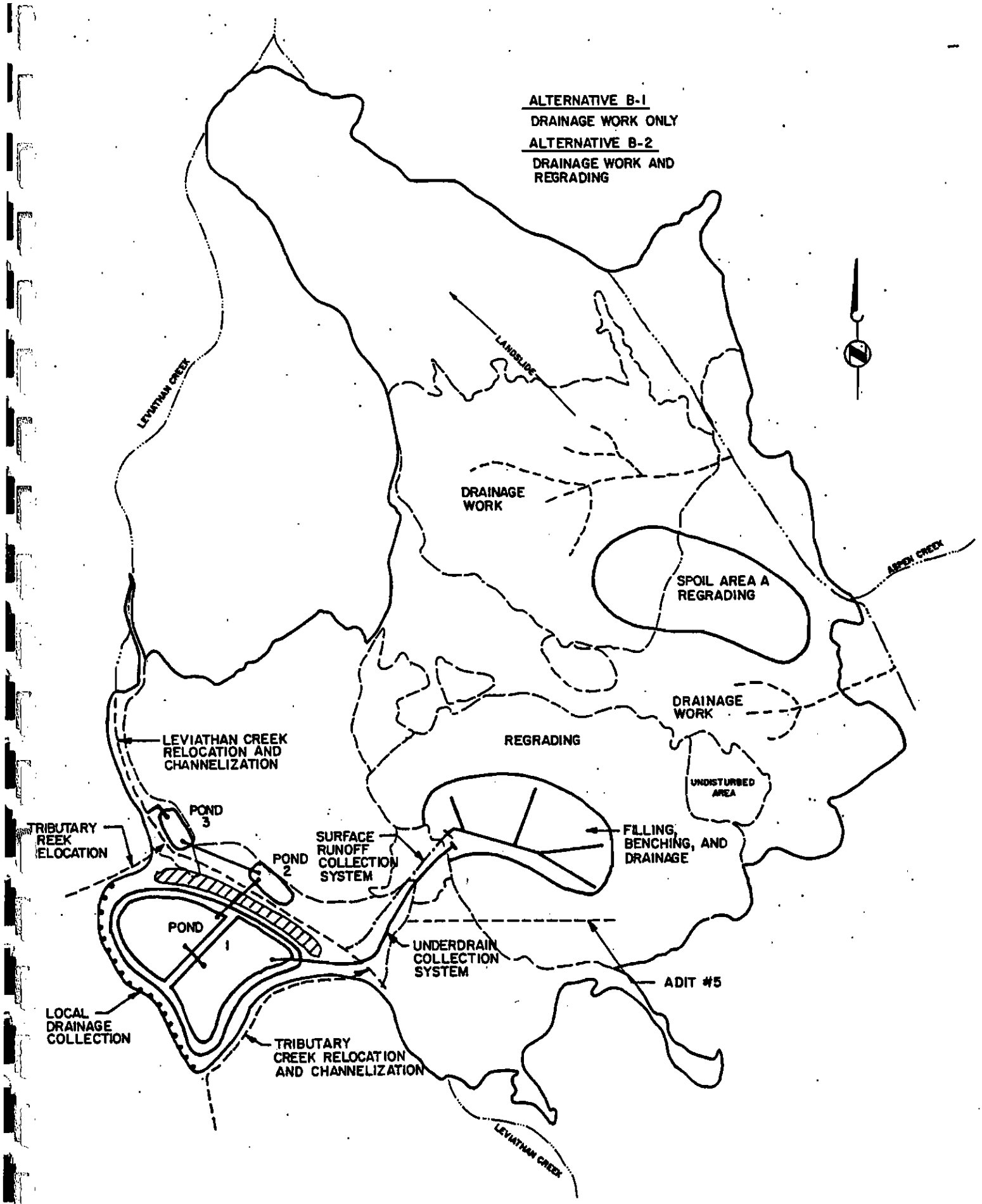


Figure 6-2 Alternative B - Creek Relocation and 0.6 MCY Excavation/Fill

DESCRIPTION

Pit

Level 3--Underdrain system will collect 20.4 million gallons of flow from the pit and portal of Adit No. 5; all 20.4 million gallons exported from the site in a 10-inch polyvinyl chloride pipeline 10 miles to Double Springs Flat.

Waste Dump

Level 1--Regrade surface depressions, flat areas, and erosion gullies; relocate Leviathan Creek and tributaries in lined channel around waste dump, and elevate above delta.

Spoil Area A

Alternative C-1 (Level 1)--Drain surface depressions.
Alternative C-2 (Level 2)--Drain surface depressions and regrade slopes.

CONSTRUCTION COSTS

ALTERNATIVE C-1

Description of work	Cost, dollars
Pit/Adit Work	
Mobilization	166,000
Underdrain system	115,000
Export line	1,529,000
Evaporation ponds	1,670,000
Subtotal	3,480,000
Waste Dump	
Mobilization	15,000
Excavation, filling, and grading	95,000
Creek relocation	456,400
Subtotal	566,400
Spoil Area A	
Drainage work	91,000
Subtotal	4,137,400
Contingencies (20 percent)	827,500
Total	4,964,900

ALTERNATIVE C-2

Alternative C-1 Cost	4,137,400
Spoil Area A regrading	192,000
Revegetation	52,500
Subtotal	4,381,900
Contingencies (20 percent)	876,400
Total	5,258,300

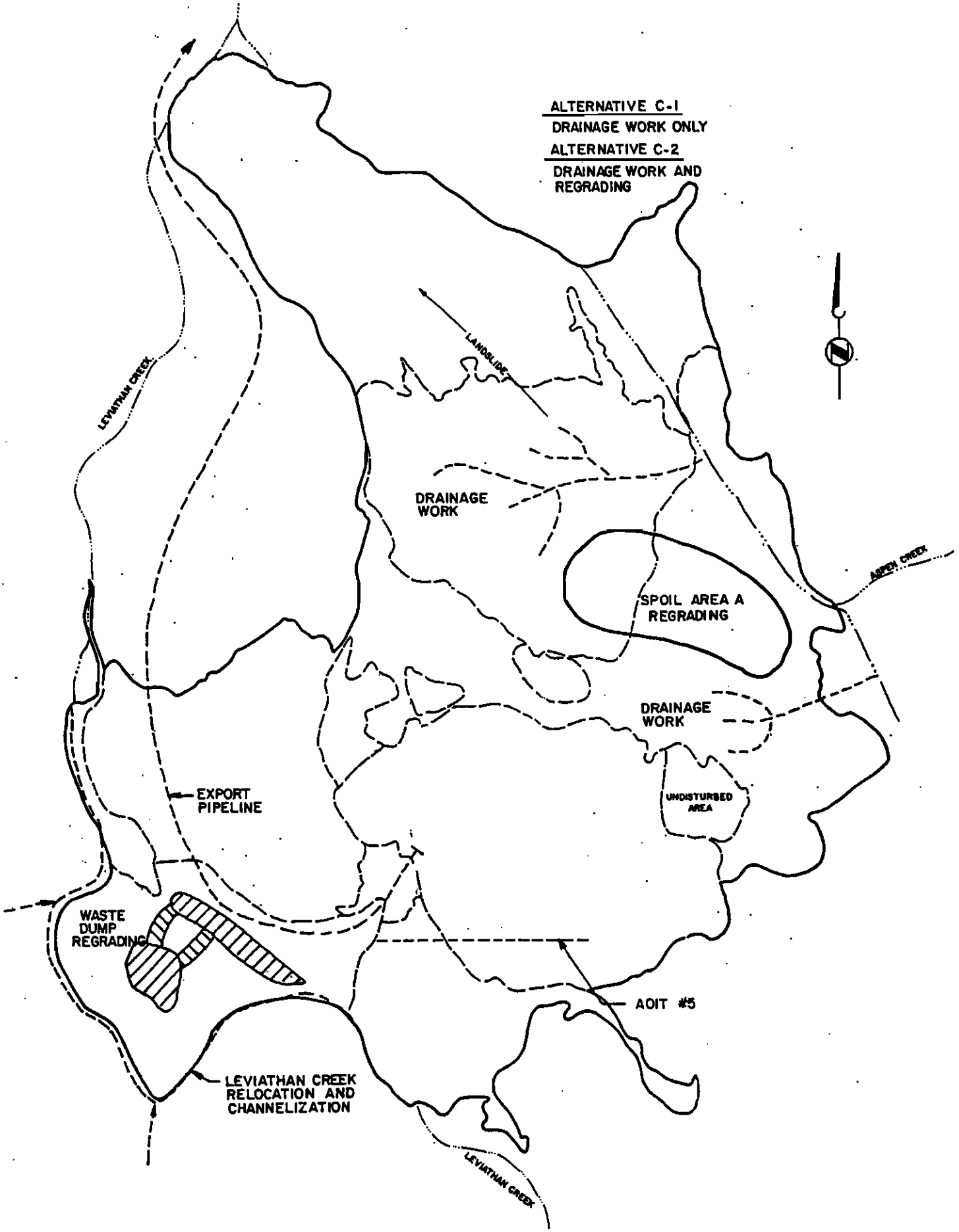


Figure 6-3 Alternative C - Creek Relocated and Minimum Waste Dump Regrading, and Export Line

DESCRIPTION

Pit

Level 4--Fill with 1.8 mcy from waste dump; construct stable slopes, benches, and lined drainage ditches up to elevation 7,300 feet (about 83 percent surface area); regrade remaining area to improve surface runoff; discharge 15.5 million gallons of surface runoff to Leviathan Creek; construct underdrain system to convey 3.8 million gallons to 8.5 acres of ponds for evaporation.

Waste Dump

Level 2--Excavate 0.6 mcy to elevation 7,030 feet; construct 7 acres of lined ponds; relocate Leviathan Creek and tributaries in lined channel across waste dump and elevated above delta; regrade north and east faces, and construct stable slopes, benches, and lined drainage ditches on regraded areas.

Spoil Area A

Level 3--Excavate 1.2 mcy to eliminate surface depressions and unstable slopes and to provide positive surface drainage.

CONSTRUCTION COSTS

ALTERNATIVE D

Description of work	Cost, dollars
Pit/Adit Work	
Mobilization, grubbing, and leveling	215,200
Excavation, filling, and compaction	3,330,000
Drainage channels and piping	665,000
Underdrain system and piping	133,000
Evaporation ponds	475,800
Subtotal	4,819,000
Waste Dump	
Mobilization	80,000
Regrading	53,000
Tributary creek channel and liner	59,800
Leviathan Creek channel and liner	160,000
Subtotal	352,800
Spoil Area A	
Cost covered above in excavation for pit fill	—
Subtotal	5,171,800
Contingencies (20 percent)	1,034,400
Total	6,206,200

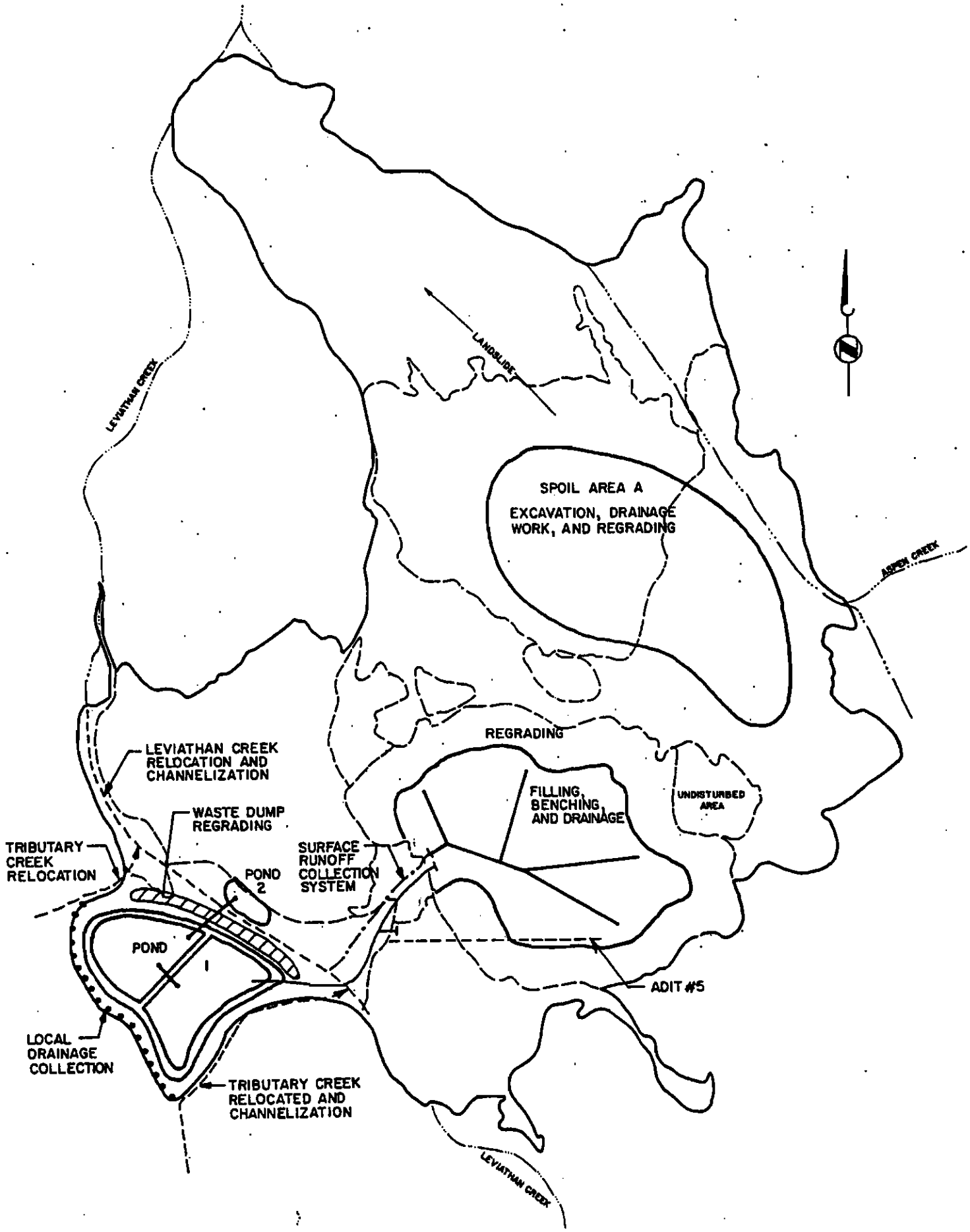


Figure 6-4 Alternative D - Creek Relocation and 1.8 MCY Excavation/Fill

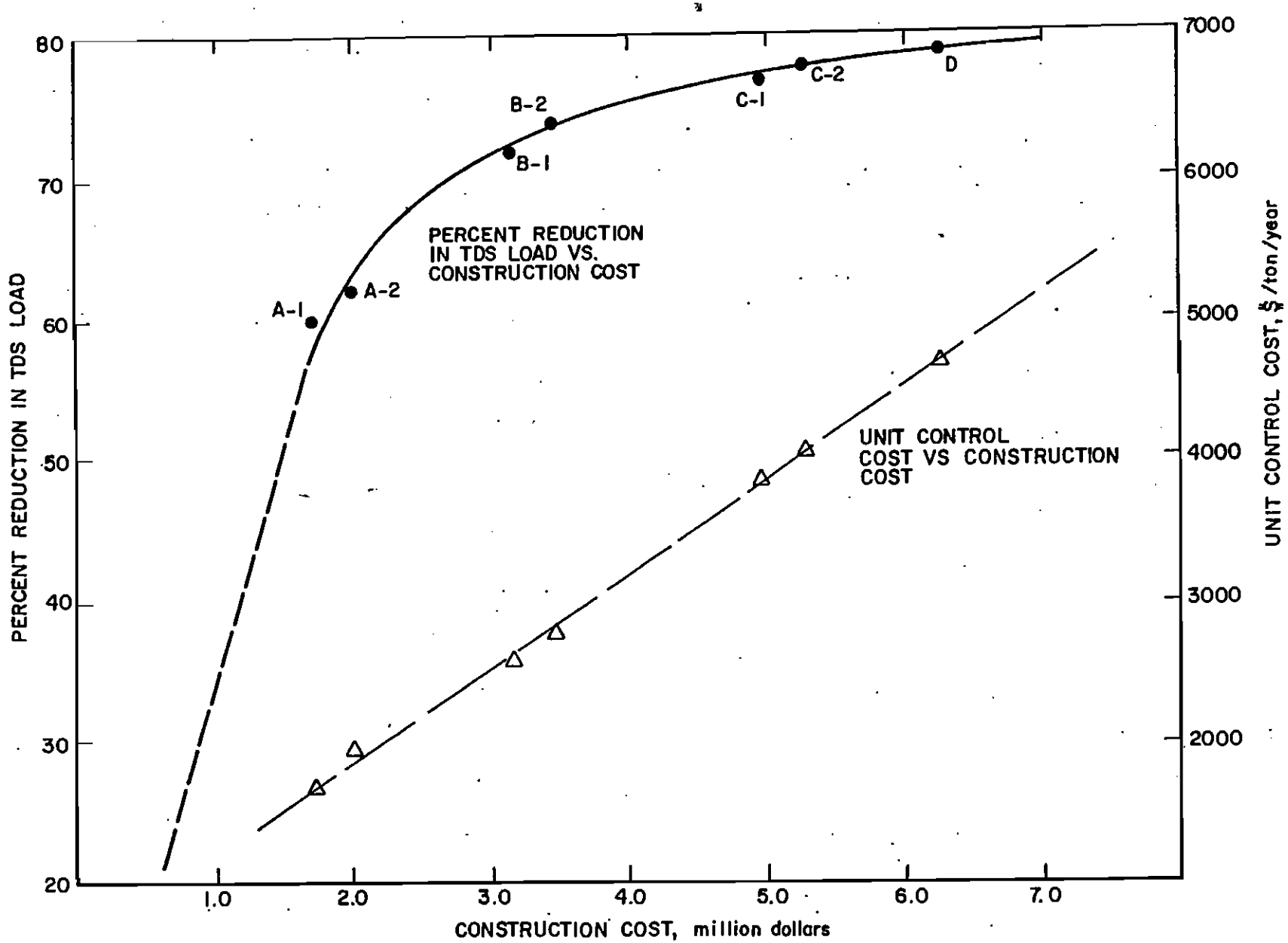


Figure 6-5 Average Annual Cost-Effectiveness of Alternatives

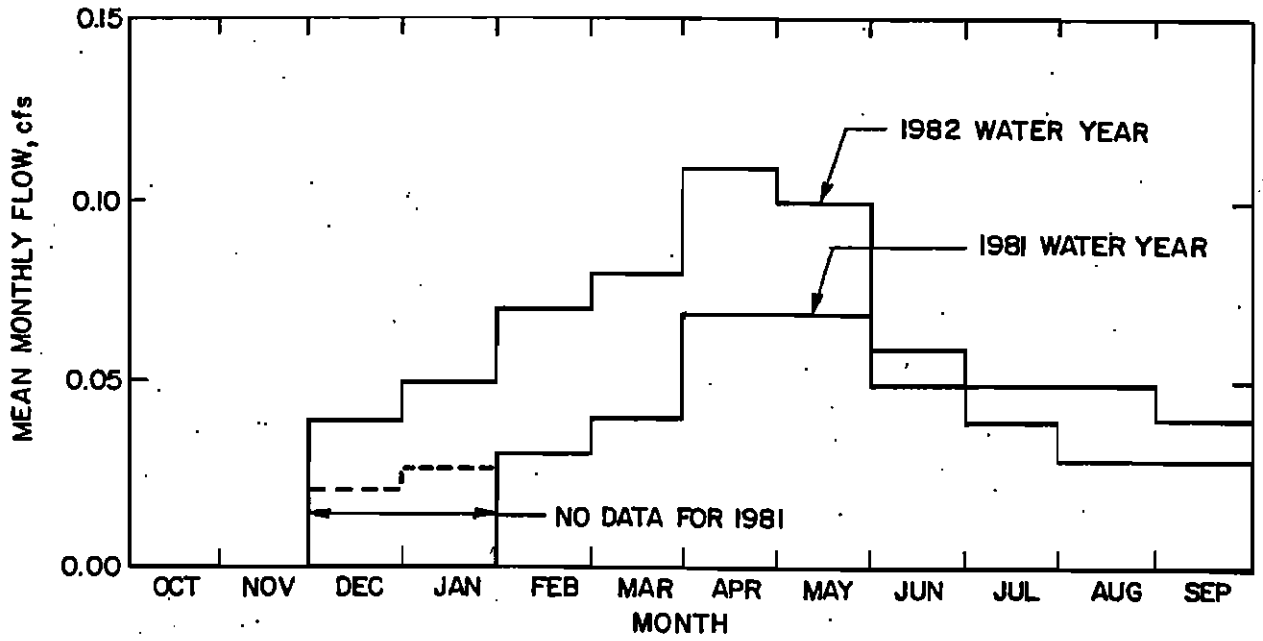
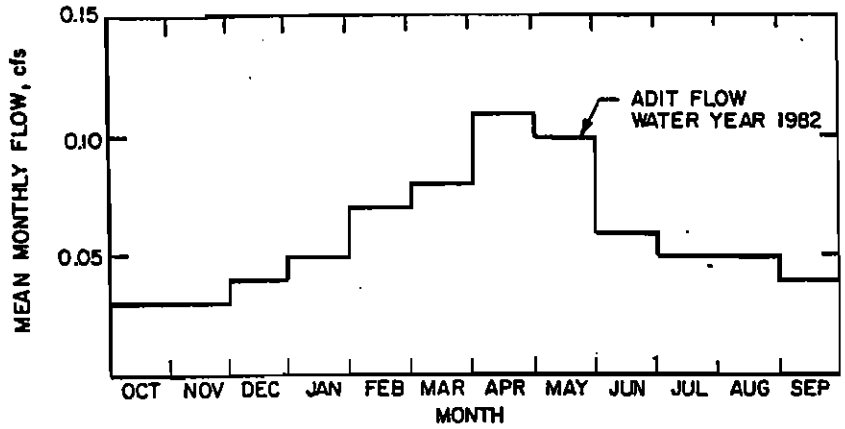
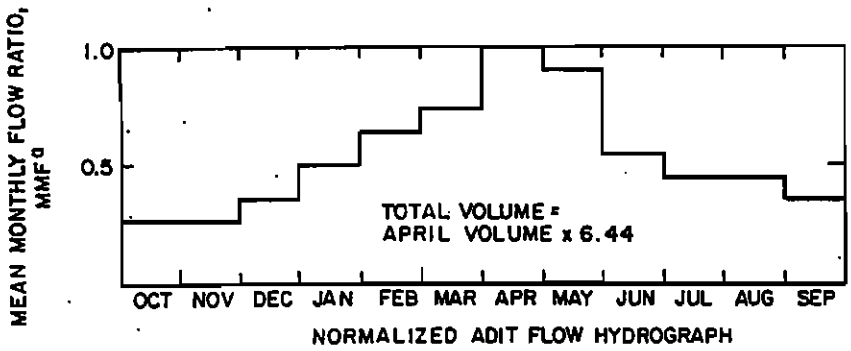
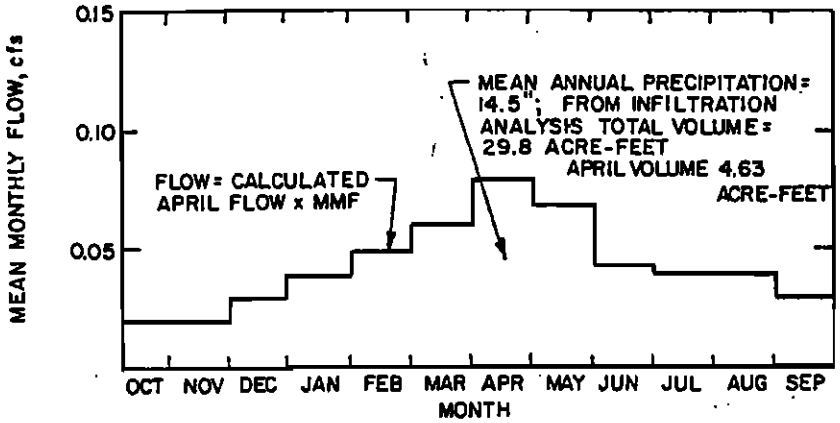


Figure 6-6 Mean Monthly Flow From Adit



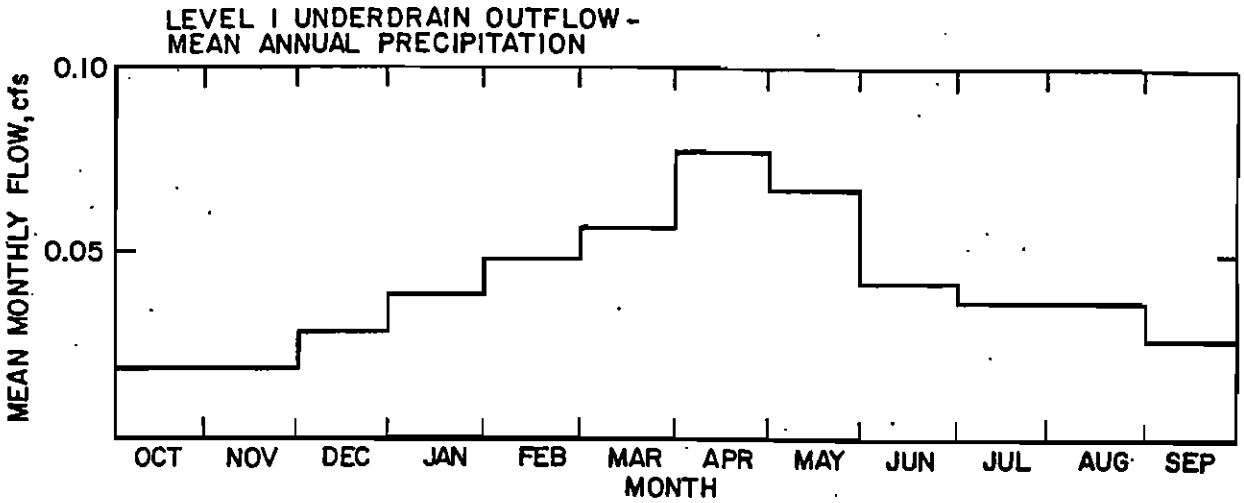


[a] MEAN MONTHLY FLOW RATIO IS RATIO OF MONTHLY FLOW TO APRIL FLOW FROM 1982 WATER YEAR DATA RECORD



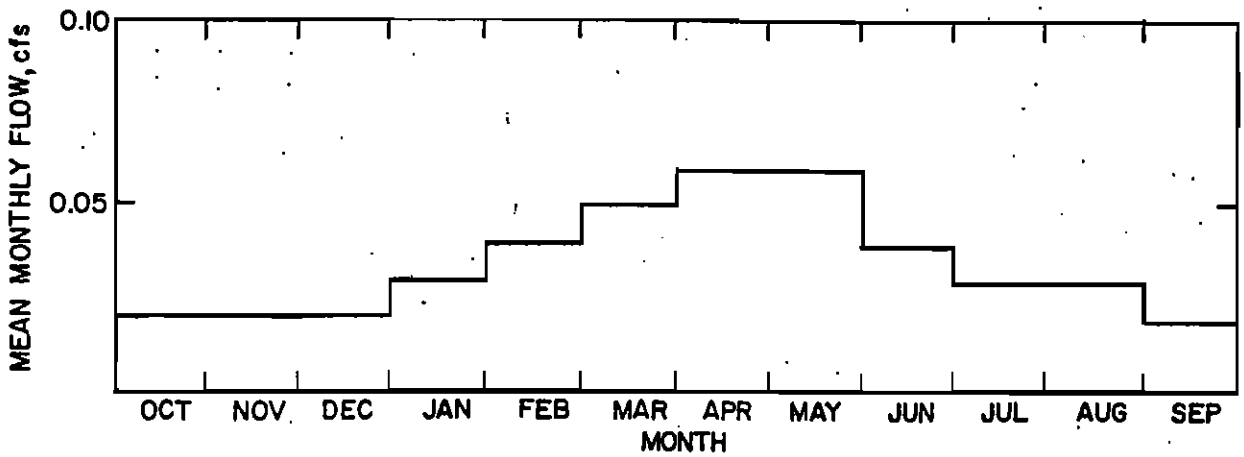
ALTERNATIVE A OUTFLOW HYDROGRAPH SUBSURFACE OPEN PIT DRAINAGE

Figure 6-7 Alternative A Hydrograph Development



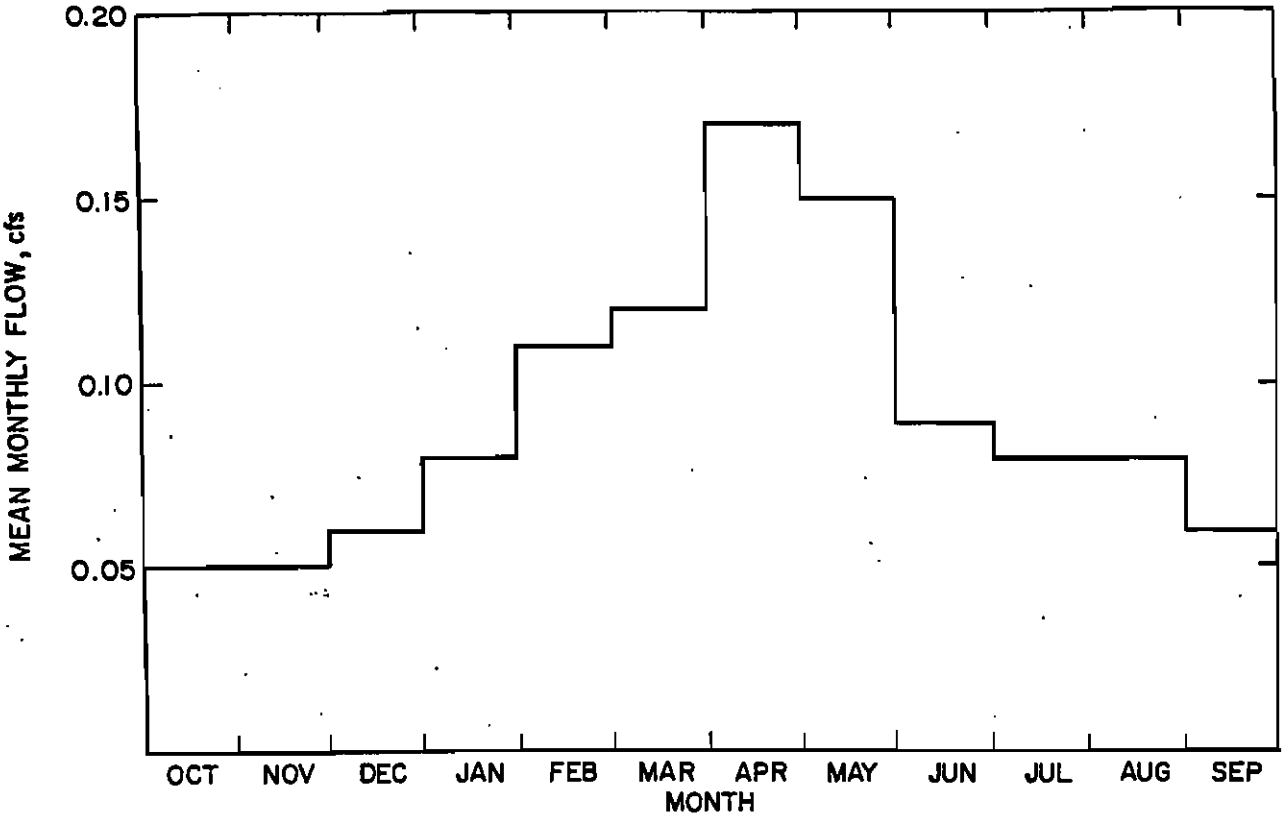
a/ Hydrographs assume mean monthly rainfall

Figure 6-8 Alternative A Subsurface Outflow From Open Pit a/



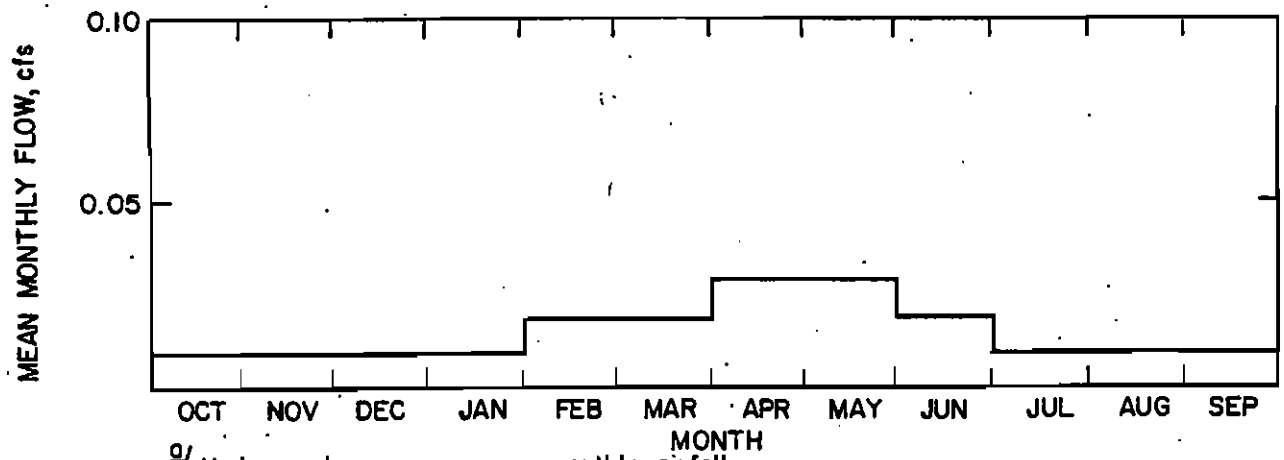
a/ Hydrographs assume mean monthly rainfall

Figure 6-9 Alternative B Subsurface Outflow From Open Pit a/



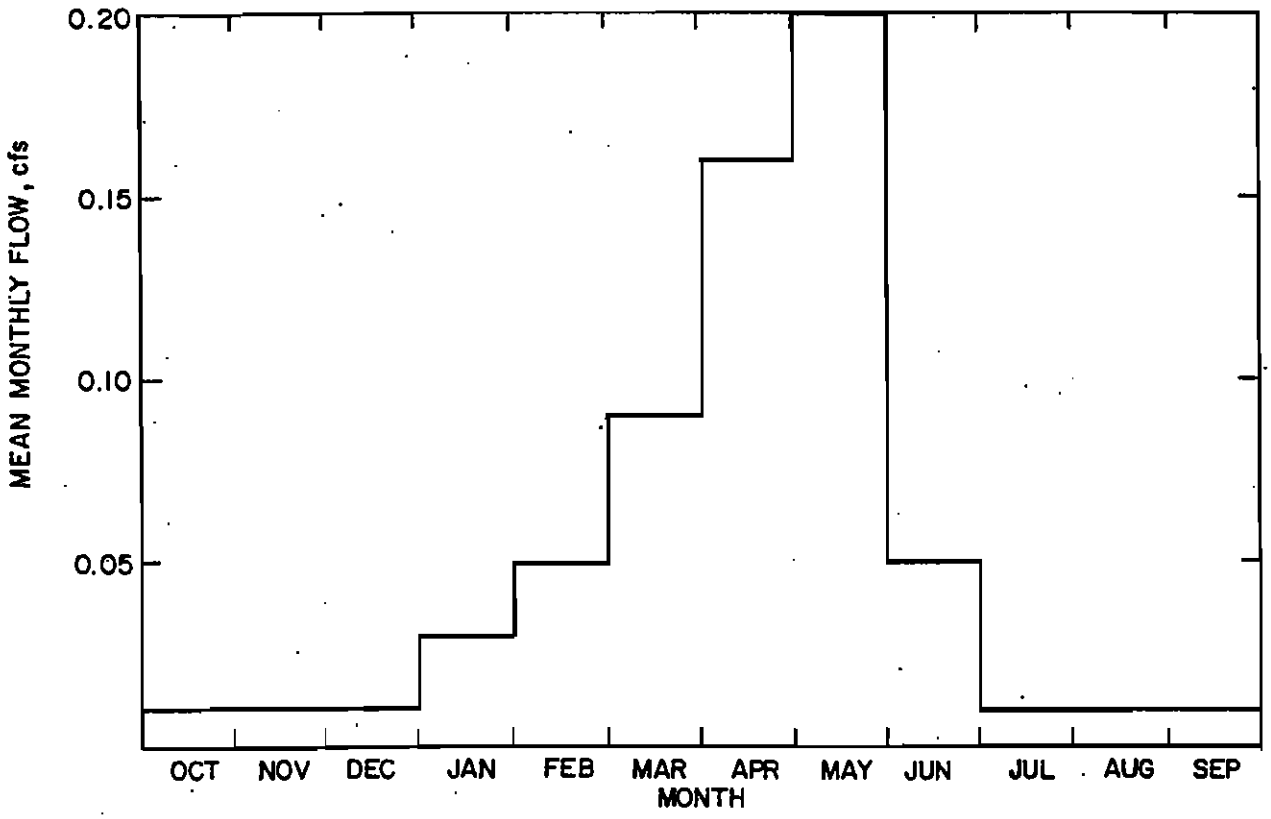
g/ Hydrographs assume mean monthly rainfall

Figure 6-10 Alternative C Subsurface Outflow From Open Pit g/



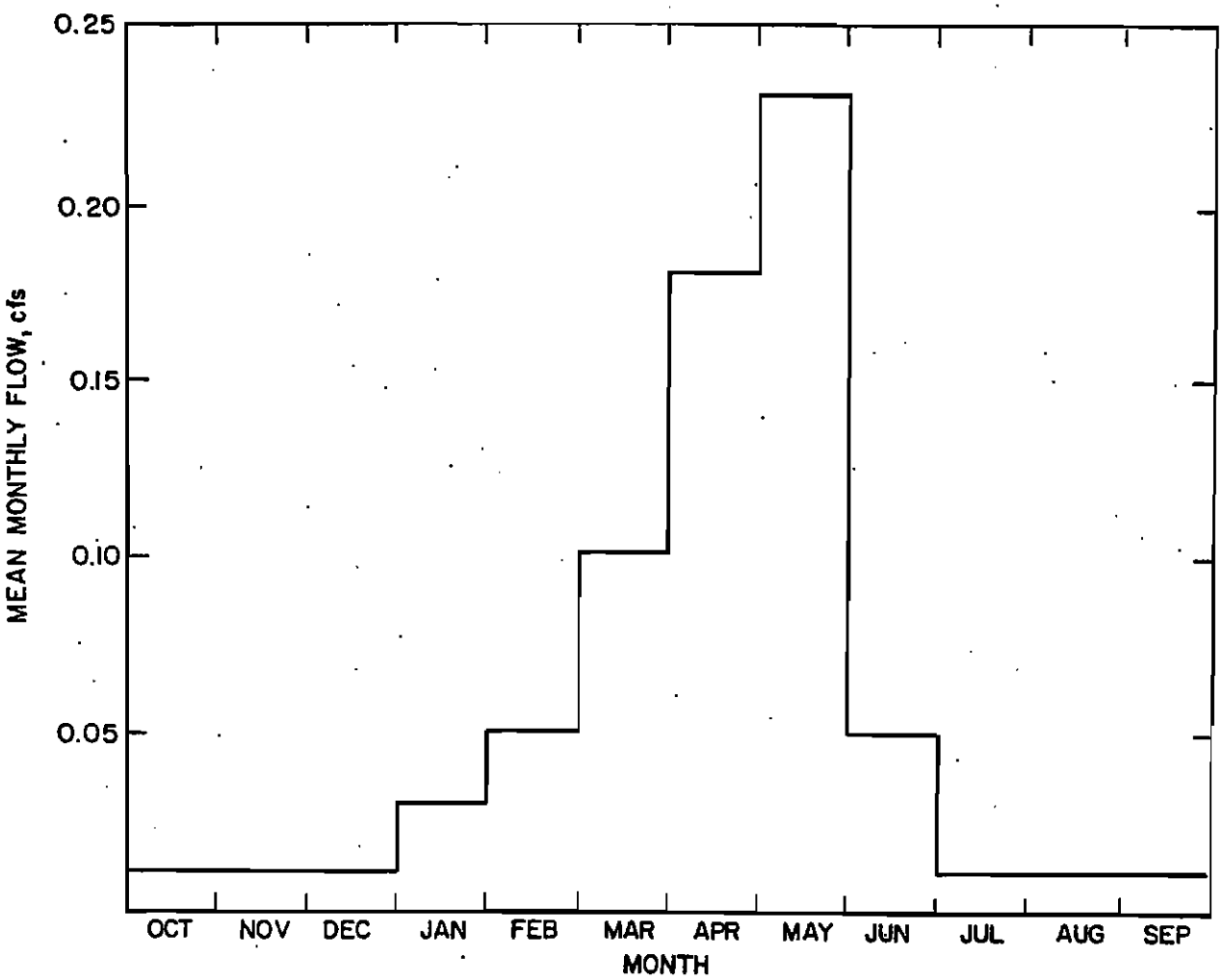
g/ Hydrographs assume mean monthly rainfall

Figure 6-11 Alternative D Subsurface Outflow From Open Pit g/



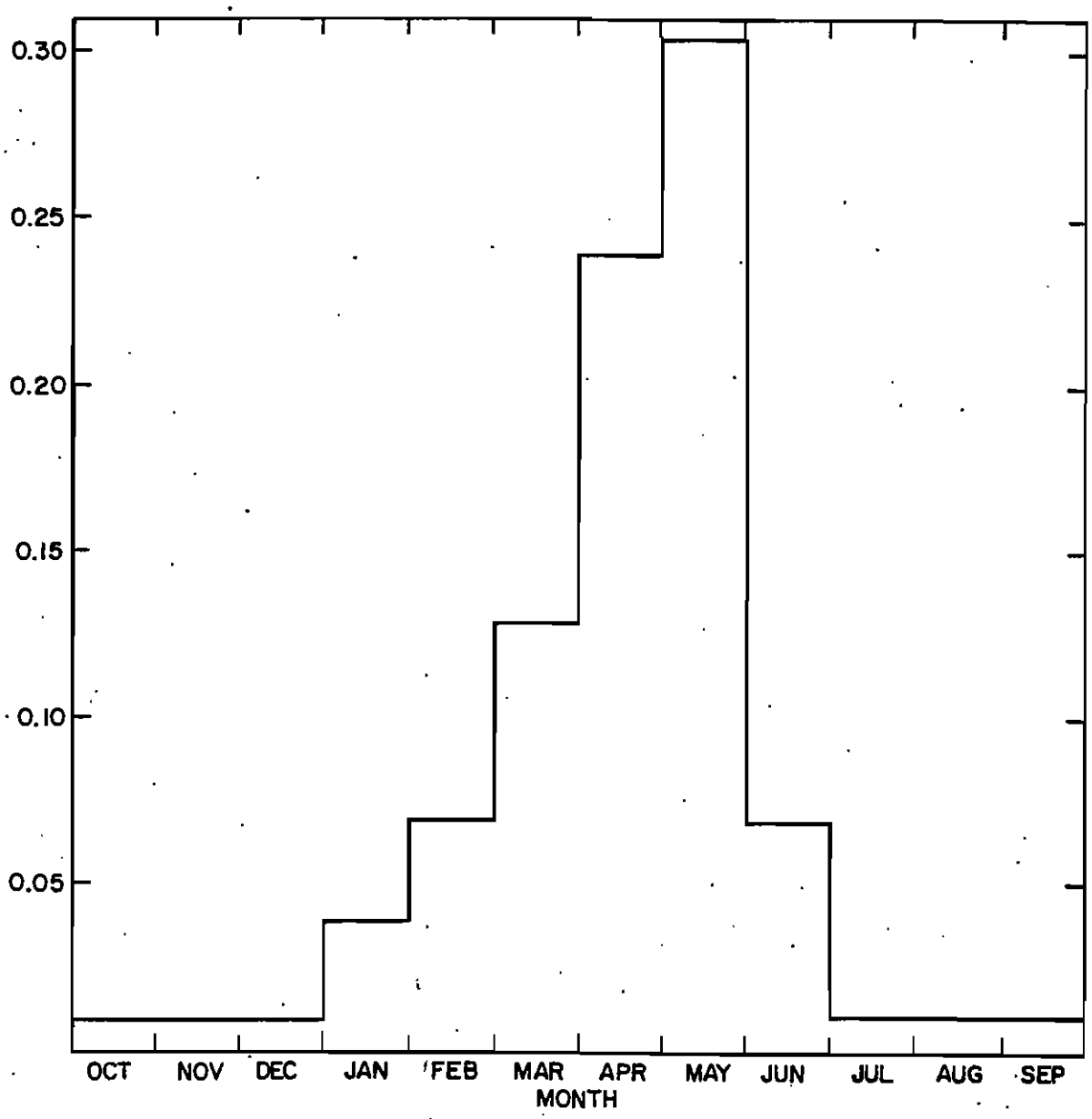
g/ Hydrograph assume mean monthly rainfall

Figure 6-12 Alternative A Surface Outflow From Open Pit g/



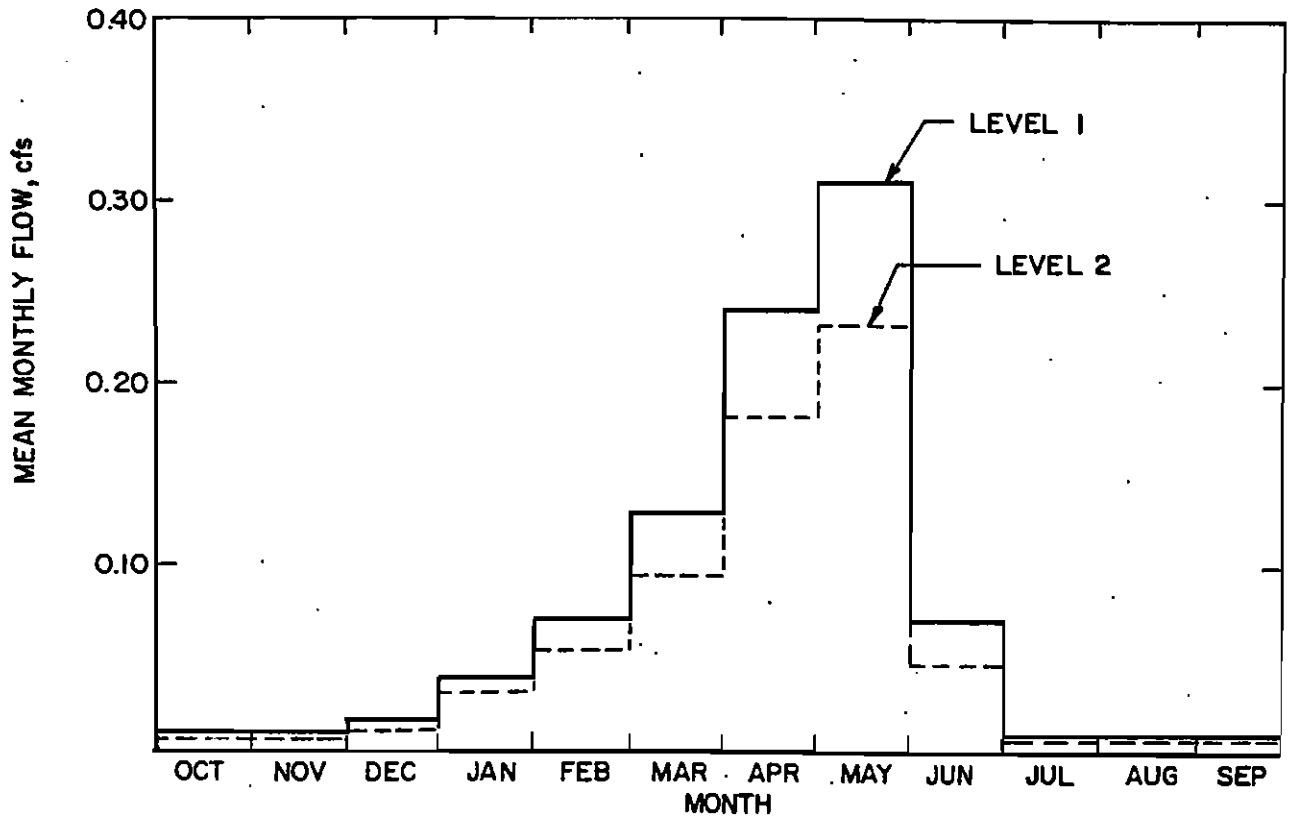
[g] Hydrographs assume mean monthly rainfall

Figure 6-13 Alternative B Surface Outflow From Open Pit [g]



a/ Hydrographs assume mean monthly rainfall

Figure 6-14 Alternative D Surface Outflow From Open Pit a/



[a] Hydrographs assume mean monthly rainfall

Figure 6-15 Total Runoff From Waste Dump, Spoil Areas B & C, and Delta [a]

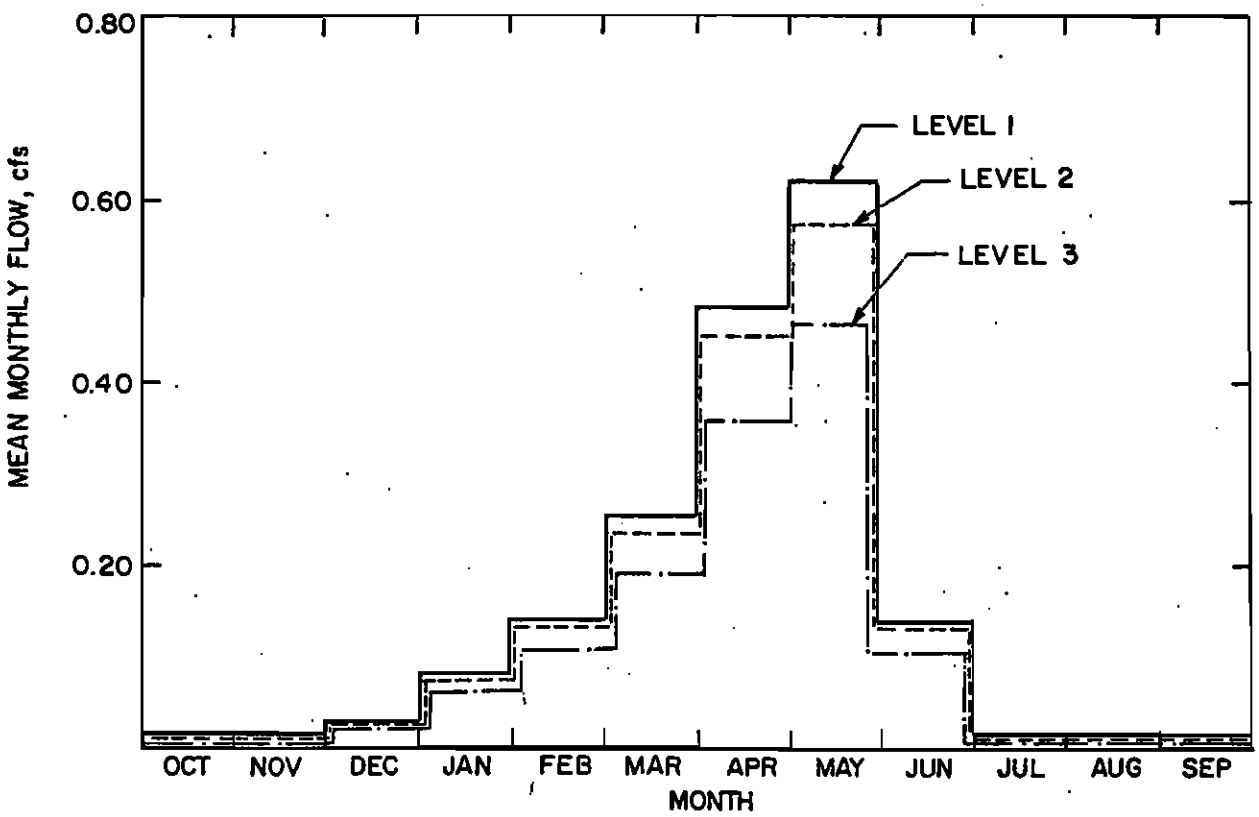


Figure 6-16 Total Runoff From Spoil Area A and Landslide

CHAPTER 7

RECOMMENDED PROJECT AND MAXIMUM FEASIBLE POLLUTION ABATEMENT PROJECT

The recommended project has been developed by modifying the apparent best project described in Chapter 6 and is designed to achieve the maximal water quality improvement to Leviathan Creek within the limitations of expected funding available. The recommended project, as described in this chapter, has a construction cost estimated to be $2.80 million. Project maintenance is estimated at an average annual cost of $10,520 per year for the first five years.

The recommended project includes most of the elements identified in the apparent best alternative discussed in Chapter 6. Further analysis and refinement of the best alternative in developing the recommended project has resulted in both reduced project costs and improved water quality in Leviathan Creek. Major differences between the recommended project and apparent best alternative include the following:

1. Addition of a 2.7-acre evaporation pond (hereafter identified as Site 5) located west of the pit.

2. Reduction in the quantity of material excavated from the waste dump to develop pond Site 1.

3. Deep limestone underdrain system in the mine pit is replaced with a shallower rock underdrain at the mouth of the pit because of unknown groundwater flow and soil characteristics beneath the pit.

4. Open drainage channels on fill slopes and pit floor in lieu of pipeline transport.

Because an additional objective of this study was to develop a project that could restore water quality as nearly as possible to its pre-mine conditions, an alternative project has also been developed which more closely approaches that goal within a feasible cost level. The alternative project is referred to in this report as the "maximum feasible pollution abatement project" and is described in this chapter. Two options have been developed to achieve maximum feasible pollution abatement, depending on the funding available. Both could be implemented at the same time, or each one could be undertaken separately or in stages. To attain the greatest benefits, a composite of the two options could be desirable. Estimated construction costs would be $5.82 million, with average annual maintenance of $91,800 for the first five years for this composite site.

RECOMMENDED PROJECT DESCRIPTION

The recommended project consists of the following five major elements. Figure 7-1[a] shows the general areas of the site where each of the elements apply.

1. Leviathan Creek Channelization
2. Mine Pit Filling and Regrading
3. Waste Dump Excavation and Regrading
4. On-Site Evaporation Ponds
5. Spoil Area A Regrading and Drainage Work

The following is a detailed description of each of the major elements included in the recommended project.

Leviathan Creek Channelization

Leviathan Creek will be channelized east of its present alignment from a point just south of the waste dump northerly just beyond the delta. Total length of the rechannelization is approximately 1,900 feet. The slope of the channel invert will be in the range of 5 feet/1,000 feet to 200 feet/1,000 feet, depending upon localized conditions. Two options were analyzed in detail for the channel section. One option is for the channel to be constructed by cut and fill to a generally trapezoidal cross-section with side slopes of 2.5:1 (horizontal:vertical) as shown on Figure 7-2). The channel bottom and sides will be sealed to reduce permeability by the use of soil cement. To provide adequate erosion protection, the channel must be riprapped along its entire length and the riprap grouted. The other option is to construct a wire mesh reinforced concrete channel with a rectangular section as shown on Figure 7-3. This type of section is more durable, provides some additional factor of safety, and is slightly less costly, and has thus been selected as the preferred option. Figure 7-4 shows several sections along the channel alignment. Where there are significant changes in grade or in other potential localized areas of expected turbulence, channel walls will be extended up another couple of feet for added protection. Two unnamed former tributaries of Leviathan Creek which now terminate into the mine dump are to be reconnected to the new Leviathan Creek channel. These channels will have sections similar to that shown on Figure 7-2 and will be sealed with soil cement. The grades are relatively mild for most of the length of these channels, but

[a]Throughout this report, figures referenced in the text are included at the end of the chapter where first referenced. Plates referenced are included in a map pocket following the appendices.

will require some localized riprapping in steeper sections. In the delta, the creek will be elevated approximately 10 feet above its present alignment to prevent acid groundwater seepage from entering the channel through the sides and bottom.

Mine Pit Filling and Regrading

The mine pit will be filled and regraded from its present bottom elevation of about 7,060 feet to approximately elevation 7,160 feet. Figure 7-5 shows a plan view of mine pit regrading. The compacted pit fill will be constructed as a series of from two to four terraces placed around the circumference of the pit. The top slopes of the terraces will be about 2 feet per 100 feet. The faces of the terraces will be constructed on 3:1 to 10:1 fill slopes. Pit fill material will be obtained on site from the mine waste dump excavation. Approximately 380,000 cubic yards of fill is required. Earthen drainage channels will be placed around the circumference of each terrace to collect runoff from the top slope. These terrace drainage channels will be sealed using soil cement and will discharge into open channels constructed on the fill slopes to carry the runoff to the bottom of the pit runoff collected at the pit bottom will be transported in an open channel to a transition structure located near the mouth of the pit. There, the open channel flows will be collected and piped out of the pit and discharged to Leviathan Creek. During design, consideration will be given to channelizing these flows to the creek or other methods to avoid potential clogging of the pipeline.

Prior to placement of the pit fill, a pit underdrain system will be constructed to drain groundwater which now underlies the pit bottom and to provide continued underdrainage to this area after project construction. The underdrain system will consist of a rock-filled trench with flat bottoms at elevation 7,054 feet throughout. The trench will be installed across the mouth of the pit in a T-shaped pattern as shown on Figure 7-6. A concrete barrier wall will be constructed to aid in collecting the underdrain flow in a perforated pipe. Around the rock-filled trenches, geotechnical fabric will be placed to prevent soil filling of the rock voids. The trench will then be backfilled with compacted trenching spoil. The underdrain flows will be piped out the pit mouth and combined at a control structure with flows collected from the adit as described in the subsection on On-Site Evaporation Ponds.

The underdrain system in the recommended project is substantially modified and reduced in extent from the concept introduced in Chapter 5. These modifications were made because of: (1) the high cost of the more extensive system discussed in Chapter 5, (2) concern that although the suggested lime rock fill would likely have a significant buffering effect in its initial period of use, this capacity would diminish rapidly as

the lime rock surfaces became coated with precipitates, and (3) concern that the transmissivity of the formations into which the drain would be placed would be sufficiently low that the rock drains would not produce significant quantities of water unless uneconomically large wall areas were provided. Accordingly, the extensive lime rock drain system described in Chapter 5 has been value-engineered to a simpler rock-filled collector system positioned to intercept flows emerging underground through the mine pit breach and Adit No. 5.

Waste Dump Excavation and Regrading

The waste dump will be regraded from its present maximum elevation of 7,117 feet to a new maximum elevation of 7,045 feet. Material excavated from the waste dump will be used for filling and regrading the mine pit and for filling and regrading the north and east sides of the waste dump and the area south of the abandoned crusher structure (pond Site 5). A typical section showing work on the waste dump is presented on Figure 7-7. Finished slopes on the regraded waste dump will be 2:1 on both the north and east faces. A total of approximately 472,000 cubic yards of material will be removed in the waste dump regrading. About 92,000 cubic yards will be used in fills adjacent to the waste dump and 380,000 cubic yards will be used as mine pit fill. This major regrading of the waste dump will provide a large flat area on top of the regraded dump for placement of a 9.3-acre evaporative waste disposal pond.

On-Site Evaporation Ponds

A total of 15.1 acres of evaporation ponds will be constructed at four locations on the site as shown on Figure 7-8. The size and locations of the ponds include 9.3 acres at Site 1, 1.5 acres at Site 2, 1.6 acres at Site 3, and 2.7 acres at Site 5. Earthen pond dikes are to be constructed in compacted lifts using material obtained from the mine site. The maximum base to crest height of the pond dikes will be about 6 feet. The dike cross-section is trapezoidal with a top width averaging about 12 feet. Side slopes on the exterior dikes are to be 3:1 on the waterside and 2:1 on the landside. In some cases, interior dikes divide the pond area into cells. The interior dikes are to be constructed similarly to the exterior dikes except that all side slopes will be 3:1.

The pond bottoms are to be constructed on engineered fill and sealed with a 36-mil PVC acid-resistant liner which extends up the interior slopes of the exterior and interior dikes to an elevation above the high-water line. Within each pond cell, the pond bottom is to be sloped mildly to a maintenance drainage sump in one corner. The pond membrane will be protected by a minimum cover of one foot of earth.

At Sites 1 and 5, the ponds are divided into two cells each to permit bypassing of all or a portion of the ponds. Distribution piping from the control structure is designed to feed any of the four cells in pond Sites 1 and 5 or bypass the ponds altogether with the flows routed directly to pond Site 2. The ponds and pond cells are interconnected with pipes set below the maximum high-water line elevation. These pipes prevent the ponds from overflowing in addition to permitting gravity distribution of flow between the ponds. Water will overflow from Site 5 at elevation 7,050 to Sites 1, 2, and 3 at elevation 7,045, 6,990, and 6,900, respectively. An emergency spill overflow line is provided from Site 3 to Leviathan Creek.

Groundwater that is collected in the mine pit underdrain trench and piped out the pit mouth will be combined at a control structure with contaminated groundwater collected at the adit. Figure 7-9 shows the control structure with associated piping and control features. Water from the adit will be conveyed into the control structure, combined with the underdrain flows, and allowed to flow into the pond distribution piping. Adjustable overflow weirs will regulate flows into the ponds. Weir elevation will be set based on available pond surface area, site evaporation rates, storage capacity, and annual precipitation. Flows exceeding the quantities estimated by the above parameters will be allowed to overflow into the pipeline carrying runoff flows from the pit to Leviathan Creek. The use of an adjustable weir will allow change of the weir setting as operating experience is gained. The design and operation of this structure will not be affected if, during detailed design, an open channel in lieu of the pipeline is used to transport pit runoff flows to Leviathan Creek.

Expected acid conditions in the adit flows and mine pit underdrainage will require that the control structure's concrete be protected by an epoxy lining and that all interior fittings be similarly corrosion-resistant.

Spoil Area A Regrading

Surface depressions on Spoil Area A will be regraded to provide positive surface drainage. Surface channels will be constructed by bulldozer at slopes of 2 to 3 percent. Channels on slopes where velocities exceed 2.5 feet per second will be lined with 4-inch-diameter rock. The proposed drainage work is shown on Figure 7-10.

ESTIMATED COSTS OF RECOMMENDED PROJECT

The estimated construction bid price project cost is $2,798,000. The estimated average annual cost for project maintenance is $10,520 per year for the first five years. These costs are detailed in Tables 7-1 and 7-2.

Table 7-1. Estimated Construction Bid Price--Recommended Project

Item No.	Description	Estimated quantity	Unit price, dollars	Total cost, dollars
1	Mobilization for two seasons	Lump sum	--	110,000
2	Pre-fill stripping and leveling of mine pit	10 acres	1,520.00	15,200
3	Waste dump excavation to elevation 7,045 and pit fill			
	a. Fill/regrade north and east sides of dump	31,000 yards	1.60	49,600
	b. Fill/regrade side slopes for Pond Site 5	57,000 yards	1.75	99,800
	c. Fill/regrade mine pit	290,000 yards	1.85	536,500
5	Regrade pit above elevation 7,160	20 acres	1,900.00	38,000
6	Bench surface drainage channels complete including lining with concrete	2,200 feet	30.00	66,000
7	Fill slope surface drainage channels complete including lining with concrete	2,150 feet	35.00	75,300
8	Surface drainage collection channel complete including lining with concrete	670 feet	47.00	31,500
9	Surface drainage concrete transition structure	12 yards	450.00	5,400
10	Surface drainage transport pipe, 36-inch VCP	1,140 feet	50.00	57,000
11	Surface drainage concrete outfall structure at Leviathan Creek	2 yards	500.00	1,000
12	Mine pit underdrain trench with rockfill	Lump sum	--	2,400
13	Underdrain piping from pit underdrain trench to underdrain control structure, 8-inch PVC	600 feet	5.00	9,000
14	Underdrain control structure and equipment	Lump sum	--	9,500
15	Leviathan Creek rechannelization with concrete rectangular channel	Lump sum	--	280,000
16	Tributary creek rechannelization, including soil cement liner and localized riprapping	Lump sum	--	60,000
17	Evaporation ponds, including distribution and interconnection piping			
	a. Site 1, 9.3 acres of pond surface	Lump sum	--	533,000
	b. Site 2, 1.5 acres of pond surface	Lump sum	--	76,000
	c. Site 3, 1.6 acres of pond surface	Lump sum	--	82,000
	d. Site 5, 2.7 acres of pond surface	Lump sum	--	105,000
18	Spoil Area A regrading and drainage works			
	a. Regrade surfaces	22,000 yards	1.25	27,500
	b. Regrade drainways	8,100 yards	1.55	12,600
	c. Erosion protection with rock	2,100 tons	17.50	36,800
	d. 18-inch-diameter CMP culvert	300 feet	40.00	12,000
	Project subtotal	--	--	2,331,100
	Contingency @ ±20 percent	--	--	466,900
	Total estimated price	--	--	2,798,000

Table 7-2. Estimated Annual Maintenance Cost—Recommended Project

Project element	Maintenance cost, dollars			
	Initial year	Fifth year	First five years total	Second five years total
1. Regraded dump, pit, and associated surface drainage facilities	5,700	900	16,500	4,500
2. Underdrain system, ponds, and associated piping	6,100	4,600	26,800	23,000
3. Creek channels	2,600	400	7,500	2,000
4. Spoil Area A	600	100	1,800	500
Total	15,000	6,000	52,600	30,000

Estimated Construction Bid Price

The bid price construction cost detailed in Table 7-1 is a predesign estimate of contractor bid price for the work. Definitions of this and other terminology used in Table 7-1 are presented in the Chapter 5 discussion of the basis of cost estimates.

The cost levels used in the estimate reflect bidding of the entire project in the late spring (approximately May) of 1983. If significant delay occurs in bidding so as to extend construction into a third construction season, inflationary cost escalation on delayed project work would be expected. Northern California construction cost inflation is currently averaging about 5 percent per year. The inflation rate for construction cost in this region averaged about 9 percent per year in the period 1977 through 1981.

Estimated Maintenance Cost

The estimated annual maintenance cost shown in Table 7-2 decreases from $15,000 in the initial year to $6,000 in the fifth year. The five-year total cost is $52,600. The highest ongoing maintenance cost is for the waste pond system which will require regular inspection. Maintenance of regraded slopes and surface runoff facilities is highest in the initial years decreasing to a rather low inspection and minor correction level by the fifth year. This also applies to the creek channels.

The maintenance cost estimate for all items assumes annual use of a crew consisting of (1) A D-4 type bulldozer with operator, (2) four laborers, and (3) a foreman with pickup truck. In the initial year, it is assumed that 15 crew days of work are required. An initial year materials cost of $1,200 is included in the estimate. By the fifth year and thereafter, it is assumed the five crew days work are required along with $1,000 in materials.

REVEGETATION ADDITION TO RECOMMENDED PROJECT

It is possible to enhance the control effectiveness of the recommended project by selected revegetation. At this point, the success of establishment of vegetation on the site is uncertain. Pilot revegetation studies to be conducted over the next two years will demonstrate the potential for revegetation. If integrated into the recommended project, revegetation could (1) help physically stabilize the surfaces of slopes in the pit, and on the waste dump and Spoil Area A, (2) evapotranspire the drainage that can be expected to collect in the delta (by planting willows), and (3) reduce surface runoff and infiltration of precipitation on the site, and thus reduce pollutant loadings to the creeks.

The estimated costs for effective revegetation of the major exposed areas of the mine elements is shown in Table 7-3.

Table 7-3. Costs for Revegetation Addition to Recommended Project

Description	Estimated quantity, acres	Unit price, dollars	Total cost, dollars
Waste dump	7	3,500	24,500
Mine pit	38	3,500	133,000
Spoil Area A	15	3,500	52,500
Delta	2	5,000	10,000
Total			220,000

Annual maintenance costs will be greatly increased with revegetation as shown in Table 7-4. Replanting of vegetation contributes heavily to the cost in the initial year and diminishes to zero by the fourth year. These costs assume that 15 to 20 percent of the initial revegetation cost must be expended for replanting in the first year. In the second and

third years, this reduces to 5 to 10 percent of the first planting cost. Thereafter, no additional replanting will be required.

Table 7-4. Estimated Annual Maintenance Cost for Revegetation Addition to Recommended Project

Project element	Maintenance cost, dollars			
	Initial year	Fifth year	First five years	Second five years
Waste dump	4,300	0	7,900	0
Mine pit	23,300	0	43,300	0
Spoil Area A	9,200	0	17,000	0
Delta	1,800	0	3,400	0
Total	38,600	0	71,600	0

CONTROL EFFECTIVENESS OF THE RECOMMENDED PROJECT

The effectiveness of the recommended project in reducing pollutant loads and partially restoring beneficial uses of Leviathan and Bryant Creeks has been evaluated for two cases as follow:

1. Recommended project
2. Recommended project with addition of revegetation

Reduction of TDS Load and Concentration

Following the same procedures described in Chapter 6 for evaluation of the alternatives, the expected reduction in TDS load and concentration has been estimated for the recommended project and for the recommended project with addition of revegetation.

Recommended Project. The recommended project is estimated to reduce the annual mean TDS load from the mine site from an estimated 1,680 tons/year to about 356 tons/year; a 79 percent reduction. This equates to a unit control cost of about $2,200/ton of TDS load reduction/year. In comparison to the alternatives presented in Chapter 6, the recommended project nearly achieves the control of the most expensive alternative at a control cost comparable to the least expensive alternative.

The resultant TDS concentrations in Leviathan Creek just below the waste dump, and at the downstream end of the mine site that are estimated to result from implementation of the recommended project, are shown in Table 7-5.

Table 7-5. Estimated TDS Concentrations in Leviathan Creek with the Recommended Project, Without Revegetation

Annual mean TDS concentration, mg/l		Maximum monthly mean TDS concentration, mg/l	
Below waste dump	Below mine site	Below waste dump	Below mine site
214	346	286	422

Recommended Project With Revegetation. Revegetation appears to offer good potential for enhancement of the control effectiveness of the recommended project, but it would probably take 5 to 10 years before it matured to the point of effective control of infiltration and reduction of surface runoff. Table 7-6 shows the estimated water quality after initial addition of revegetation to the project and several years later when the vegetation has matured.

Table 7-6. Estimated TDS Concentrations in Leviathan Creek with the Recommended Project, With Revegetation

	Annual mean TDS concentration, mg/l		Maximum monthly mean TDS concentration, mg/l	
	Below waste dump	Below mine site	Below waste dump	Below mine site
Prior to maturity of revegetation	214	346	286	422
Upon maturity of revegetation	170-180	310-320	180-190	399-413

Limitations of Control Effectiveness Estimates

The calculations of TDS concentrations used to compare alternatives and to estimate the effects of the recommended project rely on the simplifying assumption that dissolved substances remain in solution when mine drainage is mixed with the natural flow in the creeks. However, when the two flows are mixed, several chemical reactions are likely to occur which will affect the mass balances of some substances by precipitation or dissolution. Accurate prediction of the concentrations of various pollutant species in Leviathan Creek after construction of improvements depends upon accurate calculation of pH and identification of important precipitation/dissolution reactions.

The simplest method of calculating pH in the creek would be to use characteristic alkalinity and acidity values for the natural impacts and for mine drainage. Even with adequate acidity and alkalinity measurements available, precise prediction of pH in the stream is difficult. Reduced sulfur species may be present which can contribute to acid-generating potential, but which would not be measured in an acidity determination. Similarly, high concentrations of minerals such as aluminum and iron may contribute to the acid-generating potential of the mine drainage.

The calculation of pH and identification of acid-producing species present is important in the prediction of concentrations of dissolved minerals which may be involved in precipitation or dissolution reactions. This is particularly relevant to the calculation of heavy metal concentrations. Between surface water quality Stations 10 and 17, the existing data indicate that some precipitation of sulfate, iron, copper, aluminum, manganese, and arsenic is occurring under present conditions. After improvements, such precipitation can be expected to increase due to higher pH values in the creek and increased dilution. Several of the species involved in precipitation reactions are among the most important contaminants contributing to decreased beneficial uses in Leviathan Creek. Because iron, sulfur, and aluminum all are significant portions of the total dissolved solids concentrations, precipitation of these species will also affect the expected TDS concentrations.

WATER QUALITY BENEFITS OF THE RECOMMENDED PROJECT

The reduced TDS load and concentration in Leviathan Creek resulting from the recommended project are presented in the previous section. The mean annual TDS concentration below the mine site will be about 180 mg/l without addition of

revegetation to the recommended project and potentially 140 mg/l if revegetation was added and proved successful. As discussed in Chapter 6, all of the beneficial uses of Leviathan and Bryant Creeks would be achieved at this TDS concentration if the TDS was composed of nontoxic anions and cations. In Leviathan and Bryant Creeks, dissolved toxic metals constitute a large portion of the TDS concentration.

The metals concentrations at Stations 17, 25, and 26 were estimated based on calculations which take into account the effects of increased pH of the stream below the mine and reduced metals emissions, both of which would result from the recommended project. The resultant estimated metals concentrations are presented in Table 7-7.

Table 7-7. Estimated TDS and Metals Concentrations With the Recommended Project, Without Revegetation

Parameter	Units	Concentration		
		Station 17	Station 25	Station 26
TDS	mg/l	346	150-155	150-155
Iron	ug/l	20,100	5,600	2,300
Copper	ug/l	72	52	43
Cadmium	ug/l	10	4	2
Chromium	ug/l	50	17	4
Zinc	ug/l	55	34	15
Arsenic	ug/l	73	26	13
Nickel	ug/l	172	72	61
Lead	ug/l	3	1	2

The concentrations presented in Table 7-7 were compared to the water quality criteria presented in Table 3-1 to determine which of the designated beneficial uses would be achieved with the recommended project. Table 7-8 presents the results of this comparison. The concentrations were compared to the criteria for cold freshwater habitat, irrigation, stock watering, and domestic water supplies. The criteria for domestic water supplies were used since there are no criteria for groundwater recharge. The table shows that irrigation and stock watering criteria will be met with the recommended project. All of the criteria except iron and nickel will be met for domestic water supplies. Table 7-8 shows that most of the criteria for cold freshwater habitat will not be met with the recommended project.

Table 7-8. Stations Which Meet the Criteria for Beneficial Uses With the Recommended Project, Without Revegetation.

Parameter	Beneficial use			
	Cold freshwater habitat	Irrigation	Stock watering	Groundwater recharge and domestic water supplies
TDS	All	All	All	All
Iron	None	26	-	None
Copper	None	All	All	All
Cadmium	None	All	All	All
Chromium	None	All	All	All
Zinc	25,26	All	All	All
Arsenic	25,26	All	All	-
Nickel	None	All	-	None
Lead	None	All	All	All

The metals concentrations at Stations 17, 25, and 26 were estimated based on the recommended project with revegetation. The estimated concentrations are presented in Table 7-9. The concentrations in Table 7-9 were compared to the water quality criteria presented in Table 3-1 to determine which of the beneficial uses would be achieved with the recommended project and revegetation. Table 7-10 shows that irrigation, stock watering, and groundwater recharge criteria will be met but the criteria for cold freshwater aquatic life will be exceeded. Although revegetation results in lower metals concentrations in the creeks, the concentrations will not be sufficiently reduced to meet the cold freshwater habitat criteria.

MAXIMUM FEASIBLE POLLUTION ABATEMENT PROJECT

The evaluation of alternatives and comparison of their cost-effectiveness led to the development of the recommended project. The recommended project was developed by refinements which minimized the cost of the apparent best alternative while maintaining the same or an increase in the expected water quality. A more intense (and costly) application of the pollution abatement concepts employed in the recommended project can be used to develop a cost-effective project which

Table 7-9. Estimated TDS and Metals Concentrations With the Recommended Project, With Revegetation

Parameter	Units	Concentration		
		Station 17	Station 25	Station 26
TDS	mg/l	310-320	150-155	150-155
Iron	ug/l	16,000	4,500	2,500
Copper	ug/l	67	48	41
Cadmium	ug/l	10	4	2
Chromium	ug/l	48	16	3
Zinc	ug/l	49	30	13
Arsenic	ug/l	7	3	1
Nickel	ug/l	142	60	51
Lead	ug/l	3	1	2

Table 7-10. Stations Which Meet the Criteria for Beneficial Uses With the Recommended Project, With Revegetation

Parameter	Beneficial use			
	Cold freshwater habitat	Irrigation	Stock watering	Groundwater recharge and domestic water supplies
TDS	All	All	All	All
Iron	None	25,26	-	None
Copper	None	All	All	All
Cadmium	None	All	All	All
Chromium	None	All	All	All
Zinc	25,26	All	All	All
Arsenic	All	All	All	-
Nickel	26	All	-	None
Lead	None	All	All	All

more nearly returns water quality to its pre-mine condition. Although the cost of this maximum feasible abatement project far exceeds the estimated available construction funding of $2.5 to $2.7 million, the resulting analysis is useful for comparison with the recommended project and for identifying where additional funds might most effectively be spent if they become available at a future date.

Two variations of the recommended project to produce the maximum feasible pollution abatement project have been developed. Selection of the appropriate variation will depend upon the results of the 1983-84 pilot revegetation study, including tests of survivorship and evapotranspirative capacity of plantings. One variation of the recommended project includes substantial additional regrading and filling of the mine pit to further reduce infiltration and promote surface runoff. Except for Spoil Area A, work on other site features is not substantially different from the recommended project. Extensive excavation of Spoil Area A is required to provide the necessary fill material for the mine pit. This variation recognizes the mine pit as the single, most important contributor to water quality problems in Leviathan Creek, and includes provision for complete control of subsurface drainage from the mine pit in years in which higher than normal annual rainfall occurs. The second variation of the recommended project relies heavily on site revegetation to control drainage from all areas of the site, including the pit. This variation is potentially much more effective than regrading, but involves a great deal of uncertainty at this time. If the results of the pilot revegetation study are favorable, the second variation can be expected to produce more permanent and effective control of the water quality problems at Leviathan Mine.

Description of Project Variations

Figure 7-11 schematically depicts the maximum feasible pollution abatement project if revegetation is not relied upon heavily. The mine pit is nearly completely filled and regraded to produce a series of terraces in the compacted pit fill. The regrading work is similar to that for the recommended project, but covers roughly twice the surface area in the pit. The terraces would be constructed to the same slope specifications as for the recommended project, and would be provided with earthen drainage channels, sealed with soil cement. Runoff from the terraces would be collected in a surface drainage system and routed to Leviathan Creek. Fill work in the pit would require approximately 770,000 cubic yards of material, which would be obtained on site. Approximately 380,000 cubic yards would come from regrading of the mine waste dump area and 390,000 cubic yards would come from Spoil Area A.

An underdrain system similar to that included in the recommended project would be constructed in the floor of the pit. Drainage would be collected in a rock-filled trench with a bottom elevation of 7,054 feet. The underdrain flows would then be piped out of the pit to evaporation ponds. The size and location of the evaporation ponds would be exactly as described for the recommended project.

Revegetation of the pit would be included in this variation, although primarily for the purpose of slope stabilization rather than elimination of percolation. The vegetation would have the potential to further reduce subsurface flows once it became established. The same level of revegetation of the mine pit used in the recommended project is assumed for this variation of the maximum feasible pollution abatement project.

The second variation of the maximum feasible pollution abatement project relies heavily on revegetation of the entire site. In this case, successful results from the pilot revegetation study are assumed, and the primary mechanism for elimination of contaminated seepage to the creeks is an increase in the evapotranspiration from the mine site. Physical improvements to the site would be nearly exactly the same as for the recommended project. However, the entire mine site would be planted at a high density, and the plantings maintained (for about three years) until the maximum vegetative carrying capacity of the site was obtained.

A combination of the two maximum feasible pollution abatement project options would provide additional benefits. Maximum early control of water quality problems can be combined with maximum long-term control by using both regrading and revegetation work. Such a composite of the two maximum feasible project variations would provide effective control of the pit problem over a wide range of hydrologic conditions as soon as construction was completed. Eventually, after vegetation reached maturity, more effective control of other sources on the ite would be obtained.

Control Effectiveness--Maximum Feasible Project

The control effectiveness of each of the variations can be estimated with calculations of surface and subsurface flows and concentrations. Regrading and filling of the pit drastically reduces the quantity of infiltrating water and resulting subsurface flow. More than twice the area of the pit is filled and regraded in one variation of the maximum feasible project than in the recommended project. Using a 20-year return period (wet year) annual precipitation (based on Woodfords data and estimated conversion to Leviathan Mine precipitation), the resulting subsurface flow from the pit can

be completely contained and evaporated in the ponds. This zero discharge compares with a 274 acre-feet per year discharge of subsurface drainage to Leviathan Creek with the recommended project and the 20-year return precipitation level.

Surface flows out of the pit can also be estimated by calculation for average annual and 20-year return period precipitation levels. Using estimated concentrations for surface and subsurface drainage from the pit, the total annual TDS loads are shown in Table 7-11 for comparison.

Table 7-11. Estimated Annual TDS Loads to Creeks

Project	TDS load to creeks, tons/year	
	Average precipitation	20-year return period wet year precipitation
Maximum feasible pollution abatement project regrading variation	311	488
Maximum feasible pollution abatement project revegetation variation	220-260	389-650
Combination project	175-240	286-388
Recommended project	374	805

The monthly mean and mean annual TDS concentrations in receiving streams can be estimated as before using the hydrograph pattern developed as described in Chapter 6. This analysis results in the concentrations shown in Table 7-12. for an average rainfall year. It should be noted that the concentrations shown for the maximum feasible pollution abatement project are not significantly different from those shown for the recommended project. This result is due to the fact that the release to Leviathan Creek of subsurface drainage from the pit under mean precipitation conditions is quite small even in the recommended project. However, as evidenced by the difference in total annual loads to the creek for average and 20-year return period precipitation levels in Table 7-11, larger differences in water quality improvements between the recommended project and the maximum feasible pollution abatement project can be expected for precipitation levels higher than normal. On a statistical basis, discharge of subsurface drainage should be required only once every 20 years in the maximum feasible project, but nearly every year in the recommended project.

Table 7-12. Estimated TDS Concentrations In Leviathan Creek, Maximum Feasible Pollution Abatement Project Under Maximum Monthly Mean and Mean Annual Precipitation

Project	Below waste dump		At Station 17	
	Maximum monthly mean, mg/l	Mean annual, mg/l	Maximum monthly mean, mg/l	Mean annual, mg/l
Maximum feasible pollution abatement project regrading variation	209	205	390	317
Maximum feasible pollution abatement project revegetation variation	175-190	170-185	307-344	254-280
Combination project	170-190	161-182	263-327	222-268
Recommended project	286	201	422	346

Heavy revegetation of the site would affect the discharge from all site areas. It, therefore, has a large potential beneficial impact on water quality. Use of high-density planting is expected to result in little or no percolation into spoil materials and into the pit. With control of subsurface drainage and reduction of surface infiltration, the principal remaining source of TDS load to the creeks is surface runoff from the mine site. Tables 7-11 and 7-12 show the resulting TDS load and TDS concentration figures for the revegetation variations of the maximum feasible pollution abatement project.

Water Quality Benefits--Maximum Feasible Project

The reductions in heavy metals concentrations at Stations 17, 25, and 26 were estimated for the maximum feasible pollution abatement project, combination project. Table 7-13 presents the estimated concentrations. Although the concentrations are significantly reduced, the beneficial uses fully restored in the maximum feasible pollution abatement project are the same as those for the recommended project but the level of protection of these restored uses is significantly greater. Even where the water quality criteria for other uses are exceeded, the impacts can be expected to be significantly less with the maximum feasible project.

Table 7-13. Estimated Mean Annual TDS and Metals Concentrations for the Maximum Feasible Pollution Abatement Project

Parameter	Units	Station 17	Station 25	Station 26
TDS	mg/l	220-270	150-155	150-155
Iron	ug/l	11,400	3,200	1,700
Copper	ug/l	58	41	34
Cadmium	ug/l	7	3	2
Chromium	ug/l	36	12	3
Zinc	ug/l	43	27	12
Arsenic	ug/l	6	2	1
Nickel	ug/l	112	47	40
Lead	ug/l	3	1	2

Estimated Costs of Maximum Feasible Pollution Abatement Project

The estimated construction bid prices are $4,275,000 for the mine pit regrading variation (see Table 7-14) and $4,571,000 for the revegetation variation (see Table 7-15) of the maximum feasible pollution abatement project. The average annual maintenance costs for the first five years are $24,800 per year and $91,800 per year, respectively (Table 7-17).

Maximum early control of water quality problems can be combined with maximum long-term control by using both regrading and revegetation work. Such a composite of the two maximum feasible project variations would provide effective control of the pit problem over a wide range of hydrologic conditions as soon as construction was completed. Eventually, after vegetation reached maturity, more effective control of other sources on the site would be obtained. The construction bid price for a project which combines major regrading in the mine pit with heavy revegetation elsewhere on the site is estimated at $5,245,000 (see Table 7-16).

Table 7-14. Estimated Construction Bid Price--Maximum Feasible Pollution Abatement Project Regrading Variation

Item No.	Description	Estimated quantity	Unit price, dollars	Total cost, dollars
1	Mobilization for two seasons	Lump sum	--	110,000
2	Pre-fill stripping and leveling of mine pit	10 acres	1,520.00	15,200
3	Waste dump excavation to elevation 7,045 and pit fill			
	a. Fill/regrade north and east sides of dump	31,000 yards	1.60	49,600
	b. Fill/regrade side slopes for Pond Site 5	57,000 yards	1.75	99,800
	c. Fill/regrade mine pit	290,000 yards	1.85	536,500
4	Bench surface drainage channels complete including lining with concrete	4,400 feet	30.00	132,000
5	Fill slope surface drainage channels complete including lining with concrete	4,300 feet	35.00	150,600
6	Surface drainage collection channel complete including lining with concrete	670 feet	61.00	40,900
7	Surface drainage concrete transition structure	15.6 yards	450.00	7,000
8	Surface drainage transport pipe, 42-inch VCP	1,140 feet	60.00	68,400
9	Surface drainage concrete outfall structure at Leviathan Creek	2.6 yards	500.00	1,300
10	Mine pit underdrain trench with rockfill	Lump sum	--	2,400
11	Underdrain piping from pit underdrain trench to underdrain control structure, 8-inch PVC	600 feet	15.00	9,000
12	Underdrain control structure and equipment	Lump sum	--	9,500
13	Leviathan Creek rechannalization with a concrete rectangular channel	Lump sum	--	280,000
14	Tributary creek rechannelization, including soil cement liner and localized riprapping	Lump sum	--	60,000
15	Evaporation ponds, including distribution and interconnection piping			
	a. Site 1, 9.3 acres of pond surface	Lump sum	--	533,000
	b. Site 2, 1.5 acres of pond surface	Lump sum	--	76,000
	c. Site 3, 1.6 acres of pond surface	Lump sum	--	82,000
	d. Site 5, 2.7 acres of pond surface	Lump sum	--	105,000
16	Spoil Pile A regrading and drainage works			
	a. Regrade drainageways	8,100 yards	1.55	12,600
	b. Erosion protection with rock	2,100 ton	17.50	36,800
	c. 18-inch-diameter CMP culvert	300 feet	40.00	12,000
	d. Regrade slopes/fill mine pit	479,000 yards	1.85	886,200
17	Site revegetation			
	a. Waste dump	7 acres	3,500.00	24,500
	b. Mine pit	38 acres	3,500.00	133,000
	c. Spoil Pile A	15 acres	3,500.00	52,500
	d. Delta	2 acres	5,000.00	10,000
	e. Miscellaneous gully control	Lump sum	--	27,000
	Project subtotal	--	--	3,562,800
	Contingency @ ±20 percent	--	--	712,200
	Total estimated price	--	--	4,275,000

Table 7-15. Estimated Construction Bid Price--Maximum Feasible Pollution Abatement Project, Revegetation Variation

Item No.	Description	Estimated quantity	Unit price, dollars	Total cost, dollars
1	Mobilization for two seasons	Lump sum	--	110,000
2	Pre-fill stripping and leveling of mine pit	10 acres	1,520.00	15,200
3	Waste dump excavation to elevation 7,045 and pit fill			
	a. Fill/regrade north and east sides of dump	31,000 yards	1.60	49,600
	b. Fill/regrade side slopes for Pond Site 5	57,000 yards	1.75	99,800
	c. Fill/regrade mine pit	290,000 yards	1.85	536,500
4	Regrade pit above elevation 7,160	20 acres	1,900.00	38,000
5	Bench surface drainage channels complete including lining with concrete	2,200 feet	30.00	66,000
6	Fill slope surface drainage channels complete including lining with concrete	2,150 feet	35.00	75,300
7	Surface drainage collection channel complete including lining with concrete	670 feet	47.00	31,500
8	Surface drainage concrete transition structure	12 yards	450.00	5,400
9	Surface drainage transport pipe, 42-inch VCP	1,140 feet	50.00	57,000
10	Surface drainage concrete outfall structure at Leviathan Creek	2 yards	500.00	1,000
11	Mine pit underdrain trench with rockfill	Lump sum	--	2,400
12	Underdrain piping from pit underdrain trench to underdrain control structure, 8-inch PVC	600 feet	15.00	9,000
13	Underdrain control structure and equipment	Lump sum	--	9,500
14	Leviathan Creek rechannelization with a concrete rectangular channel	Lump sum	--	280,000
15.	Tributary creek rechannelization, including soil cement liner and localized riprapping	Lump sum	--	60,000
16	Evaporation ponds, including distribution and interconnection piping			
	a. Site 1, 9.3 acres of pond surface	Lump sum	--	533,000
	b. Site 2, 1.5 acres of pond surface	Lump sum	--	76,000
	c. Site 3, 1.6 acres of pond surface	Lump sum	--	82,000
	d. Site 5, 2.7 acres of pond surface	Lump sum	--	105,000
17	Spoil Pile A regrading and drainage works			
	a. Regrade surfaces	22,000 yards	1.25	27,500
	b. Regrade drainageways	8,100 yards	1.55	12,600
	c. Erosion protection with rock	2,100 ton	17.50	36,800
	d. 18-inch-diameter CMP culvert	300 feet	40.00	12,000
	e. Regrade slopes to 2:1 or less	120,000 yards	1.60	192,000
18	Site revegetation			
	a. Waste dump	26 acres	5,900.00	153,400
	b. Mine pit	40 acres	5,900.00	236,000
	c. Spoil Pile A	104 acres	5,900.00	613,600
	d. Delta	5 acres	5,900.00	29,500
	e. Spoil Piles B and C	37 acres	5,900.00	218,300
	f. Miscellaneous gully control	Lump sum	--	27,000
	Project subtotal	--	--	3,900,900
	Contingency @ ±20 percent	--	--	760,100
	Total estimated price	--	--	4,571,000

Table 7-16. Estimated Construction Bid Price--Maximum Feasible Pollution Abatement Project, Composite Project Combining Regrading and Revegetation

Item No.	Description	Estimated quantity	Unit price, dollars	Total cost, dollars
1	Mobilization for two seasons	Lump sum	--	110,000
2	Pre-fill stripping and leveling of mine pit	10 acres	1,520.00	15,200
3	Waste dump excavation to elevation 7,045 and pit fill			
	a. Fill/regrade north and east sides of dump	31,000 yards	1.60	49,600
	b. Fill/regrade side slopes for Pond Site 5	57,000 yards	1.75	99,800
	c. Fill/regrade mine pit	290,000 yards	1.85	536,500
4	Regrade pit above elevation 7,160	20 acres	1,900.00	38,000
5	Bench surface drainage channels complete including lining with concrete	4,400 feet	30.00	132,000
6	Fill slope surface drainage channels complete including lining with concrete	4,300 feet	35.00	150,600
7	Surface drainage collection channel complete including lining with concrete	670 feet	61.00	40,900
8	Surface drainage concrete transition structure	15.6 yards	450.00	7,000
9	Surface drainage transport pipe, 42-inch VCP	1,140 feet	60.00	68,400
10	Surface drainage concrete outfall structure at Leviathan Creek	2.6 yards	500.00	1,300
11	Mine pit underdrain trench with rockfill	Lump sum	--	2,400
12	Underdrain piping from pit underdrain trench to underdrain control atructure, 8-inch PVC	600 feet	15.00	9,000
13	Underdrain control structure and equipment	Lump sum	--	9,500
14	Levisthan Creek rechannelization with a concrete rectangular channel	Lump sum		
15	Tributary creek rechannelization, including soil cement liner and localized riprapping	Lump sum	--	60,000
16	Evaporation ponds, including distribution and interconnection piping		--	280,000
	a. Site 1, 9.3 acres of pond surface	Lump sum	--	533,000
	b. Site 2, 1.5 acres of pond surface	Lump sum	--	76,000
	c. Site 3, 1.6 acres of pond surface	Lump sum	--	82,000
	d. Site 5, 2.7 acres of pond surface	Lump sum	--	105,000
17	Spoil Pile A regrading and drainage works			
	a. Regrade drainageways	8,100 yards	1.55	12,600
	b. Erosion protection with rock	2,100 ton	17.50	36,800
	c. 18-inch-diameter CMP culvert	300 feet	40.00	12,000
	d Regrade slopes/fill mine pit	479,000 yards	1.85	886,200
18	Site revegetation			
	a. Waste dump	26 acres	5,900	153,400
	b. Mine pit	38 acres	3,500	133,000
	c. Spoil Pile A	104 acres	5,900	613,600
	d. Delta	5 acres	5,900	29,500
	e. Spoil Piles B and C	37 acres	5,900	218,300
	f. Miscellaneous gully control	Lump sum	--	27,000
	Project subtotal	--	--	4,850,600
	Contingency @ ±20 percent	--	--	970,400
	Total estimated price	--	--	5,821,000

Table 7-17. Estimated Annual Maintenance Costs, Maximum Feasible Pollution Abatement Project

Project	First year	Fifth year	First five years total
Regrading variation	53,000	6,000	124,200
Revegetation variation	234,000	6,000	459,000
Composite project	234,000	6,000	459,000

Estimated Construction Bid Price. The bid price construction costs listed in Tables 7-14, 7-15, and 7-16 are predesign estimates of contractor bid price for the work. The costs represent the expected price if bidding occurs in the late spring of 1983.

Estimated Maintenance Costs. The highest costs are associated with maintenance of heavy revegetation of the site. These costs are estimated as a percentage of the initial planting costs based on the level of replanting estimated to be necessary to obtain the required vegetative stands. Other costs were estimated as described for the recommended project.

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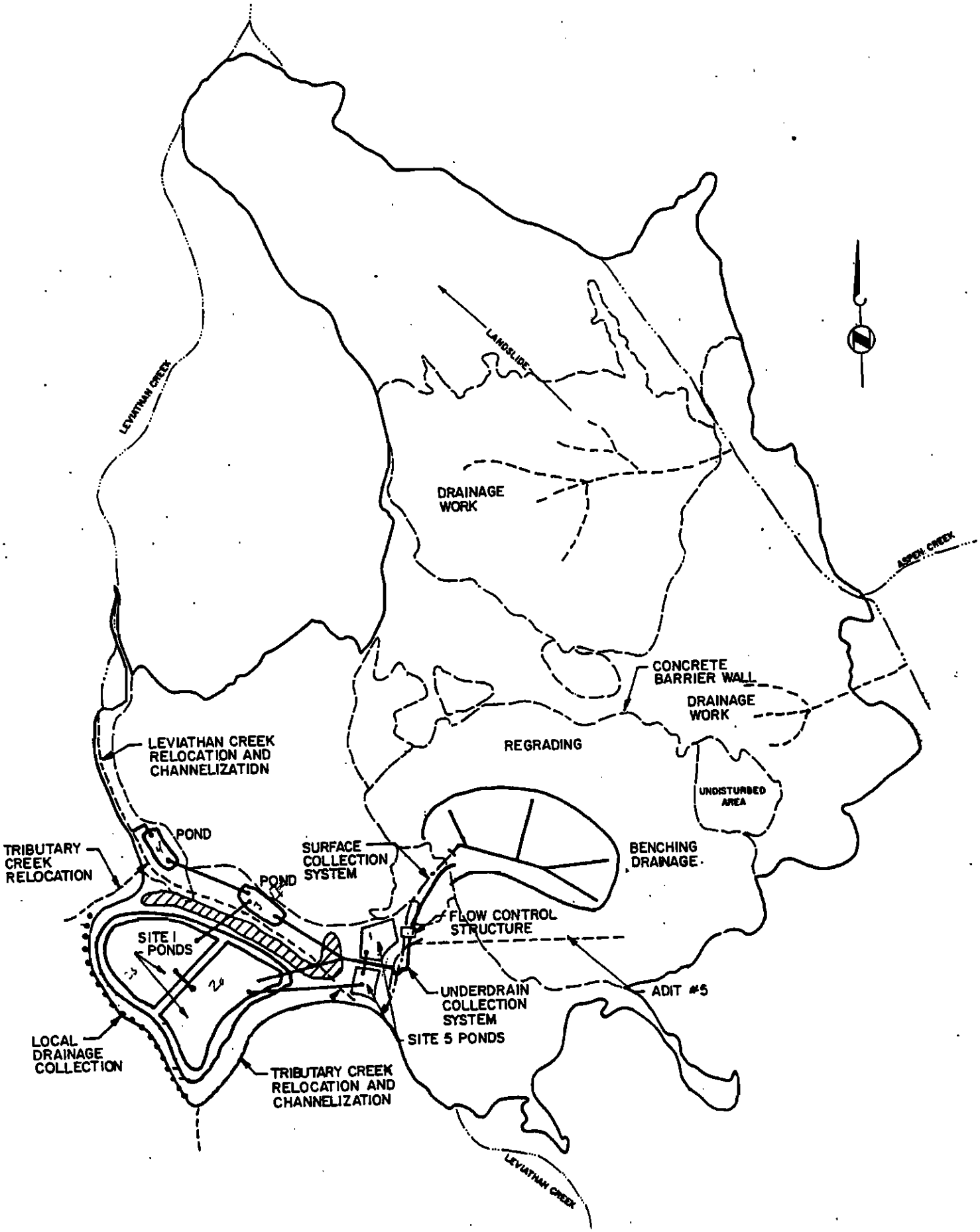


Figure 7-1 Location of Recommended Project Elements

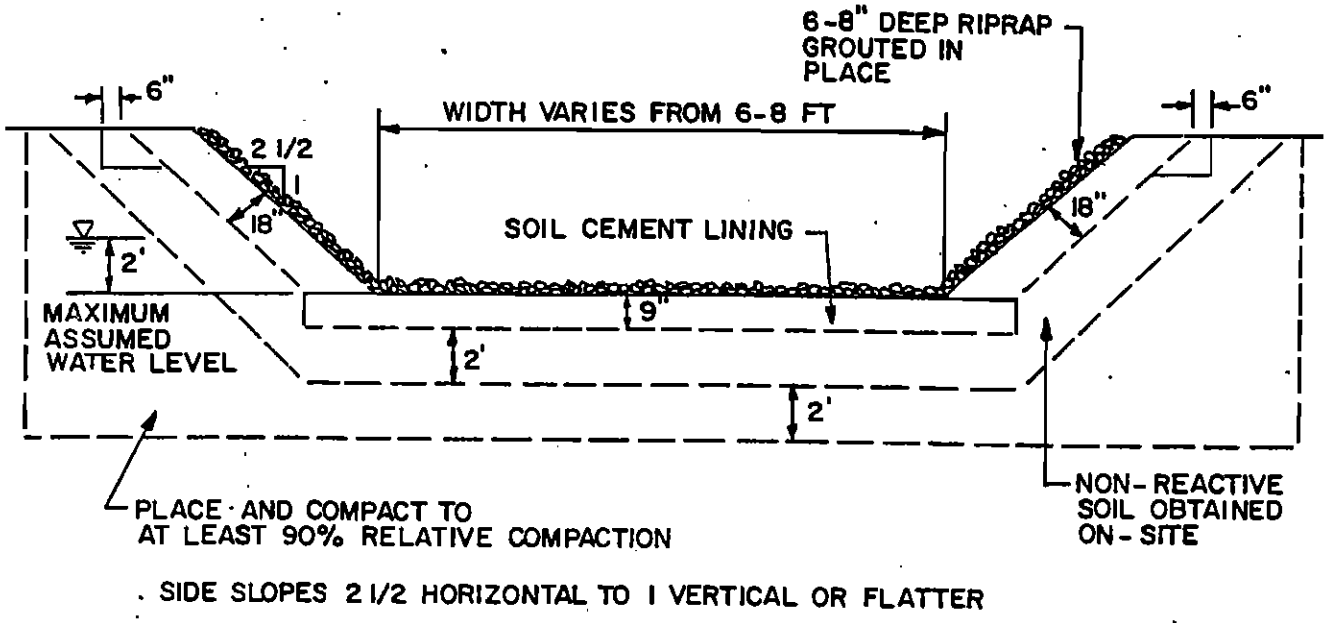


Figure 7-2 Typical Cross-Section of Leviathan Creek Soil Cement Channel

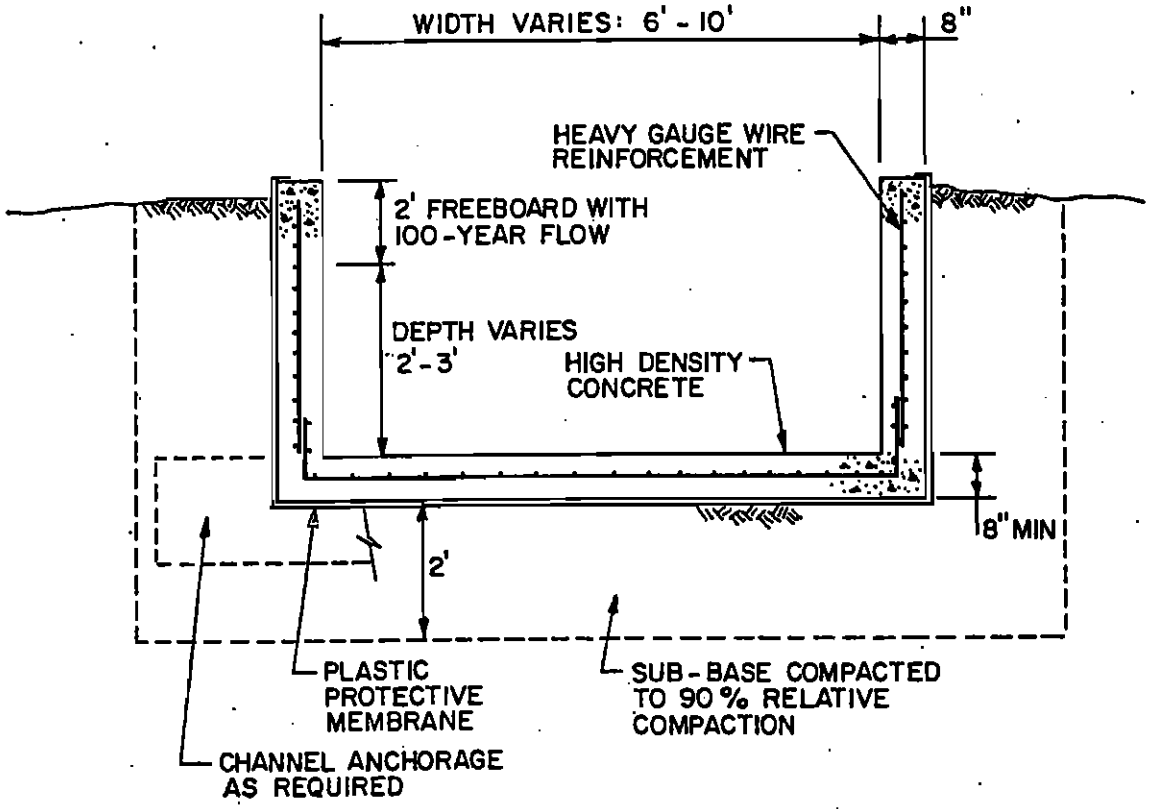
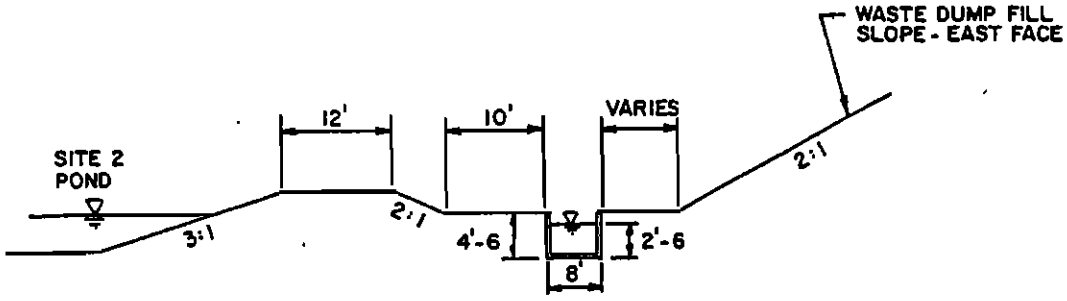
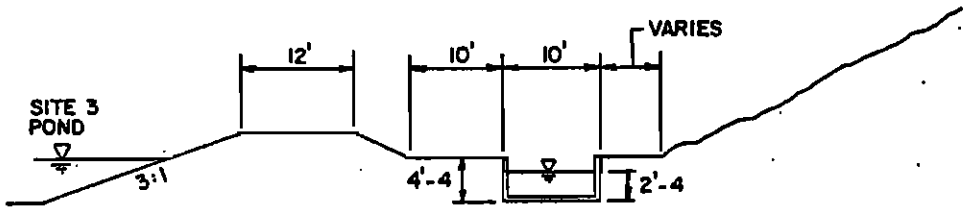


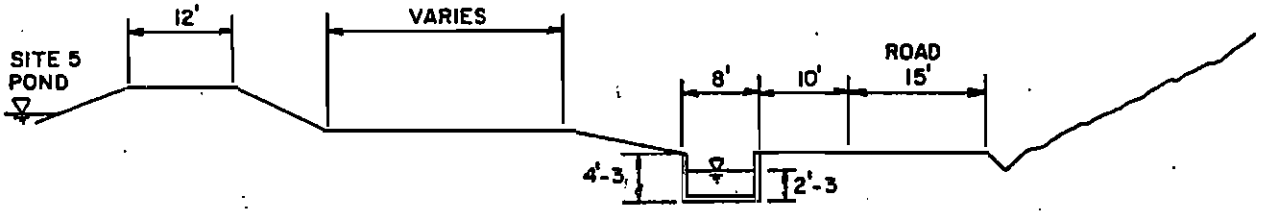
Figure 7-3 Typical Cross-Section of Leviathan Creek Reinforced Concrete Channel



CROSS-SECTION THROUGH LEVIATHAN CREEK
NEAR SITE 2 POND/WASTE DUMP



CROSS-SECTION THROUGH LEVIATHAN CREEK
IN THE DELTA NEAR SITE 3 POND



CROSS-SECTION THROUGH LEVIATHAN CREEK
NEAR SITE 5 POND

Figure 7-4 Typical Sections on Leviathan

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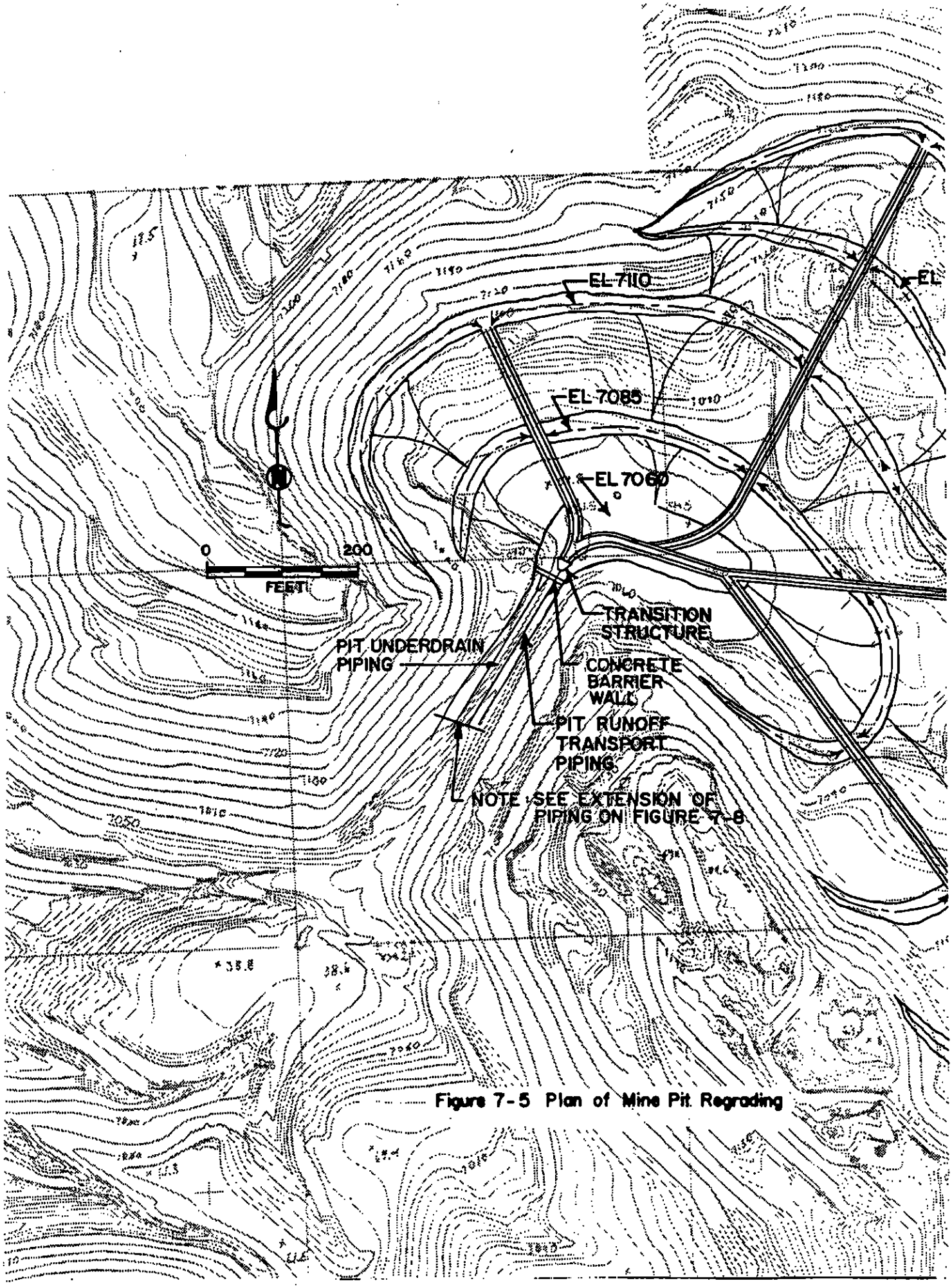
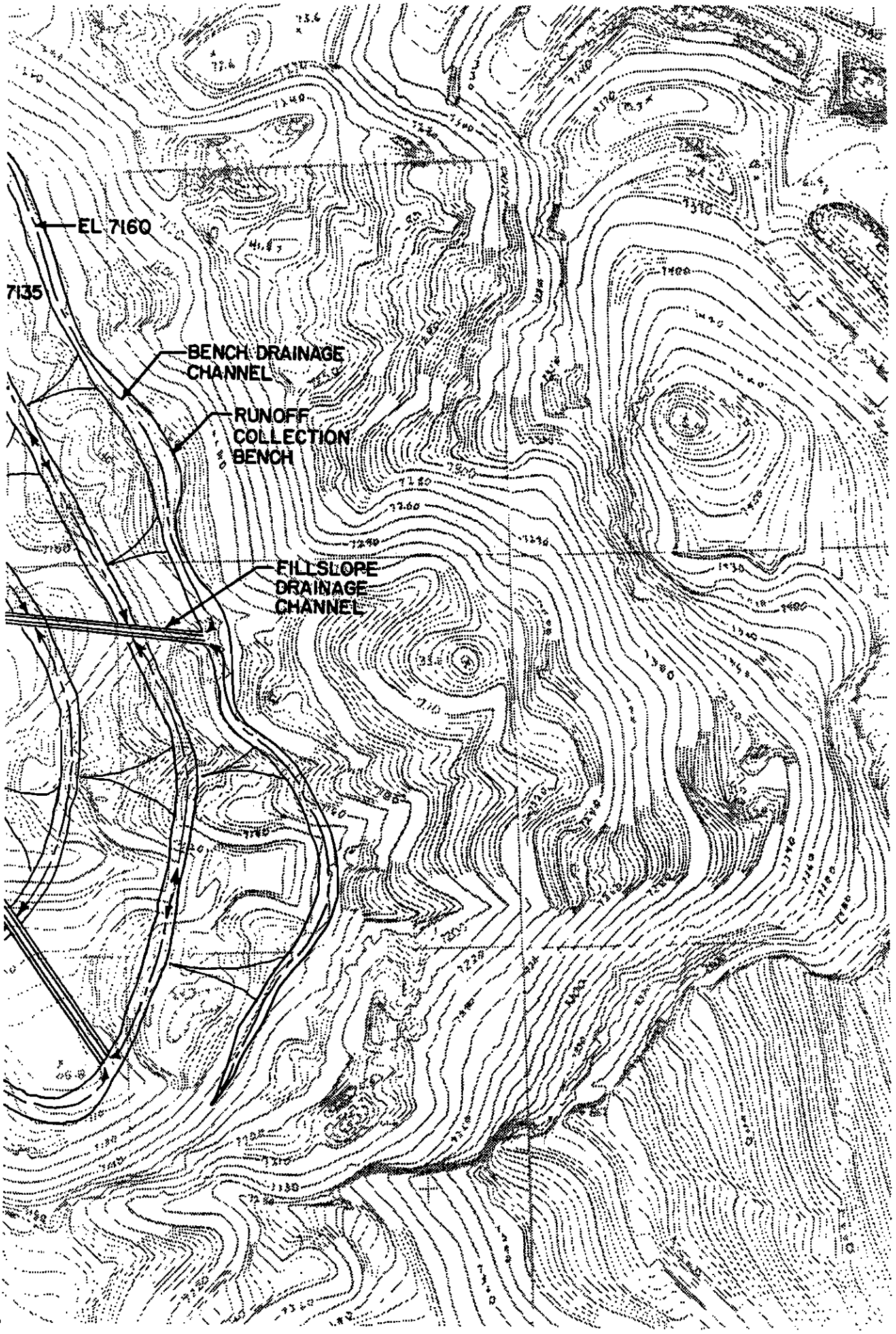


Figure 7-5 Plan of Mine Pit Regrading


EL 7160
7135
BENCH DRAINAGE CHANNEL
RUNOFF COLLECTION BENCH
FILLSLOPE DRAINAGE CHANNEL

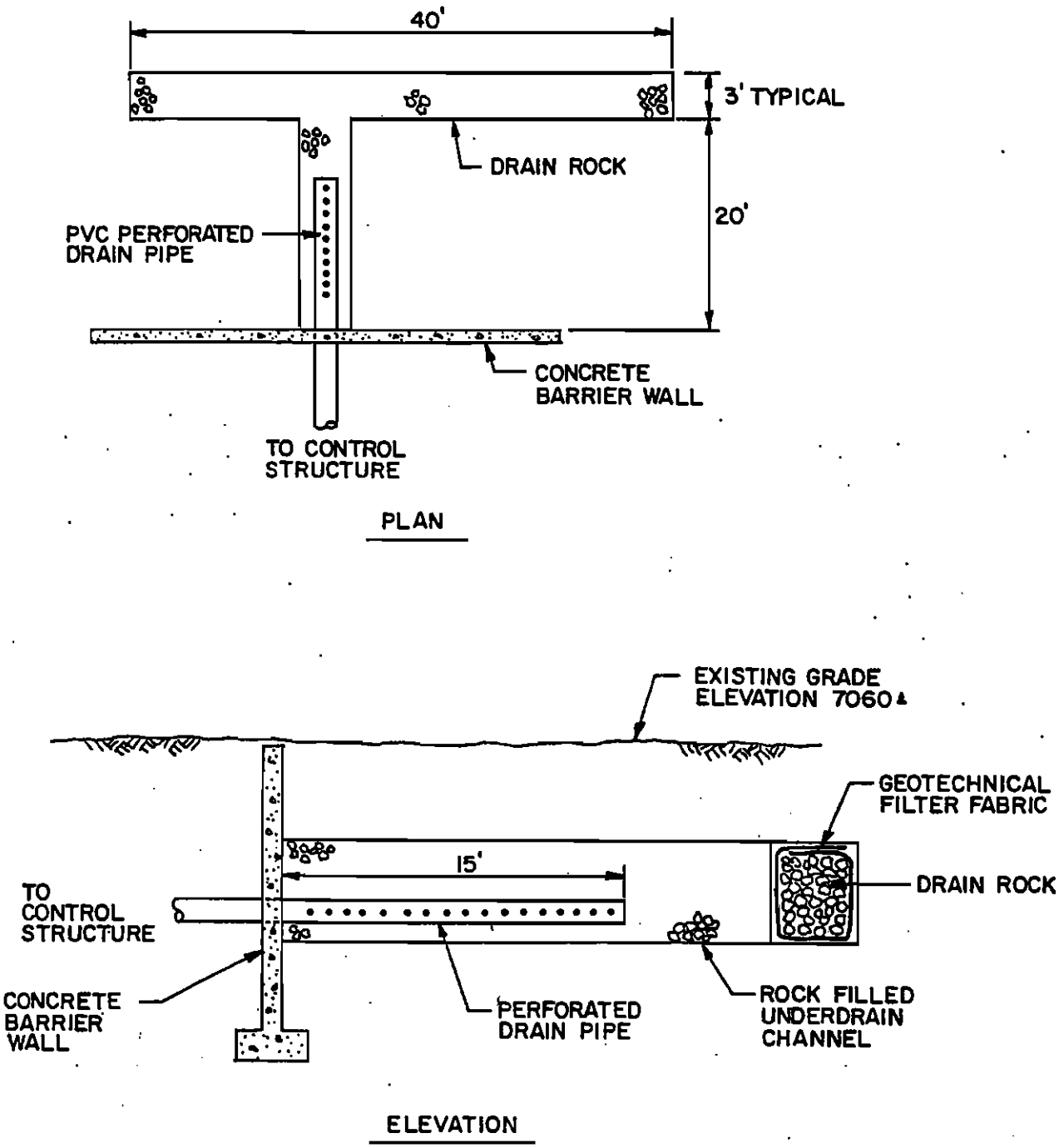


Figure 7-6 Mine Pit Underdrain System

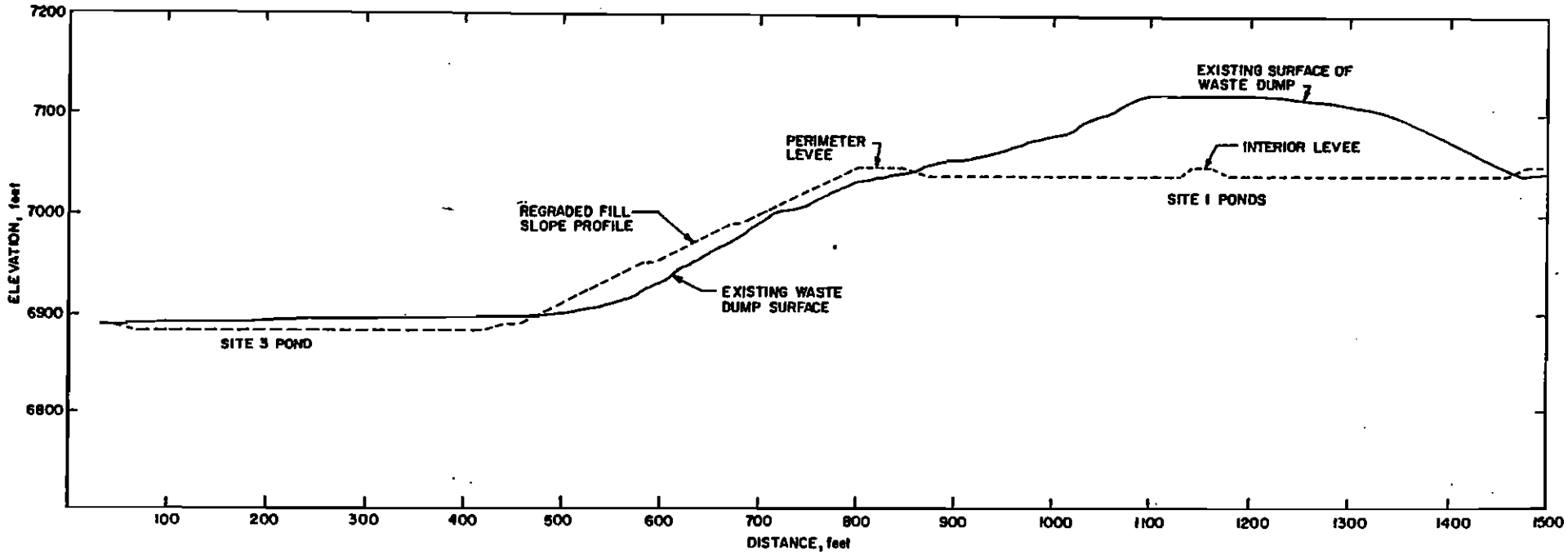


Figure 7-7 Typical Cross-Section Through Waste Dump

EMERGENCY OVERFLOW TO CREEK
TRIBUTARY CHANNEL
CELL 2
DRAINAGE SWALE
0
200
FEET

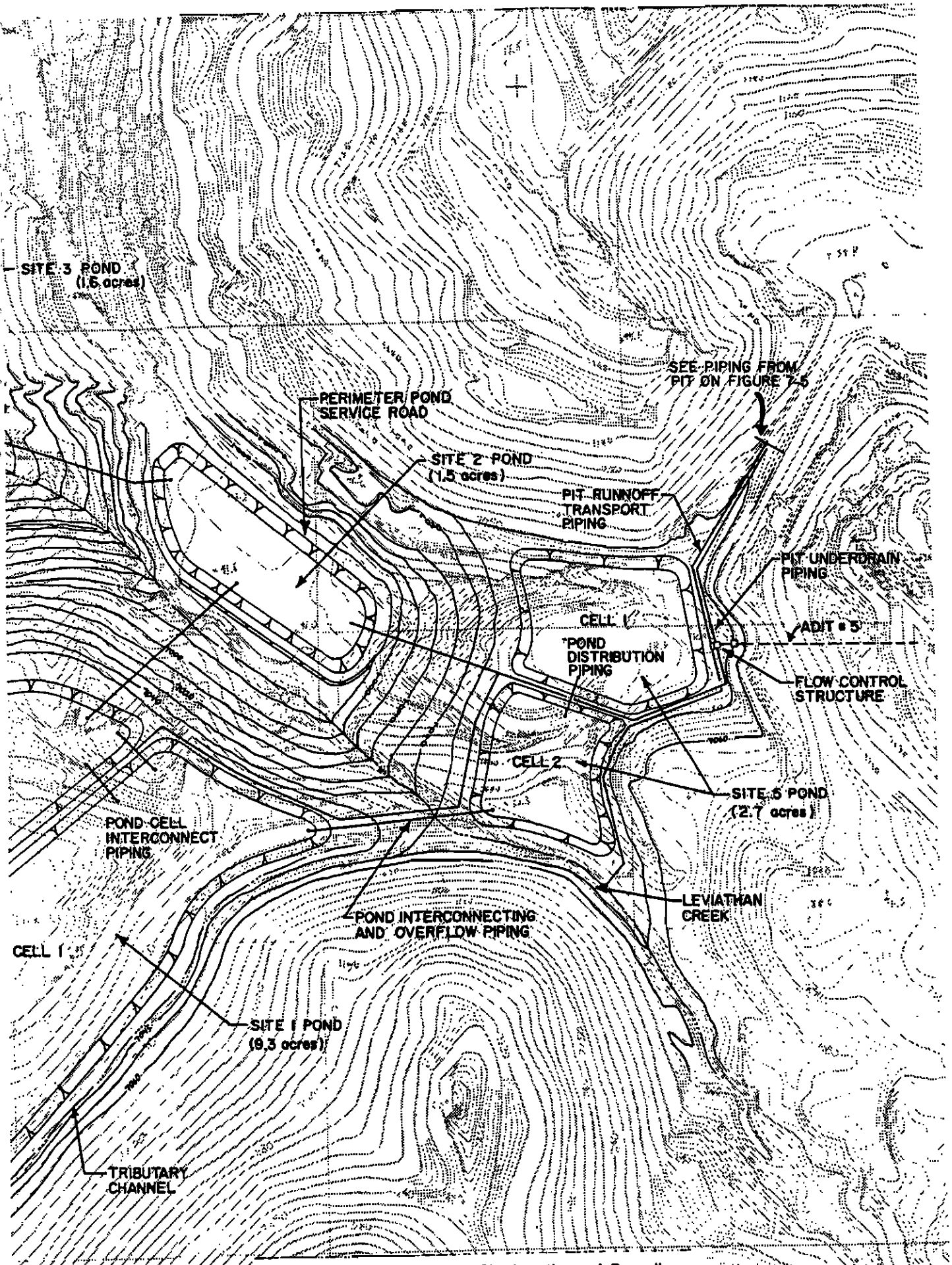


Figure 7-8 Plan of Pond Site Location and Regrading

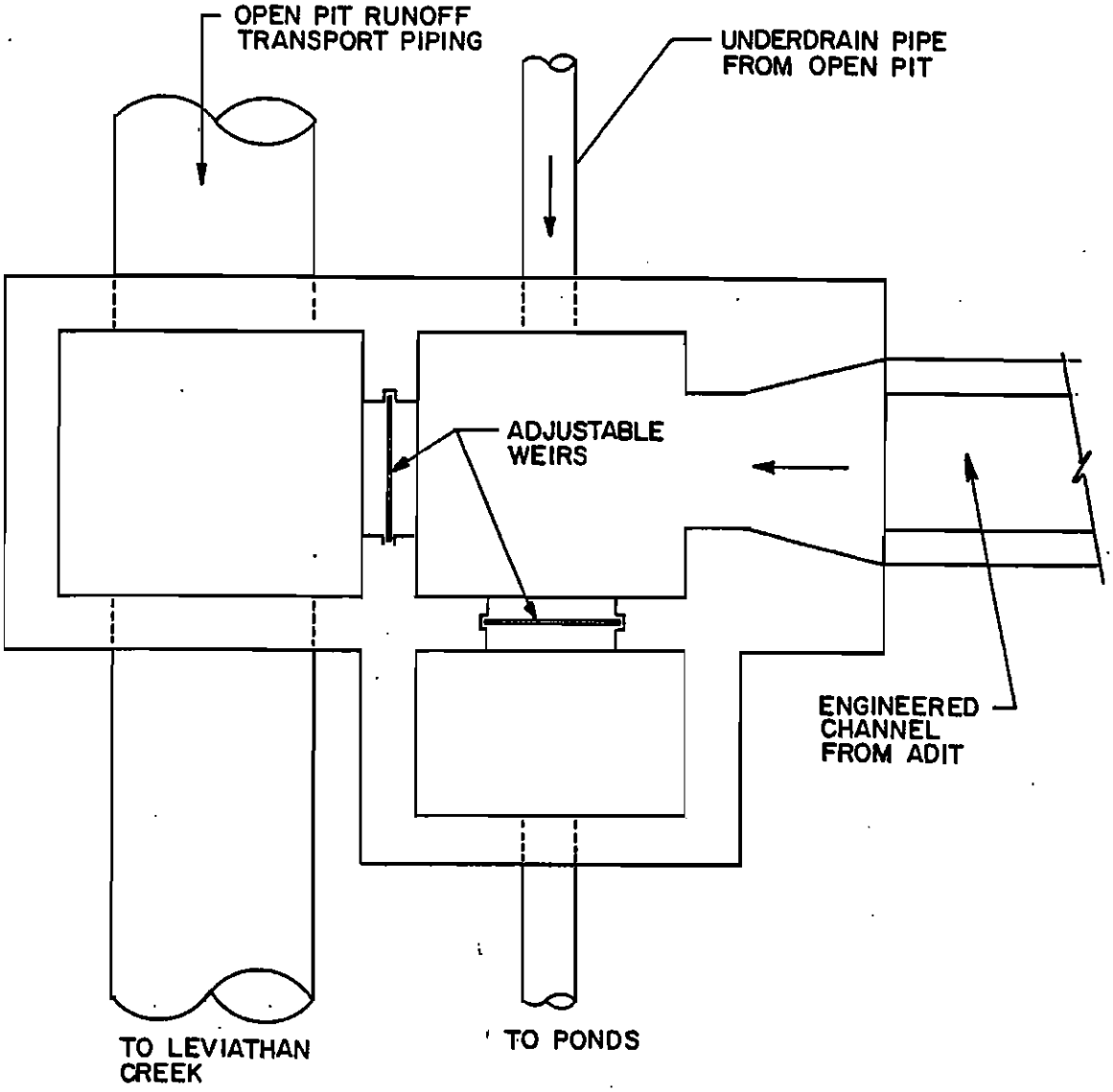


Figure 7-9 Plan View of Flow Control Structure

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SURFACE DRAINAGE CHANNEL (TYP)
TYPICAL SURFACE DEPRESSION REGR
TO DRAIN

Figure 7-10 Spoil Area A Drainage Control/Regrading Work

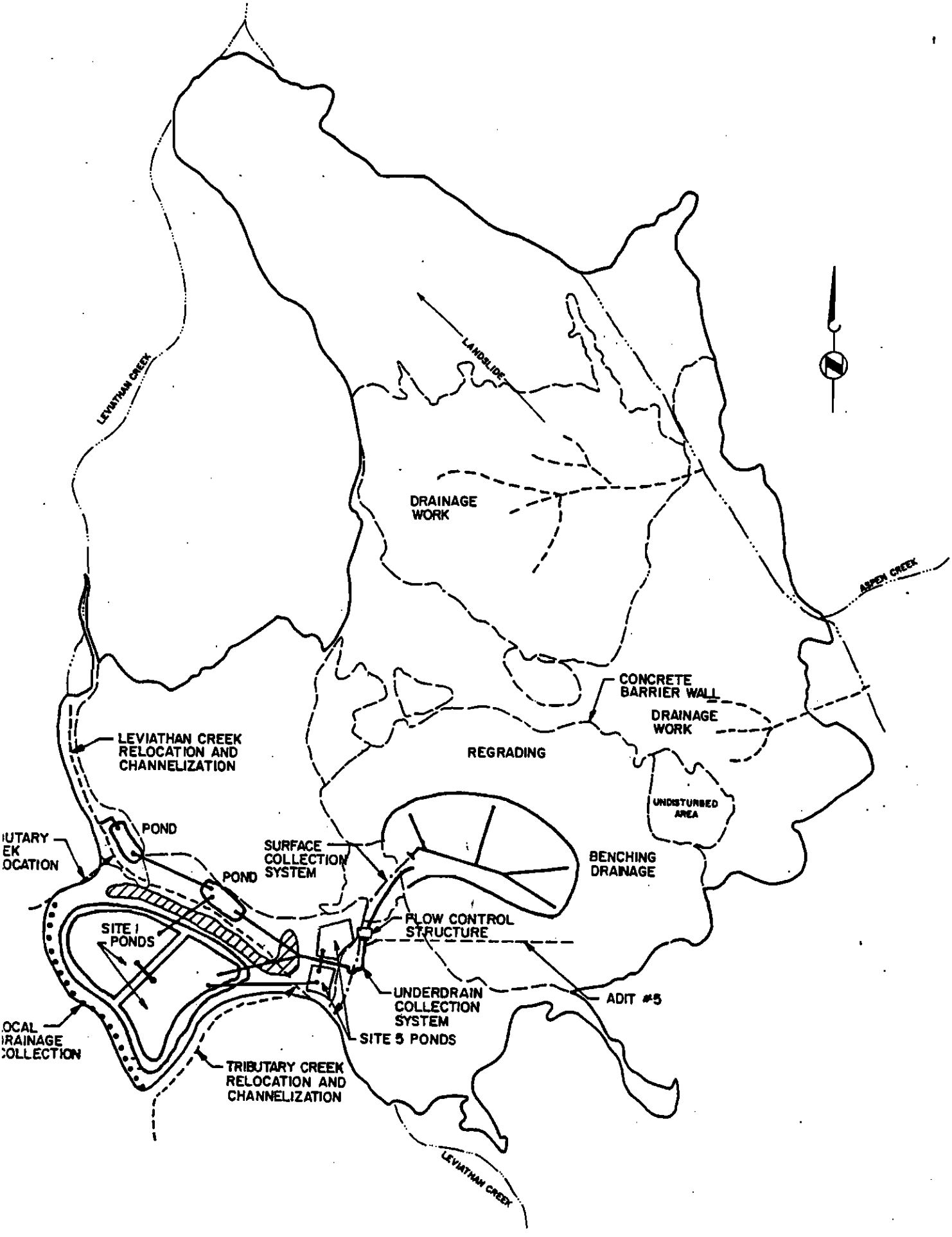


Figure 7-11 Maximum Feasible Pollution Abatement Project

CHAPTER 8

ENVIRONMENTAL IMPACT ASSESSMENT OF THE APPARENT BEST PROJECT

The environmental impacts of the proposed Leviathan Mine Pollution Abatement Project are discussed in this chapter. The chapter is organized into the following four sections.

1. Project Description and Objective
2. Environmental Impacts
3. Organizations and Persons Consulted
4. List of Preparers

The assessment of impacts presented in this chapter is one component of the environmental impact report. The other components are the description of the environmental setting (Chapter 2), the description and environmental assessment of alternative projects (Chapter 6), and the description of the recommended project (Chapter 7). The impact presentation in this chapter references discussion in the above and other chapters of this report. Reviewers of this document are encouraged to examine the information presented in other chapters so that they may gain the fullest possible appreciation of the immensity of the Leviathan Mine pollution problem which must be addressed within the constraints of comparatively limited funding.

PROJECT OBJECTIVE AND DESCRIPTION

The objective of the Leviathan Mine Pollution Abatement Project is to reduce the serious pollution of Leviathan Creek which stems from the abandoned mine workings and spoil and waste areas. To this end, the project incorporates features and measures to: (1) minimize the contact of unpolluted Leviathan Creek waters with mine waste and spoil materials, (2) encourage rapid runoff of on-site precipitation and snowmelt, (3) reduce deep percolation of on-site precipitation which becomes heavily polluted with acid and minerals as it moves to the groundwater table and then emerges at an abandoned mine adit, and (4) contain emerging polluted groundwater which cannot be fully eliminated by cost-effective ground surface percolation reduction measures.

A complete description of the proposed project is provided in Chapter 7. The project consists of five major elements as follows:

1. Leviathan and tributary creeks channelization
2. Mine pit filling and regrading
3. Mine waste dump regrading
4. Mine spoil area regrading
5. Evaporation pond construction

ENVIRONMENTAL IMPACTS

The environmental impacts of leaving Leviathan Mine in its current condition (the no-action alternative) and the impacts of the recommended pollution abatement project are described in this section. The environmental impacts during construction and during operation of the project are also discussed.

Environmental Impacts of No-Action

If the no-action alternative is implemented, Leviathan Mine will remain in its existing condition. The environment will continue to be adversely affected as discussed on the following pages.

Land Resources. The no-action alternative will result in the continued erosion of soil from the mine pit, spoil areas, and waste dump. Erosion resulting from construction activities will be avoided if the no-action alternative is implemented.

Air Resources. There will be no adverse impacts on air quality. Wind erosion will continue to generate dust, as it currently does. The minor, temporary, air quality impacts associated with construction will be avoided.

Water Resources. The water quality of Leviathan and Bryant Creeks and East Fork Carson River will continue to be adversely impacted as described in Chapter 3. All of the designated beneficial uses of Leviathan Creek are currently adversely impacted by the mine discharges. The short-term adverse impacts associated with construction will be avoided if the no-action alternative is implemented.

Biological Resources. The impacts of the no-action alternative on vegetation, wildlife, fish, and aquatic life are discussed in this section.

1. Vegetation--Without the proposed project, the existing vegetation will remain at the project site and the gradual process of natural revegetation will continue. There will not be any adverse impacts on the existing vegetation if the project is not constructed. Any potential adverse impacts associated with construction will be avoided.

2. Wildlife--The existing conditions at Leviathan Mine provide poor wildlife habitat. The vegetation is scarce and the water is not suitable for wildlife watering. These conditions will be maintained if the no-action alternative is implemented. The minor impacts associated with construction will be avoided.

3. Fish and Aquatic Life--As discussed in Chapters 2 and 3, the existing water quality is not suitable for fish and aquatic life. If the no-action alternative is implemented, existing conditions will be maintained and fish and aquatic life will not inhabit Leviathan and Bryant Creeks to any significant extent. Fish kills in the East Fork Carson River will probably occur periodically. Short-term impacts on fish and aquatic life, associated with construction activities, will be avoided.

Environmental Impacts of the Recommended Project

A detailed discussion of the project alternatives is presented in Chapter 6. The apparent best project identified in Chapter 6 was refined to the recommended project presented in Chapter 7.

Project Description. The pit will be filled with material excavated from the waste dump. A series of fill slopes, terraces, and runoff collection benches will be constructed in the pit using the excavated mine dump materials and some imported materials. Surface runoff from the pit benches will be collected and conveyed in lined channels and pipes constructed between the pit and Leviathan Creek. Surface runoff from the pit that will be discharged into Leviathan Creek is estimated to average 12 million gallons annually. An underdrain system will be constructed to collect contaminated groundwater from the pit and adit. The groundwater will be piped to impervious storage and evaporation ponds. Approximately 28 acre-feet annually will be collected in the underdrains and evaporated in 15 acres of ponds. The surface water runoff discharges will occur during the wet season when the flows are highest in Leviathan Creek. Leviathan Creek and two small tributaries will be rerouted in engineered channels around the waste dump. A more detailed discussion of the recommended project is presented in Chapter 7. The environmental impacts of the project are presented on the following pages.

Land Resources. Construction of the project will result in major modifications to the topography of the project site. The existing topography is the result of mining activities and has been greatly modified. The project modifications will improve drainage and reduce erosion over the long term. There will

likely be localized increased erosion during construction as the site features are reworked to more stable slopes and grades. The major locations where such temporary increased erosion is likely to occur are:

1. Along the temporary diversion channel of Leviathan Creek which must be used to carry stream flow while the new stream channel is being constructed.

2. On Spoil Area A, as a result of its regrading to eliminate surface depressions, some of which will likely contain entrapped water which will be released during the regrading.

3. On the waste dump where a huge quantity of material is to be excavated and moved to the mine pit and adjacent areas.

4. Within the mine pit where a large quantity of the mine dump materials are to be placed and a major portion of the surface is to be regraded.

The construction, as described in Chapter 9, will be conducted during the summer seasons of 1983 and 1984. The potential construction period erosion areas described in Items 1 through 4 will be most susceptible to erosion during the fall of 1983 and the spring of 1984 between the two periods of construction. Susceptibility to erosion in the areas discussed in items 2 through 4 will depend upon the extent to which final grades can be established in the first of the expected two construction seasons. The scope of the regrading work on the mine dump and in the pit is such that it is unlikely that finished grades can be accomplished in the brief first construction season. The project construction management plan presented in this report addresses the issue of construction scheduling. Although it will be in the contractor's own interest to leave the site at the end of the first season in a condition where erosion between the seasons (and necessary redo of his work) is minimized, the contract documents will include requirements which make reasonable provisions for erosion controls between seasons mandatory. Such provisions might, for example, include hydromulching of particularly vulnerable areas. An effort will be made to complete the Leviathan Creek rechannelization as early as possible in the project construction, thereby minimizing the period of use of the Leviathan Creek diversion. Major impacts on project construction costs can result from overly severe intrusion into the contractor's scheduling or the order of conduct of work. The possibility that the Leviathan Creek diversion may need to be used throughout both construction seasons should be taken as a given in this project, although an effort will be made to reduce the duration of the temporary diversion.

With regard to construction period erosion, the principal environmental concern is the sedimentation impact on Leviathan and Aspen Creeks below the erosion areas. It is noted that in both streams, the stream bottoms have already been heavily impacted by the severe degradation from Leviathan Mine over the past 30 years. Increased erosion and sedimentation during the construction period will not likely produce permanent damage in addition to that already existing. With the objective of the project being the long-term improvement of these conditons, the unavoidable construction-period erosion and stream sedimentation associated with this project is a justifiable impact.

Air Resources. Fugitive dust resulting from construction activities will locally increase the total suspended particulates (TSP) concentration. The major sources of dust will be haul roads, handling of material from the waste dump during regrading, and construction of evaporation ponds and mine pit fill. The construction contractor may choose to employ dust control methods to reduce the TSP concentration and improve his working conditions. The impacts on air quality will be localized and intermittent. There may be significant increases in TSP at the mine, but there will not be any adverse impacts on regional air quality.

Construction vehicles and heavy equipment will emit gaseous pollutants such as oxides of nitrogen (NO_x), hydrocarbons (HC), and carbon monoxide in small quantities. These emissions will be comparable to those from any small construction operation and will have a negligible impact on local air quality. The recommended project will not have an effect on air quality after completion of construction.

Water Resources. The objective of the recommended project is to improve the water quality of Leviathan and Bryant Creeks so that the designated beneficial uses of these streams will be at least partially restored. There will be some unavoidable degradation of water quality during construction. Potential water quality problems during construction are listed below:

1. There will be increased turbidity and siltation in Leviathan and Aspen Creeks during creek rechannelization, waste dump and spoil pile regrading, waste pond construction, and haul road construction. This problem is discussed in detail in the section on erosion.

2. Rechannelization of Leviathan Creek will result in the death of aquatic organisms in the existing channel. As discussed in Chapter 2, there are no fish and very few aquatic organisms in Leviathan Creek immediately downstream of the mine at the present time.

3. Acid groundwater containing high concentrations of arsenic and heavy metals will be released to Leviathan Creek during construction of the underdrain system in the pit and prior to completion of the waste ponds. More groundwater is expected to flow out of the pit during and immediately following construction than is currently flowing out of the collapsed mine adit. As discussed in Chapter 9, the waste evaporation ponds cannot be constructed before the groundwater drainage system so there is no reasonable way to avoid the additional contaminated groundwater discharge to Leviathan Creek. Early construction of one or more ponds and construction of a temporary storage pond were considered but were determined to be infeasible. There is not adequate space available for construction of a temporary pond. Once the mine pit fill is completed, the contaminated groundwater flow will be reduced because of lesser infiltration of precipitation within the mine pit. With completion of evaporation pond construction, the severely degraded groundwater discharges to Leviathan Creek will be eliminated except in years of above average precipitation.

4. Unoxidized waste materials from the bottom of the waste dump will be brought to the surface during rechannelization of Leviathan Creek, construction of the pit fill, other site regrading, and waste pond construction. When these unoxidized materials come into contact with oxygen and runoff water during the wet season, the runoff pollutant loads to Leviathan Creek will be locally increased. Since construction will take place over two summers, water quality may be severely degraded during the winter following the first construction season. The water quality impacts of site runoff will be reduced after completion of construction as the regrading improvements take effect. Sealed channels collecting runoff will allow only minimal contact with the unoxidized materials. Runoff will be discharged to Leviathan Creek only during the wet season when flows in the creek will be high due to upstream runoff.

The long-term impact of the project on water quality will be beneficial. The recommended project will reduce the salt load discharged from the mine from 1,680 tons per year to 356 tons per year. This represents a 79 percent reduction. The resulting decreased heavy metals concentrations at Stations 17, 25, and 26 are presented in Chapter 7.

The project will have a minor long-term impact on flows in Leviathan and Bryant Creeks. Peak flows after completion of the project may be slightly higher than current peak flows due to

better runoff from the mine site. This is likely to be a small increase since the drainage area of the mine presents a small portion of the total drainage areas of Leviathan and Bryant Creeks. There may be a minor reduction in base flows since the mine seeps will be reduced in quantity and confined in ponds for evaporation. The mine seeps are highly toxic to aquatic organisms so the minor reduction in base flow will be more than offset by the improved water quality.

Biological Resources. The impacts of the recommended pollution abatement alternative on vegetation, wildlife, fish, and aquatic life are discussed in this section.

1. Vegetation--There will be some unavoidable loss of vegetation during regrading and fill activities. Due to the severe conditions at the site, vegetation takes years to become established. The contractor will be required to avoid disturbing vegetation, particularly trees, whenever it is possible to do so. Some vegetation will have to be removed during construction of the creek channelization along the west and south sides of the waste dump. This is necessary to maximize the available area for construction of evaporation ponds for control of pit underdrain flow. There will also be some damage to vegetation since deposition of dust will result in reduced vigor of plants due to lower rates of photosynthesis. Some loss of vegetation is unavoidable, but most effects on vegetation are reversible following the end of construction activities.

   There will be no adverse long-term impacts on vegetation after completion of the project. Riparian vegetation will eventually become established along the new channel of Leviathan Creek. The stabilization of the pit walls and waste dump will allow vegetation to become established naturally.

2. Wildlife--Wildlife will be temporarily disturbed by construction activities at the project site. The presence of humans, noise, light, and glare will cause wildlife to avoid the site during construction. When construction is completed, the site should be more attractive to wildlife. Leviathan Creek will provide a significantly better source of drinking water than it currently does. The regrading and stabilization of the pit and waste dump will allow natural revegetation to occur more easily, providing food and shelter for wildlife. The presence of toxic waters in the evaporation ponds may lead to losses of small mammals and birds that gain access to the ponds. The entire pond area will be fenced with three strands of barbed wire to discourage access by large mammals.

3. Fish and Aquatic Life--The recommended project will significantly improve the water quality of Leviathan and Bryant Creeks so that irrigation and stock watering will be safe with Bryant Creek water. The improvement in water quality will make the creeks more habitable for fish and aquatic life, but many of the metals concentrations will still exceed the chronic toxicity criteria for cold freshwater habitat. The criteria for cold freshwater habitat are concentrations that will not be chronically toxic to trout. The lesser metals concentrations in Leviathan and Bryant Creeks resulting from the recommended project may not be ideal for trout over a long period of time but trout may be able to inhabit the creek for short periods of time. Other less sensitive fish may be able to inhabit the creek for long periods of time without any adverse impacts.

Human Resources. The impacts of the recommended project on noise, recreation, visual resources, archaeology, and socioeconomics are discussed in this section.

1. Noise--There will be increased noise during construction from construction vehicles and heavy equipment. Since the mine is in a remote area, the increased noise during construction will not be a significant impact. The noise levels during operation of the project will not be increased beyond existing levels, except during short periods of site visits and periodic maintenance during the summer

2. Recreation--Signs are currently posted on the project site warning the public that there are hazardous materials on the site. The U.S. Forest Service will assume ownership and manage the site after the pollution abatement project is completed, and does not intend to use the site for recreational activities.

3. Visual Resources--The project site is currently aesthetically unpleasing. Although the goal of this project is to improve water quality, the aesthetic appearance of the site will be significantly improved by the revegetation work on the regraded areas. The regraded and terraced areas will be revegetated with woody shrubs, conifers, and other native vegetation as described in detail in Appendix A. This will improve the visual resources of the site.

4. Archaeology--Any archaeological resources that may have been present at the site were destroyed by the past mining activities. If any archaeological resources are discovered during construction, a qualified archaeologist will be retained to investigate the discovery.

5. Socioeconomics--Approximately 20 to 30 construction workers will be employed on the project during the summers of 1983 and 1984. Some workers will come from Alpine County and the Carson Valley and some may be expected to come from outside the local area. The construction project will create demand for materials and supplies, and will subsequently create jobs in surrounding areas. Jobs may be created in firms that supply materials needed at the mine site during construction and in businesses that provide services to the local population. The effects of the project on the local population and housing demand are unknown, but likely insignificant, because it is not possible to estimate the number of people that will move into the area during construction. Construction workers may commute from Carson City or South Lake Tahoe rather than moving into the local area. The effect of the project on public services will be minor. Since construction will take place during the summer months, it is unlikely that construction workers with families will move into the area and place a demand on the local public schools or other similar public services. A water supply and wastewater disposal system will be provided by the contractor on site so there will be no additional demand on the local municipal services. There will be a minor increase in traffic in the local area during the two construction seasons from construction workers traveling to the mine site and from supply trucks and other construction vehicles.

Summary of Environmental Impacts and Mitigation Measures

The impacts of no project and the recommended project on the environment and possible mitigation measures were discussed in the previous section. Table 8-1 summarizes the adverse and beneficial environmental impacts. Mitigation measures proposed to lessen the adverse impacts are also presented in this table.

Alternatives to the Proposed Action

A detailed analysis of the project alternatives is presented in Chapters 5 and 6.

Growth-Inducing Impacts of the Proposed Project

The recommended project will not have any long-term growth-inducing impacts on the local area. As discussed previously, there may be some short-term increase in visitor populations during the two construction seasons from construction workers.

Table 8-1. Summary of Environmental Impacts and Mitigation Measures

Alternative	Environmental impact	Mitigation measure
No action:		
1. Construction	a. None.	
2. Operation	a. Land—Erosion from pit, spoil piles, waste dump.	
	b. Air—None.	
	c. Water—Water quality of Leviathan and Bryant Creeks will remain poor. Beneficial uses will not be achieved.	
	d. Biology—Poor wildlife habitat, fish kills in East Fork Carson River may continue.	
Recommended project:		
1. Construction	a. Land—increased erosion.	a. Best management practices will be used.
	b. Air—Increased total suspended particulates, nitrogen oxides, hydrocarbons, and carbon monoxide.	b. Dust control methods will be used.
	c. Water—	
	(1) Increased turbidity and siltation in Leviathan and Aspen Creeks.	c. (1) Best management practices to control erosion will be used.
	(2) Acid groundwater released to Leviathan Creek will degrade water quality.	(2) None possible.
	(3) Increased concentrations of toxic materials in Leviathan Creek due to runoff coming in contact with unoxidized materials from bottom of waste dump.	(3) None possible.
	d. Biology—	
	(1) Loss of vegetation during regrading and fill.	d. (1) Best management practices will be used.
	(2) Wildlife will be temporarily disturbed.	(2) None possible.
	(3) Increased turbidity and siltation in creeks will harm benthic organisms. Rerouting stream channel will result in death of some organisms in existing channel.	(3) Best management practices to reduce erosion will be used.
	e. Human resources—	
	(1) Minor increase in noise.	e. (1) None needed.
	(2) 20 to 30 construction jobs will be created. Some jobs in service industries may be created.	(2) Positive impact.
	(3) Minor increase in traffic due to construction vehicles and workers' automobiles.	(3) None needed.
2. Operation	a. Land—improved drainage and reduced erosion.	a. Positive impact.
	b. Air—None.	b. None required.
	c. Water—Long-term effect will be marked increase in water quality and attainment of the following designated beneficial uses in streams below the site: • Irrigation • Stock watering	c. Positive impact.
	d. Biology—	
	(1) Natural vegetation will become established more easily due to slope stabilization.	d. (1) Positive impact.
	(2) Leviathan Creek will provide better source of drinking water for wildlife.	(2) Positive impact.
	(3) Toxic wastes in evaporation ponds may lead to losses of wildlife that gain access to the ponds.	(3) Evaporation ponds will be fenced with
	(4) Leviathan Creek will provide better habitat for fish and aquatic life.	(4) Positive impact.
	e. Human resources—None.	e. None required.

Cumulative Impacts

There are no other projects in the vicinity of Leviathan Mine which will lead to the production of cumulative impacts.

ORGANIZATIONS AND PERSONS CONSULTED

The Notice of Preparation of an EIR was sent to the agencies, organizations, and individuals listed in Table 8-2.

LIST OF PREPARERS

This design report and draft EIR was prepared by Brown and Caldwell Consulting Engineers. Geologic information was provided by Geotechnical Consultants. Information on existing vegetation was provided by Dr. Andrew Leiser. The list of preparers of the EIR is ahead of the table of contents in this report.

Table 8-2. Leviathan Mine NOP Distribution List

California State Agencies

State Water Resources
Control Board
John Huddelson
1416 Ninth Street
Sacramento, California, 95814

California Department of
Fish and Game
Paul Jensen
Regional Manager
1701 Nimbus Road, Suite A
Rancho Cordova, California 95760

State Lands Commission
Ted Fukushima
1807 - 13th Street
Sacramento, California 95814

Air Resources Board
Anne Geraghty
Post Office Box 2815
Sacramento, California 95812

California Department of
Water Resources
Ken Pellows
1416 Ninth Street
Sacramento, California 95814

Department of Health Services
Hazardous Waste Management Branch
Jim Pappas
4250 Power Inn Road
Sacramento, California 95826

Office of Historic Preservation
Nick del Cioppo
1220 "K" Street Mall,
Third Floor
Sacramento, California 95814

Department of Conservation
Ester Maser
1416 Ninth Street, Room 1354
Sacramento, California 95814

Office of Planning and Research
State Clearinghouse
Norma Wood
1400 Tenth Street, Room 121

Sacramento, California 95814

Division of Mines and Geology
Zoe Mankowski
610 Bercut Drive
Sacramento, California 95814

Local Agencies

Alpine County Health Department
Post Office Box 306
Markleeville, California 96120

Alpine County Planning Department
Leonard Turnbull
Route 1, Box 37
Markleeville, California 96120

Great Basins Valley Air Pollution
Control District
157 Short Street, Suite 6
Bishop, California 93514

Truckee-Carson Irrigation District
Post Office Box 13[illegible]
Fallon, Nevada 8940[illegible]

Carson River Basin Council
of Governments
Post Office Box 1927
Carson City, Nevada 89701

Nevada State Agencies

Nevada Division of
Environmental Protection
201 South Fall Street, Room 221
Carson City, Nevada 89701

Nevada Division of Water Resources
Department of Conservation and
Natural Resources
201 South Fall Street
Carson City, Nevada 89701

Desert Research Institute
University of Nevada
Peter Krenkel
Post Office Box 60220
Reno, Nevada 89506

Federal Agencies

U.S. Environmental Protection
Agency, Region IX
215 Fremont Street
San Francisco, California 94105

U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

U.S. Fish and Wildlife Service
Ralph Swanson
1230 "N" Street
Sacramento, California 95814

U.S. Geological Survey
Dale Hammermeister
705 North Plaza Street
Room 227 Federal Building
Carson City, Nevada 89701

U.S. Soil Conservation Service
Post Office Box 517
Minden, Nevada 89423

Forest Supervisor
Mickey Beland
Toiyable National Forest
111 North Virginia Street, Room 601
Reno, Nevada 89501

U.S. Department of the Interior
Bureau of Mines
1605 Evans Avenue
Reno, Nevada 89520

U.S. Bureau of Reclamation
Lahontan Basin Projects Officer
Post Office Box 640
Carson City, Nevada 89701

U.S. Department of the Interior
Bureau of Land Management
1050 East William
Carson City, Nevada 89701

U.S. Forest Service
Carson Ranger District
Hiram B. Smith
1536 South Carson Street
Carson City, Nevada 89701

Organizations and Individuals

Brooks Park
Route 2, Box 70
Gardenville, Nevada 89410

Mother Lode Chapter of Sierra Club
Post Office Box 1335
Sacramento, California 95806

The Wilderness Society
Roger Scholl
Post Office Box 9096
Reno, Nevada 89507

CHAPTER 9

CONSTRUCTION MANAGEMENT PLAN

This chapter describes the project in a form and detail comparable to that found in the introductory description in the contract specifications. The responsibilities and relationships of all project participants are presented and construction supervision procedures discussed. Finally, the strategy for contracting for the construction work is analyzed.

PROJECT DESCRIPTION

The Leviathan Mine Pollution Abatement Project is to correct existing acid drainage problems at a remote, inactive, and unreclaimed sulfur mine in Alpine County, California. The Acid Mine Drainage (AMD) problems have caused the pollution of a tributary of the East Fork Carson River as it flows through the property. The work is intended to abate water pollution at this point and to restore the quality of the affected creeks as much as possible to their premining condition.

The site is located at about the 7,000-foot elevation on the rugged, eastern flank of the Sierra Nevada, approximately 25 miles southeast of Lake Tahoe. Primary access is provided to the north end of the site by an 8-mile, unpaved U.S. Forest Service road from U.S. Highway 395, about 20 miles south of Gardnerville, Nevada. Secondary access is provided to the south end of the site by a narrow, 2-mile unpaved Alpine County road from California Route 4 (Monitor Pass Road) southeast of Markleeville, California. The effects of winter storms generally preclude access to the mine from November through May.

The site encompasses 245 acres of land devastated by mining operations. Much of it is covered by mining and waste to a considerable depth. A large open pit lies on the southerly portion of the site and there is a 30-acre landslide on the northern portion. A waste dump, consisting of several million cubic yards of material excavated from the lower zone of the mine pit lies to the west of the pit. Overburden spoil piles surround the pit on three sides. The waste and spoil material is heterogeneous, unconsolidated, and porous, whereas the material in the landslide area is plastic clay, clay loam,and a silty clay loam. This vast, barren area is bounded by Aspen Creek on the northeast, Leviathan Creek on the west, and the junction of the two streams on the north. The waste piles and the landslide have significantly diverted and disrupted Leviathan Creek as it flows past the site.

The primary items of construction work on this project are the following:

1. Repair and maintenance of the existing paved roads to the site as required to accommodate the traffic generated by the contractor, as well as the construction and maintenance of any on-site roads required by the contractor to pursue the work.

2. Construction of 60 linear feet of groundwater drains in the area just outside the mouth of the open pit, said drains being rock-filled trenches with widths of 3 feet and depths of 6 feet. The trenches contain 20 cubic yards of rock.

3. Grading of 20 acres of spoil pile surface to eliminate depressions and form swales for drainage.

4. Realignment, construction, and improvement of 1,300 linear feet of creek channel, said channel having a trapezoidal cross-section, a minimum bottom width ranging from 4 to 8 feet, and side slopes of 2:1 to 3:1. The channel surface will be sealed with soil cement and partially riprapped.

5. Realignment, construction and improvement of 1,900 linear feet of creek channel, said channel having a rectangular cross section and constructed of wire mesh reinforced concrete.

6. Removal and relocation of 470,000 cubic yards of mine waste an average distance of 1,500 feet and its placement and compaction in the open pit and as regrading fill on and in the vicinity of the waste dump. Soil cement swales will be constructed on the terraced surfaces of the pit and waste dump fills.

7. Construction of 15 acres of evaporation ponds bounded by 7,200 linear feet of dikes generally 6 feet high and lined with impermeable plastic membrane. Ancillary features include 3,000 feet of 18-inch connecting pipelines and various flow control appurtenances.

PROJECT CONSTRAINTS

The work included in the first phase is to be completed by November 1, 1983; and all project work is to be completed by the end of the second phase on November 1, 1984. The project is to be financed from a $2.50 million portion of a $3.76 million grant awarded under the provisions of the 1978 California Clean Water and Water Conservation Bond Laws. Project constraints are described below.

Length of the Construction Season

Conditions at the site caused by precipitation, snow pack, and snowmelt during the fall, winter, and spring encumber any substantial construction effort at those times. Hence, the season during which construction may be undertaken generally occurs between June 1 and November 1, a five-month period. Depending on total precipitation in a given year, the season may be as short as three months.

Conditions of Access Roads

The existing unpaved Alpine County and Forest Service roads to the site are regularly used by the U.S. Forest Service, Alpine County, and others. This use must not be impaired at any time. Alpine County or U.S. Forest Service approval of road maintenance and any necessary road modifications will be obtained by the contractor as required.

Quality of Creek Water

Compliance with the provisions of a streambed alteration permit to be issued by the California Department of Fish and Game is required. The permit is expected to outline measures to be taken to minimize water turbidity and channel siltation. The contractor must also comply with provisions of the contract documents relating to control of erosion and stream sedimentation from grading activities at the site, including provisions regarding protection of unfinished work between construction seasons.

Protection of Vegetation

Although trees and other types of vegetation located in the areas of primary work must be removed or covered to accomplish the work, vegetation may also be encountered on the periphery or in conjunction with the preparation of a desired haul road. In such cases, work shall be planned and controlled so as to minimize the disturbance of natural conditions.

Compliance with State of
California Contracting Requirements

All provisions of California law applicable to public works are to be incorporated into the contract. These relate to minimum wage rates, nondiscrimination in employment, small business, minority, women's, and labor surplus area businesses, bonding and insurance, and other like provisions.

PROJECT PARTICIPANTS

The sponsor of the Leviathan Mine Pollution Abatement Project is the California Regional Water Quality Control Board, Lahontan Region (Regional Board), a state agency with offices in South Lake Tahoe and Victorville. The Regional Board's executive officer is Mr. Roy C. Hampson and its project representative is Mr. Gerard J. Thibeault. Brown and Caldwell and its subconsultant, Geotechnical Consultants, Inc., have been engaged by the Regional Board to provide engineering and construction management services for the project. This section identifies those who will be involved in the project during its construction phase, outlines their relationships, and describes their responsibilities. It also reviews the procedures to be adopted for supervision of construction and administration of the construction contract.

Regional Board Project Manager

The Regional Board's project manager, Mr. Thibeault, will act and speak for the Regional Board in all consequential matters related to the project. He will be responsible for fulfilling all obligations of the owner and project sponsor under the contract and for deciding all significant issues, especially those involving changes of contract work, cost, or duration, or those constituting potential claims. He will be expected to maintain a general familiarity with construction work status and administrative routine, and to ensure the satisfactory performance of other project participants.

Brown and Caldwell Construction Manager

Brown and Caldwell's construction manager, Mr. R. Fred Daly, will organize, plan, and carry out the consultant's contributions to project construction. He will inform and coordinate those involved in the construction effort, establish and maintain close contact with the contractor, facilitate the contractor's understanding of and adherence to contract requirements, monitor construction activities, and administer the construction contract. He will make frequent project reports to the Regional Board's project representative either personally or through correspondence, as appropriate, and through monthly progress reports; and he will respect completely the prerogatives of the Regional Board and the authority of its representative with respect to all matters beyond the routine.

Brown and Caldwell's contract with the State of California specifically states that Brown and Caldwell, and the agents and employees of Brown and Caldwell, in the performance of services on the project are not empowered to act as officers or employees or agents of the State of California. The effect of this

contract provision is that Brown and Caldwell's construction resident engineer or manager is not empowered to direct the construction contractor on any issue or aspect of the work nor approve any contractor proposal of whatever nature. This unusual absence of resident engineer authority to direct contractor activities makes it incumbent upon the Regional Board to have available at all times, a representative with full power to direct the contractor. Brown and Caldwell's role in communication of instructions to the contractor will be to advise the Regional Board's representative as to the appropriate orders, instructions, and approvals to be given.

Project Procedures Manual

To facilitate the adoption of efficient administrative procedures and ensure that all important aspects of project control have been addressed, a project procedures manual is to be prepared for use by the time the construction contract is let. The following items will be covered in detail:

Files. Effective project control requires an efficient and reliable means of communicating, storing, and retrieving the information needed by project participants. All important project communications and observations must be recorded in writing and readily available. The accumulation of correspondence, minutes of meetings, telephone notes, plans, schedules, logs, administrative records, and reports of inspections, tests, progress, and problems will be significant. Therefore, the establishment and maintenance of orderly files at a location convenient to contract administrators is essential.

The organization of the files is properly determined by its intended use. A system compatible with its use will be understood and accepted by its users and will be readily maintained with consistency and regularity. A system patterned after the contract is usually efficient. A job file index outlining the organization of the files will be included in the project procedures manual.

Reports. Progress reports in narrative form are used to inform and coordinate project participants, to record project events, and to clarify other records such as test reports, progress payments, schedules, change orders, and claims. These reports ideally are accounts by perceptive observers, organized to facilitate information retrieval. The daily inspection report contains all significant information about site conditions, resources used, deliveries, activities, progress attained, difficulties and delays experienced, work results, tests, discussions with and instruction to the contractor, visits, and other on-site events. The periodic progress report contains a summary of progress during the report period, a comparison of the progress realized with that scheduled and an

explanation of deviations, the progress anticipated during the next report period, and a list of action items with appropriate recommendations. The content and formats for these reports will be outlined in the project procedures manual.

Communications. Communications with the contractor about the project must be adequate, consistent, and clear. Regular meetings on project planning, progress, and problems are informative and help keep the endeavor on track. Correspondence must be used to address matters likely to develop into disputes. Clear communications in writing provide a record of events which facilitates the recovery of facts and reduces the grounds of most disputes to expedite preparation and filing, the format for correspondence and minutes of meetings will be outlined in the project precedures manual.

Scheduling and Tracking. The general contractor of a public works project assumes an obligation to construct the facilities described in his contract in the time prescribed for the amount bid. His success is largely determined by the work plan he devises for project implementation. An endeavor having an explicit, carefully prepared work plan at the outset is likely to feature informed participants and proceed smoothly toward a successful conclusion. One lacking such a plan may be expected to be poorly coordinated and to entail wasted effort and lost time. Hence, those vitally concerned about the outcome of a project, especially those representing the owner and contractor, must see to the timely preparation of a sound work plan for the project. A work plan is a summary of the process by which a set of desired results are to be achieved in an alloted time with available resources. It relates the tasks which will produce these results with the time and resources which are to be expended. Work planning entails the identification of the tasks to be completed, the arrangement of these tasks in a suitable order or sequence, and the determination of the times and resources required for accomplishment of these tasks. Accuracy of the plan will be significantly affected by the plan's level of detail as well as the planner's knowledge of the times and resources associated with the tasks involved (variables ordinarily having an inverse relationship). To be useful, the plan must reflect the intentions of those responsible for doing the job. To remain useful, the plan must be modified as the job progresses in response to unexpected events. Astute observers have noted that the work must be planned and the plan must be worked. A work plan may be most succinctly presented as a work schedule. Such a schedule is a time-scaled graph of the tasks which constitute the whole endeavor. A schedule presenting the work plan in its entirety also includes the resources to be employed for each task. Preparation of a schedule is the means by which a work plan is generally developed. The completed schedule is the common instrument used to communicate intentions, guide work, and track progress.

To effectively supervise this project, the construction manager must acquire from the contractor the information needed to track work progress and to compare the time required for outstanding work with the contract time remaining. Also required at an early date is assurance that the contractor has devised and is implementing a means of completing the work within the contract period. Hence, the construction contract will require the contractor to prepare and present to the owner a schedule of the work and set forth the format for the presentation of this information. The scheduling portion of the procedures manual will amplify and explain these requirements in detail.

Submittals. To insure the accuracy and completeness of his interpretation of contract requirements, the contractor will be required to present samples of material, descriptions of material and equipment, and shop drawings for approval before construction. The number of submittals required on the project will be few, but those to be reviewed will require urgent attention in order to minimize delays in the field. The procedures established for these reviews will include a list of those required, the identity of the party responsible for each review, and the means by which the review process will be controlled.

Progress Payments. Contractors and suppliers must be paid regularly and promptly for the work completed. These payments reduce their capital requirements, encourage expeditious performance, and reduce contract bids. Payment for the work completed should be fair; it should cover materials in storage, and it should not unduly increase the project sponsor's vulnerability in the event of default. The amount withheld from these payments to insure the contractor's commitment to the project, called retainage, is now 5 percent until the project is half completed.

Progress payments must be administered systematically. Before the commencement of contract work, clear and equitable progress payment procedures will be established, procedures which address in detail the following: (1) schedules of value, i.e., methods of calculating value in place for all contract items; (2) a regular time for such determinations; and (3) a rapid payment processing sequence which is adapted to the disbursing patterns of the project sponsor. To ensure accurate measurement of earthwork quantities for purposes of payment, surveys of the work in-place will be required by the contractor; these surveys will be either supervised by or subject to the approval of the construction manager.

Contract Changes. Virtually, every construction contract must be changed as it develops. Often, the sponsor wants to improve or delete certain details within the scope of work,

details are incorrectly or incompletely described in the plans and specifications, substitutions are needed, or a differing site condition is encountered. Changes usually effect contract cost, and they may also involve project time, quality, or function. To process and dispose of them quickly on this project, the procedures established will address the following: (1) the forms to be used and the information required to describe, evaluate, and approve a change; (2) the contract provisions regarding changes and associated costs; (3) the requirements of any agencies having review and approval responsibilities; (4) the review and approval process and the assignment of authority for approval; (5) the likelihood of emergencies or small field matters best handled on a time-and-materials basis; (6) the estimate of change value prepared independently by the construction manager; (7) the negotiation of change value with the contractor; and (8) the possibility of performing a change more economically by a new procurement.

Claims. A claim is a contract change which has been identified by the contractor and which has not been recognized by the owner. These disputes are based on interpretation of the contract provisions regarding delay, suspension, acceleration, performance, work orders, and differing site conditions. All contracts require a timely notice of a particular claim. Upon receiving notice of a claim, a prudent owner will ascertain its basis, thoroughly investigate and document related facts, obtain necessary technical and legal advice, respond in writing promptly and objectively as outlined in applicable contract provisions, collect and index all evidence to facilitate retrieval, and prepare for the resolution of the claim at an appropriate time through negotiation, mediation, arbitration, or litigation. Claims which are settled usually become change orders and are processed and approved accordingly. The project procedures manual will outline the steps involved in recognizing, handling, and resolving construction claims.

Construction Inspection. The observation, verification, and recordation of events at the construction site is a significant contributant to project success. In acquiring knowledge of the contractor's intentions and flagging unacceptable materials, conditions, and techniques, the inspector minimizes problems for all concerned, reduces the likelihood of disputes, and expedites progress of the work. The level of effort required to achieve this result varies with contract, contractor, and concerns of the project sponsor; this too will be addressed with specificity in the project procedures manual.

CONTRACTING STRATEGY

Assignment of the work constituting a construction project may have an important, even critical, impact on project success. An assignment to a single contractor on the basis of a low, lump sum bid is only one of several possible contractual arrangements on any project. Other arrangements are often employed to advantage. On some projects, early construction work must commence before the completion of design; on others, the work in several areas must proceed concurrently. In some cases, specialized work must be bid separately. Sometimes, a project sponsor's commitment must be staged to retain a capacity to incorporate the most recent information into decisions abouut the project. The various assignment alternatives applicable to this project are briefly reviewed in this section.

For planning purposes, the relationships among the project work items must be recognized. It is also helpful to estimate, however roughly, the types and quantities of construction resources likely to be employed and the durations of these activities. This information is projected as follows:

1. Project mobilization, includes repair of the access roads, construction of on-site roads to accommodate initial work, construction staking of initial work, and preparation of the marshalling areas for offices, construction equipment support, and material storage. Anticipated items of equipment are a dozer, grader, and several trucks. Estimated duration of work is two weeks. Work precedes all other work items.

2. Underdrain construction in and near the open pit, including excavation of trenches, placement of crushed rock, and completion of underdrains. Anticipated items of equipment are a backhoe, loader, and trucks. Duration estimates is one week. Item precedes pit fill.

3. Surface grading, including the elimination of depressions, the formation of swales, and the construction of surface drainage channels. Anticipated items of equipment are a dozer, grader, roller, and trucks. Estimated duration of work is about six weeks.

4. Removal of a substantial portion of the waste dump and its placement and compaction in the open pit, together with appropriate treatment of the fill surface. Anticipated items of equipment are a dozer, five scrapers, roller, grader, and water truck. Estimated duration of work is 12 weeks, beginning after the completion of the pit's groundwater drain.

activities; also, the need to divert stream flow around the channel work practically precludes its fragmentation and it should be completed in a single season.

Thus, the only realistic assignment alternatives are those related to time. Either the project can be let under one contract for both seasons, or it may be let under two contracts which coincide with the seasons. The considerations associated with the one-contract alternative are: (1) only one design and contract bidding effort is required and (2) current information largely determines project scope and cost. The considerations associated with the two-contract alternative are: (1) the project sponsor's initial project commitment is limited to that which may be reasonably completed in the first season; (2) the information available after the first year of work can be easily incorporated into the second contract; and (3) the risks of bidding the second year will be lower, and bids for this work may be expected to be lower. In either case, the work to be done in a season should be clearly specified so as to facilitate project control by the sponsor and the contract bid items used should minimize unbalanced bidding, particularly if the work is to be assigned through a single contract. The selection of the appropriate assignment alternative is properly left to the sponsor's discretion.

The following is a suggested breakdown of construction work between the two available construction seasons.

Construction Season		Construction Element	Duration, weeks
1	a.	Mobilization	2
	b.	Underdrain construction and concurrent spoil area regrading	1
	c.	Majority of waste dump regrading and pit fill	10
		Total	13
2	a.	Mobilization	2
	b.	Complete waste dump regrading and pit fill	2
	c.	Evaporation pond construction and concurrent spoil area regrading and stream channels construction	12
	d.	Time contingency	3
		Total	19

I. SUMMARY AND CONCLUSIONS

The prospects for successful revegetation of the Leviathan Mine site are good.

1. Although the precipitation is less than montane sites to the west, it is adequate for the survival of many species.

2. The mine spoils have a high water holding capacity. Soils have adequate moisture for plant growth late late into the summer.

3. Spoils are acid but most are within the range of typical acid mineral soils of humid temperate regions.

4. No signs of toxicity or deficiency symptoms are exhibited by the volunteer native, or planted, introduced species except an occasional (rare) conifer with slight tip burn of needles. Growth rates appear similar to that of the same species adjacent to the mine.

5. In general, the steep slopes in the spoil areas are remarkably stable. Few areas have gullies or rill erosion.

6. Twenty-five woody species immediately adjacent to the mine site are potential revegetation candidates. Over 30 species of woody and suffrutescent species have invaded the site naturally. Twenty or more of these are in sufficient quantity to merit consideration for the revegetation project. At least four introduced species are making satisfactory growth. Numerous other introduced species are, on the basis of other mine reclamation research, potential candidates as well. At least six willow species occur on site, one, Salix exigua, has spread onto the pit floor in large numbers.

7. Prospects of dewatering mine spoils with vegetation are excellent.

8. Past experience with grasses have been poor. Unless an on-going fertilization program is practical, grasses should play a small part at best in the final revegetation plan.

9. Tentative planting densities are proposed. These could be adjusted downward somewhat but an upward adjustment

would be more desirable. Additional use of brush layering or wattling would be desirable on terraces in the pit and in other critical areas if sufficient funds are available.

II. SITE CONDITIONS

1. Introduction

The Leviathan Mine is located on the Eastern side of the Northern Sierra Nevada Mountains in Eastern Alpine County. Elevations at the mine site range from 6800 to 7500 feet (2,073 - 2,286 meters). The eastern slopes of the Sierra Nevada Mountains are considerably drier than the western slopes, consequently the vegetation spectrum is quite distinct from that of the western slopes. Climate, soils, and terrain have controlling influences on the vegetation spectrum and on revegetation problems.

2. Climate

Precipitation: Records of the climate at the Leviathan Mine site are not available. The nearest weather station recording precipitation is at Markleeville, Alpine County, six miles due west at 5501 feet (1,677 m) elevation. A 19 year precipitation record for Markleeville (Hambrick, 1941) indicates an 18.19 inch (47-48 cm) seasonal average with over 50% in November to February (presumably as snow), 85% in October through April, and less than 15% in the growing season, May through September (Table 1.). The records for Woodsford, California (10-11 miles to the northwest at an elevation of 5630 feet (1716 m) for 1941 - 1970 show a very similar precipitation pattern (Butterfield, 1977).

Although Markleeville is at a considerably lower elevation, both isohyet maps (Hambrick, 1941, pp. 794-795) and the native vegetation component indicate that precipitation totals and pattern at the Leviathan Mine are of the same order. Vegetation at Woodsford is perhaps slightly more mesic in character.

Temperatures: Hambrick (1941) does not give temperature data for Markleeville. Comparison of data for Northern Sierra Nevada stations with similar geographic (east slope of range), elevation, and precipitation (total and seasonal distribution) to Markleeville allow an estimation of parameters for the area (Table 2.).

Evapotranspiration: The evapotranspiration budget of the site is discussed under section II 6. Abatement of acid mine drainage (AMD) by the use of vegetation.

3. Soils

Parent Materials: Parent soil forming materials were derived primarily from hydrothermally altered igneous rocks, andesitic and pyroclastics with minor amounts other materials (Butter-

Table 2. Temperature data for some Northern Sierra Nevada stations with similar geographic and elevation, and precipitation parameters to Markleeville, California.

County Station	Temperature °F					Killing Frosts				Precipitation	
	Length of record	Jan. Av.	July Av.	Max.	Min.	Length of record	Last in spring	1st in fall	Growing season	Length of record	Total
Alpine											
Markleeville	--	--	--	--	--	--	--	--	--	19	18.79
Woodsford	--	--	--	--	--	--	--	--	--	29	20.69
Mono											
Gem Lake	14	26.0	60.3	91	-20	14	6/19	9/13	86	14	25.13
Lundy Lake	13	26.2	62.9	90	-34	14	6/7	9/20	105	14	14.89
Placer											
Tahoe	29	26.3	60.6	94	-15	24	6/22	9/2	72	29	29.35
Nevada											
Truckee	26	25.9	61.0	101	-28	19	6/23	8/21	59	27	26.13
Sierra											
Sierraville	28	26.4	62.7	104	-34	28	7/1	7/31	30	29	22.20
Lassen											
Westwood	16	27.8	65.0	100	-17	17	6/5	8/28	84	18	21.63
Range		25.9-27.8	60.3-65.0	90-104	-17--34		6/5-7/1	9/20-7/31	105-30		14.89-29.35
Est., Leviathan Mine Isotherm & Isohyet Maps		20-24	60-64				5/20-6/10	8/30-9/20	100-120		16-20

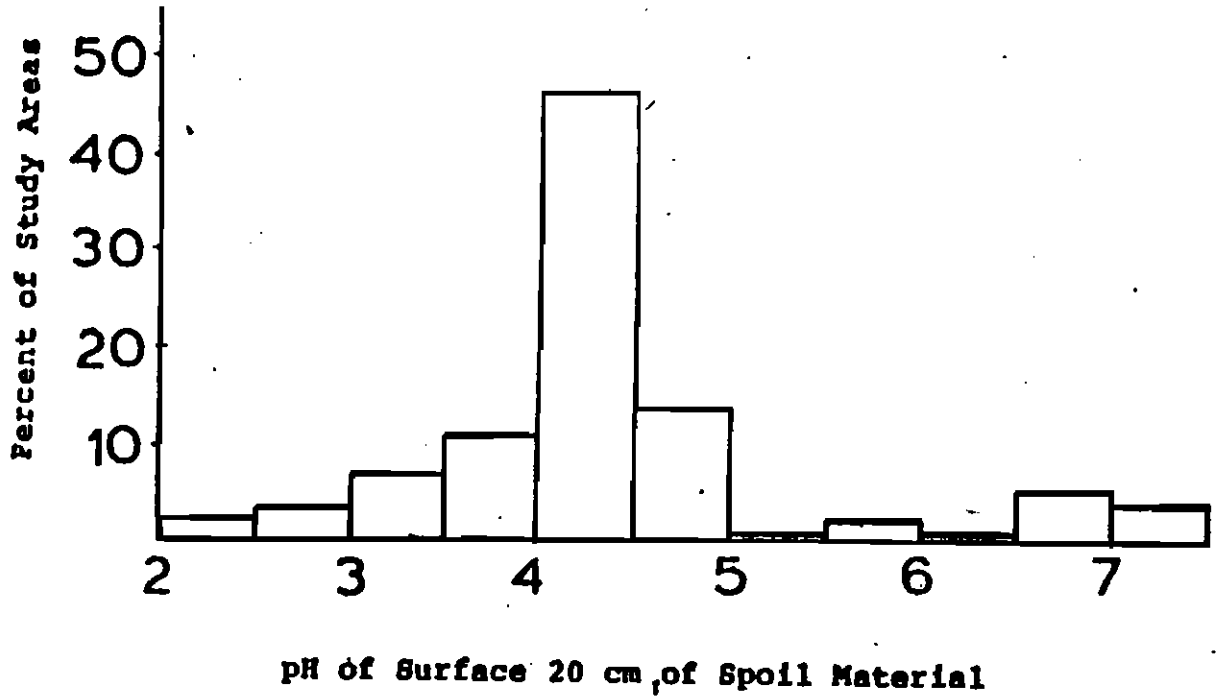


Figure 1. pH distribution on volunteer vegetation study sites on the Leviathan mine spoils.

experience has shown by numerous workers that grass establishment and growth can be improved by liming to a pH above 6. This will be discusses later under "Nutrition".

Nutrition: The mine spoil chemical analyses reported by Butterfield indicate deficiencies in nitrogen and possibly in calcium where pH levels are below 4. Only three analyses were made for phosphorus and these ranged from low to abundant. The response of native woody plants to nutrition is varied. Some respond and some do not. Results of greenhouse pot tests do not always give the same responses as occur in the field. Fertilization in the field may result in reduced transplant survival, excessive growth, and delay in plants becoming dormant in the Fall. In such cases, winter survival is reduced. These species have evolved under low nutrient regimes and seem to respond well without supplemental nutrition. Comparison of long-term growth rates of young Pinus jeffreyi, Jeffrey pine reported by Butterfield were not significantly different on or adjacent to the site. No signs of nutrient deficiencies were observed in volunteer vegetation in the 1982 vegetation survey. Therefore fertilization of woody plants is not recommended at this time.

Grasses on the other hand not only respond to but require added nutrients on soils such as these if satisfactory establishment and growth is to be attained. Butterfield reported very large gains in yields of Bromus tectorum, downey brome, and Sitanian hystrix, squirreltail when mine spoils were limed and fertilized with nitrogen and phosphorus. The use of both lime, and nitrogen/phosphorus fertilizers will probably be essential for the establishment of satisfactory grass stands. The demonstration plot plantings could be used to verify this.

4. Water

The precipitation amounts and distribution were discussed in section 2, Climate. The Leviathan mine spoils appear to hold sufficient moisture for good plant establishment. Water retention data for the 1976 growing season (from Butterfield, 1977) are given in Figure 3 . These indicate that moisture is above the permanent wilting point (PWP) at 30-40 cm (12-16 in) through the growing season. On three of eight sites the moisture dropped below the PWP on one or two sampling dates in July or Auguts. Soil moisture at 8-10 inch depths appeared adequate at all sites samples in mid-August 1982. The spoil material, with its high clay content, readily formed firm balls at this time. Spoils were so wet it did not seem necessary to run laboratory tests at this time.

The surface layers dried to below the PWP as early as May 26 in 1976 (Figure 3). For this reason, transplants should be grown in deep tubes or containers. Bare-root conifers

Table 3. Annual Evapotranspiration (ET) at Three Nearest Stations to the Leviathan Mine.

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Truckee	0.6	0.8	1.7	3.1	4.5	5.7	6.3	5.7	4.4	2.6	1.2	0.5	37.1
Tahoe City	0.5	0.7	1.6	2.8	4.3	5.4	6.1	5.5	4.1	2.2	0.9	0.4	34.5
Reno, Nevada	1.0	1.4	2.8	4.3	6.2	7.7	8.3	7.7	5.7	3.3	1.5	0.7	50.6

Table 4. Evapotranspiration for Various Length Growing Season at Tahoe City, Placer County, California[1]

Growing Season	ET
March 1 - October 30	32.0
April 1 - October 30	30.4
May 1 - October 30	27.6
May 1 - September	25.4

1 Evergreen trees and shrubs transpire whenever ground is not frozen in root zone. Deciduous native species often leaf out before the last frost in spring and retain leaves for some time after first frosts in the fall. Therefore the "growing season" is longer than the frost-free period.

Because there is little "irrigation" (rainfall) during the growing season at the site, one may safely use the ET estimates for the growing season at the site as the potential water depletion. Using the low ET values for Tahoe City in Table 4, the most conservative estimate is that for a May 1 - September 30 season where deciduous plants are the main water users more water could be used than falls during the year. Evergreen species in the plant spectrum, both conifers and broadleaved shrubs (e.g. *Ceanothus velutinus* and *Cercocarpus ledifolius*) would, like citrus, use substantial amounts of water in January, February, March, November, and December as well. In the case of citrus, this winter season use is 33% of the annual total.

Item (4), photosynthetic use is small and can be disregarded.

With a potential ET of 34.5" per year (Table 3., Tahoe City) and a growing season loss of 25-32" per year (Table 4.), and a potentially significant loss by evergreen species during the winter months it should be possible to dispose of considerably more water than is added each year.

What happens when water consumption is more than water supply?

1) Plant stands will thin to the carrying capacity of the site.

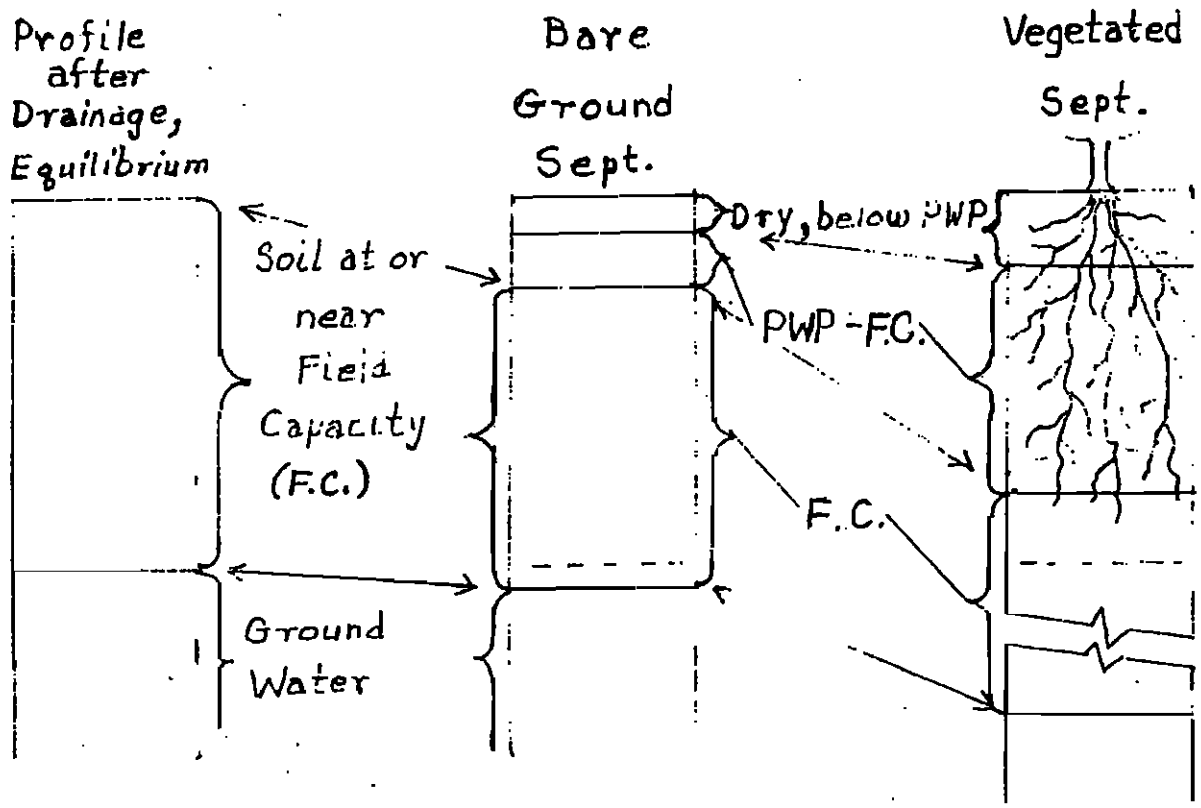
2) Plants such as many of the natives on the site; pines, ceanothus, mountain mahogany, etc.; can extract water at greater tensions (to 70 or 80 bars or more) than can many cultivated crops.

3) Many native plants may become essentially dormant, yet survive, periods of drought.

Establishment of vegetation cover at the maximum carrying capacity of the Leviathan Mine site could utilize essentially all of the annual precipitation. Percolation to ground water would only occur when the soil reservoir fills above the field capacity, where particularly coarse spoil materials occupy the bulk of the soil profile and reduce storage capacity, or when run-off from adjacent areas adds significantly to the impinging precipitation. The open pit is an area with potential for more than 18-19" of water recharge because of drainage from the surrounding headwall areas.

Many woody species are capable of reducing the water content of the top 8-9 feet or more of soil material to the wilting point (often defined as about 40-50 bars) or below (up to

Figure 4. Schematic diagram of soil profile water under different conditions. Not to scale. Ground water may be very deep or non-existent e.g. if it drains off bedrock base.[1] Vegetation increases volume below PWP and between PWP and F.C. and will lower water table if present.



[1] F.C. = field capacity. PWP = premanent wilting point.

Figure 5. Soil texture triangle. Points corresponding to the percentages of clay, silt, and sand are located on the corresponding lines. Read clay parallel to the silt tide, silt parallel to the sand side, and sand parallel to the clay side. The name in the compartment at the point of intersection is the class (texture) name of the soil in question.

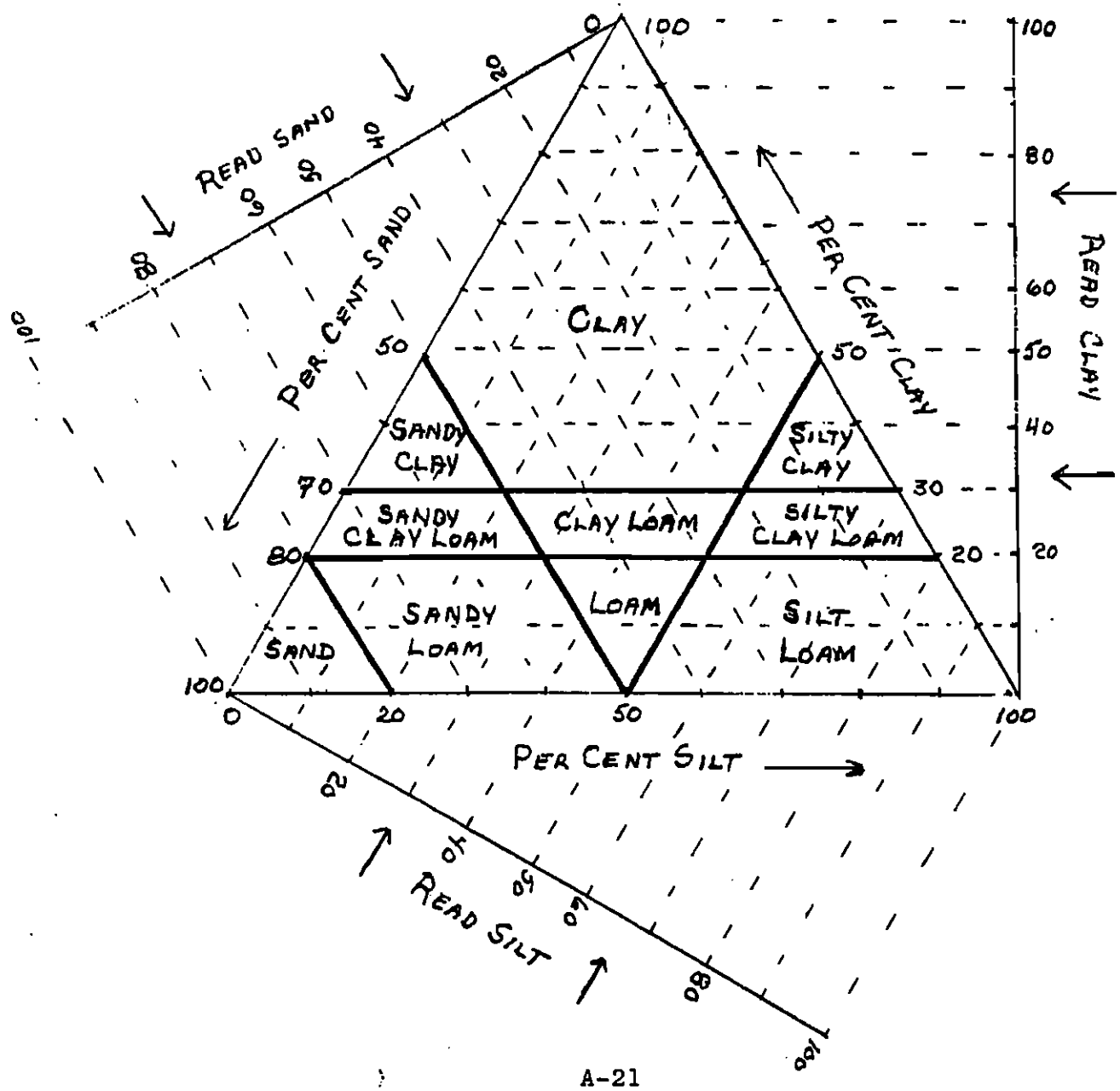


Table 7. (continued)

30 - 40 depth sample.

Site:Slope Aspect	4/4	4/14	4/24	5/9	5/26	6/18	7/9	7/30	8/20	Min. value per site
Site 1: Slope 0	11		6	12	6	6	6	9	12	12
Site 2: Slope 0			10	2	10	3	3	3	5	10
Site 3: Slope 60% Aspect SE		9	8	7	10	5	5	1	12	12
Site 4: Slope 0		11		9	4	8	3	3	7	11
Site 5: Slope 50° Aspect N		*	*	5	16	9	7	8	10	16
Site 6: Slope 65% Aspect SSE	4			2	9	6	-2	5	6	9
Site 7: Slope 0	*	*	*	3	10	8	-4	12	16	16
Site 8: Slope 70% Aspect N	*	*	*	4	11	9	2	-1	-4	11
Total	15	20	24	32	76	54	20	40	64	97
$\bar{x}$ maximum	7.5	10	8	4	9.5	7	2.5	5	8	12.125

Max = 16; mean max = 10 at PWP Min = -4; mean min. maximum, mean of highest data/site 12.1

*Frozen.

Summary: Plants will be small initially. Even with good plant establishment, the water use will not approach these values for several years. Use of vegetation to remedy the water percolation problem would not be as immediate as that obtained through mechanical means of compaction, sealing with various products etc. but the solution would be permanent. Mechanical control of water may become ineffective with time. Compaction will be reduced rapidly at least to frost depth by freezing and thawing. Artificial barriers of platicizers, plastics and asphalt fail with time. Gully or water way surface drainage systems will fail as frost loosens surface soils or excessive (abnormal) run-off occurs unless well designed and well protected with vegetation. Prospects of adequate gross stands are dim for this site without an ongoing fertilization program. On slopes, bare ground between woody plants can and will erode, but proper placement (staggered vertical alignment) and the plant root systems will reduce this erosion to levels comparable to natural undisturbed sites.

Table 9. Adjacent vegetation, immediately surrounding site. Principal woody species.

Conifers:		
Abies concolor	white fir	common, mesic areas
Juniperus occidentalis	western juniper Sierra juniper	slightly common, dry sites
Pinus jeffreyi	Jeffrey pine	dominant, abundant
P. monophylla	one-leaved pinyon	common
Pinus murryana (syn: P. contorta var. m.	lodge pole pine	occasional
Shrubs:		
Amelanchrer pallida	service-berry	occasional-deciduous
Artemisia tridentata	basin sagebrush	common-evergreen
Castanopsis sempervirens	Sierra chinquapin	rare-evergreen
Ceanothus velutinus	Tobacco brush	common-evergreen
Cercocarpus ledifolius	Curl-leaf mountain mahogany	common-evergreen
Chrysothamnus nauseosus subs. albicaulis	Rabbitbrush	common-deciduous
C. parryi subsp. nevadensis	Rabbitbrush	moderately common-deciduous
Prunus emarginata	Bittercherry	occasional-deciduous
P. virginiana var. demissa	Chokeberry	occational-deciduous
Purshia tridenta	Bitterbrush	common-deciduous
Rhamnus rubra	Coffeeberry	occasional-evergreen
Ribes cereum	Squaw current	moderately common-deciduous
R. sp.	(Needs verfication)	moderately common-deciduous
Rosa woodsii var. ultramontana	Wood's rose	rare-deciduous
Salix lemonii	willow	common (wet places)-deciduous
Salix spp	willow (to be verified)	3 or 4 spp. Leviathan Creek
Sambucus caerulea	Blue elderberry	rare-deciduous
Symphoricarpos sp.	Snowberry (to be verified)	common-deciduous
Herbaceous or Suffrutescent species of potential value		
Apocynum pumilum	dogbane	rare-deciduous
Eriogonum umbellatum	A-27	moderately common

Table 10. (continued) (on site volunteers)

C. parryi subsp. nevadensis	Rabbitbrush	Fairly common - spoil; waste dump. - deciduous
Holodiscus boursieri ?	Cream bush	Rare - semi-disturbed area No. of pit.- deciduous. Need verification in bloom, may be H. microphyllum.
Populus sp.	Poplar, cottonwood	Rare - one young plant, old Leviathan Creek. - deciduous
P. tremuloides	Qualking aspen	Rare - old spoil No. of crusher. - deciduous
Prunus emarginata	Bittercherry	Moderate numbers - delta; spoil; dsmi-disturbed area No. of pit. - deciduous
P. virginiana var. demissa	Chokeberry	Rare to moderate - waste pile; spoils; Leviathan Creek delta. -deciduous
Ribes cereum	currant	Common to abundant (less than C. ledifolius. -numerous microsites incl. waste pile; spoil. -deciduous
R. sp.	currant	Few. -various, need flowers/ fruit for ID.
Rosa woodsii var. ultramontana		Rare. -Leviathan Creek delta
Salix* exigua var. exigua	Narrow leaf willow	Common. -pit floor; delta, old Leviathan Creek.- deciduous
S. geyeriana var. argentea	Silver willow	Common. -old Leviathan Creek. -deciduous
S. lasiandra	Western black willow	Common. -old Leviathan Creek. -deciduous

*All Salix identification somewhat tentative, from herbarium sheets from Tahoe basin.

Table 11. On-site vegetation - planted.[1)]

Found August 1982, planted 1976

Amelanchier alnifolia	Service berry	Waste pile. -deciduous
Caragana arborescens	Siberian pea shrub	Waste pile. To 3' tall. -deciduous
Elaeagnus angustifolia	Russian olive	Waste pile. Trees to 12' -deciduous
Physocarpus opulifolius	Ninebark	Waste pile. -deciduous
Pinus jeffreyi	Jeffrey pine	Waste pile. Good survival. -conifer
Ribes aureum	Golden currant	Waste pile. -deciduous
Unidentified sp.		Waste pile. Might be Sherherdia, not listed by Butterfield.

[1)]Other vegetation listed by Butterfield was not located.

Precipitation variations: The estimated long term mean annual precipitatian for the Leviathan mine is estimated at 19-18 inches. Annual precipitation at any particular site in California varies widely. Wet and dry years may alternate or come in cycles lasting two or more years. These cycles cannot be predicted accurately. Specifications can only be written for the average. Every adjustment should be made in case dry years occur during planting. Planting may begin earlier and stop earlier (i.e. have a shorter planting season). In extreme cases planting might be postponed a year except that the ideal sized planting stock cannot be held for a year. A better solution would be to provide irrigation one to several times early in the growing season at two to four week intervals.

less common.

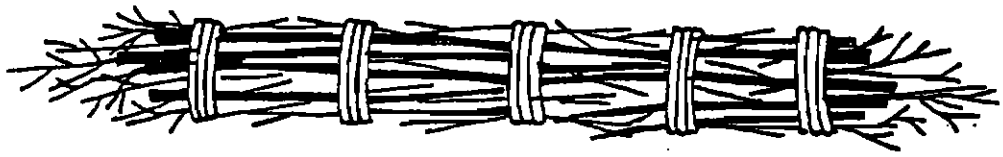
Elaeagnus angustifolia (Russian olive) is one of the most promising introduced (exotic) species. This has proven itself on mine spoil elsewhere. It is a deciduous large shrub or small tree with considerable drought tolerance and it will "fix" atmospheric nitrogen. Other Elaeagnus species (e.g. E. umbellata) should be included in the demonstration plantings.

Physocarpus (nine bark) and a "near native" (native elsewhere in the Sierras) Ribes species are also doing well in the research plantings.

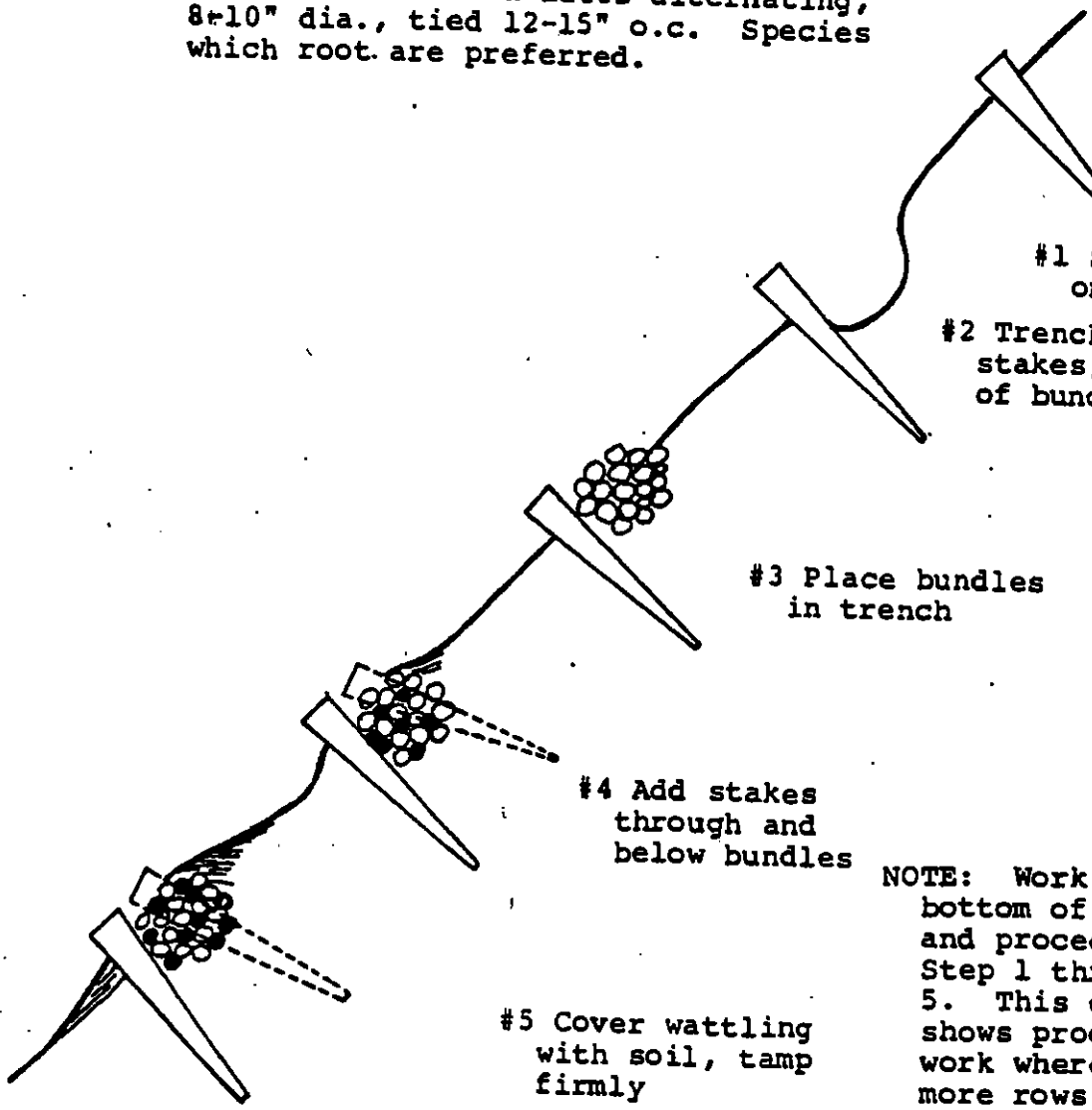
Grasses are excellent to utilize water. Native species are sparse and seed is almost impossible to obtain. Introduced species used successfully elsewhere in the Sierras have been very poor in research plantings. These should be tried again in the demonstration plantings but at the present time we should not count on gaining much benefit from them. A list of species has been prepared in the demonstration plantings.

Final selection of species of both woody plants and grasses will be dependent on sources of seeds. Some woody plants are available on a regular basis, some are not. Most of the grasses being considered for trial are available on a regular basis as well. Almost all the woody species listed in Table 10 will be considered for planting if the seeds are available. Two exceptions are the Western white pine and the mountain hemlock. Neither species was seen in the vicinity of the mine site.

Figure 6. Wattling Installation - schematic diagram.



Prepare Wattling: Cigar-shaped bundles of live brush with butts alternating, 8-10" dia., tied 12-15" o.c. Species which root are preferred.



NOTE: Work starts at bottom of cut or fill and proceeds from Step 1 through Step 5. This diagram shows progress of work where 5 or more rows of wattling are placed.

11. Stakes may be made of live wattling material greater than 1 1/2 in. in diameter or they may be construction stakes (2" x 4" x 24" or 2" x 4" x 36", diagonal cut). Reinforcing bar may be substituted only as specified below.

12. All stakes shall be driven to a firm hold and a minimum of 18 in. deep. Where soils are soft and 24 in. stakes are not solid (i.e. if they can be moved by hand), 36 in. stakes shall be used. Where soils are so compacted that 24 in. stakes cannot be driven 18 in. deep, 3/8 - 1/2 in. steel reinforcing bar shall be used for staking.

13. Work shall progress from the bottom of the cut or fill toward the top and each row shall be covered with soil and packed firmly behind and on the uphill side of the wattling by tamping or by walking on the wattling as the work progresses or by a combination of these methods.

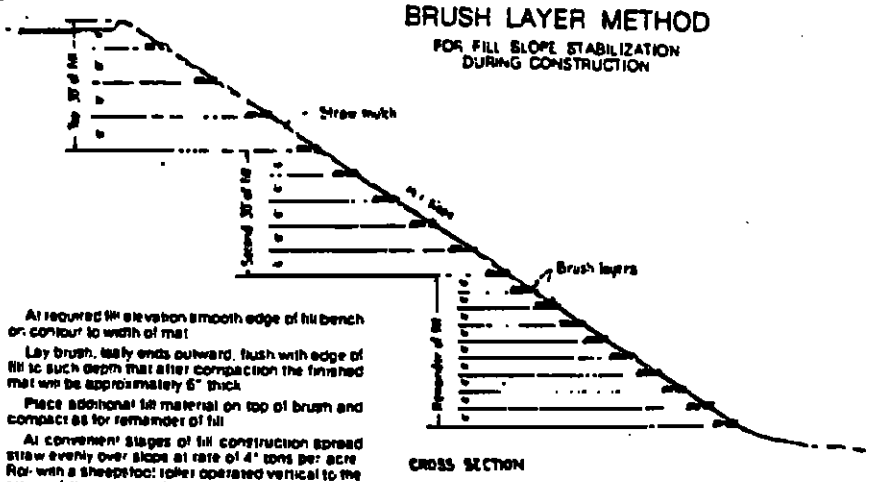
14. The downhill "lip" of the wattling bundle shall be left exposed when staking and covering are completed. However, the preceding specification must be rigorously adhered to.

Brush layering has been most frequently used during construction of fill slopes. In such situations it is probably more economical and more effective than wattling. It usually requires more material than wattling. Brush layering also has value in the reconstruction of failures in cut slopes. This use utilizes shorter lengths of brush and and involves more labor than wattling but does not require the expenditure for stakes. It is also particularly useful in the repair of gullies, lifts being filled and topped with brush. The two applications are illustrated in Figure 7. There is little information on costs in the United States although it has been used extensively in Europe.

Figure 7.

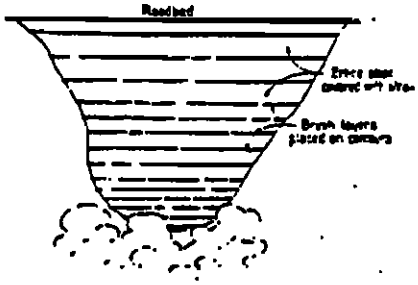
BRUSH LAYER METHOD

FOR FILL SLOPE STABILIZATION DURING CONSTRUCTION

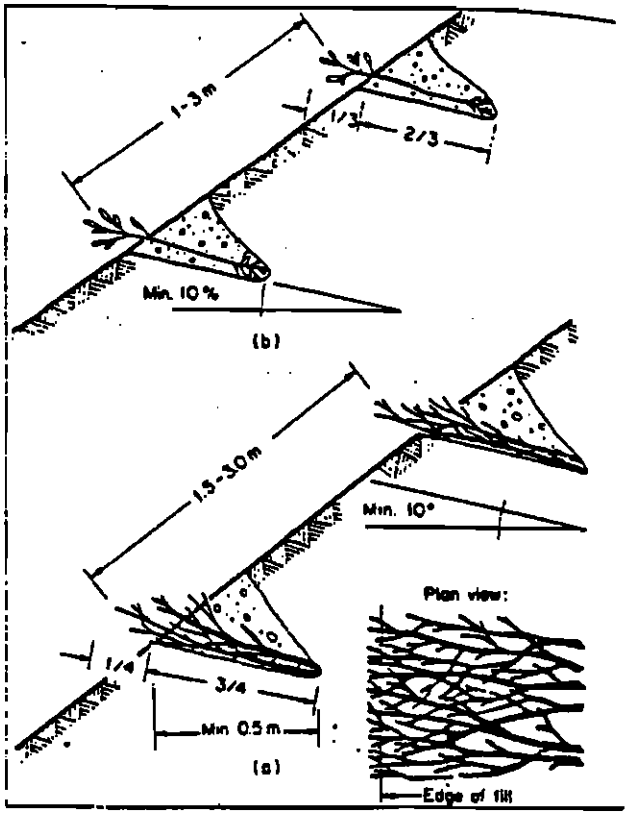


CROSS SECTION

1. At required fill elevation smooth edge of fill bench or contour to width of mat
2. Lay brush, butt ends outward, flush with edge of fill to such depth that after compaction the finished mat will be approximately 6" thick
3. Place additional fill material on top of brush and compact as for remainder of fill
4. At convenient stages of fill construction spread straw evenly over slope at rate of 4 tons per acre. Roll with a sheepfoot roller operated vertical to the plane of the slope until straw is thoroughly incorporated into the soil. At least 4 round trips of the roller will be required
5. Sow evenly over the slope a mixture of 50% Barley, 45% Rye grass and 5% Alfalfa seed by weight at rate of 200 lbs per acre
6. Spread second application of straw at rate of 4 tons per acre. Repeat rolling operation until straw is firmly imbedded in soil
7. Plant live cuttings of Baccharis and Willow, or cuttings and seed of hardy varieties of plants indigenous to the locality, between mats for permanent vegetative protection



SIDE ELEVATION



V. PRELIMINARY REVEGETATION PLAN

Basis for Revegetation Cost Estimates

The costs for revegetation are difficult to estimate on a unit cost basis because of widely varying costs for plant materials and planting labor. Table 12 lists the range of estimated costs for materials and labor. The lowest costs result from assuming that the plant materials are available from government nurseries and that prison honor crews could be used for planting work. The highest costs assume that plant materials must be obtained from common nurseries and that a landscaping contractor is retained for the planting work. The unit cost used for transplants in cost estimates later in this chapter is roughly in the middle of the range. The unit cost for willow cuttings was developed from cost data on previous work done by Dr. Andrew Leiser in the Lake Tahoe area, and assume commercial contractor labor rates. Costs for planting at various densities are listed on a cost/acre basis in Table 13.

Table 12 . Unit costs - initial planting.

Plant Mat'l	Materials		Labor		Total		Unit Cost
	from gov't nurs.	from com'l nurs.	by pris. crews	by com'l cont'r	high	low	for construction estimate
3" pots (var. sizes)	--	$0.45 each	$0.10 each	$0.30 each	$0.75 each	$0.50 each	$0.65
Tublings (various species)	$0.20 each	$0.30 each	$0.10 each	$0.30 each	$0.30 each	$0.60 each	$0.45
Willow cuttings (preparation & planting)	--	--	--	--	--	--	$0.25 each

Table 13. Initial planting costs per acre.
At different spacings.

Spacing O.C.	Plants per acre	Plant Mat'l	Unit Cost	Cost/Acre
1'	43,600	Tublings	$0.45/ea.	$19,600
		3 " pots	0.65/ea	28,300
		Cuttings	0.25/ea	10,900
2'	10,900	Tublings	0.45/ea	4,900
		3" pots	0.65/ea	7,000
		Cuttings	0.25/ea	2,700
3'	4,800	Tublings	0.45/ea	2,200
		3" pots	0.65/ea	3,100
		Cuttings	0.25/ea	1,200
4'	2,900	Tublings	0.45/ea	1,300
		3" pots	0.65/ea	1,800
		Cuttings	0.25/ea	700
6'	1,200	Tublings	0.45/ea	500
		3" pots	0.65/ea	800
		Cuttings	0.25/ea	300
8'	700	Tublings	0.45/ea	400
		3" pots	0.65/ea	500
		Cuttings	0.25/ea	200

Distribution of conifers, shrubs and willow cuttings will be adjusted within sites, considering microsite conditions of potential soil moisture. For example, willow cuttings will have the greatest density on the lower one third of the slopes.

Estimated planting costs are detailed in Table 14, 15, and 16, at two planting densities. Table 17 lists cost of supplemental work at high hazard areas.

Existing vegetation is at or near the maximum density possible in some areas of the site and would need little or no enhancement.

Revegetation efforts may not be practical in certain areas (e.g. much of the open pit headwalls) because of the steepness and erosion and because it may not be feasible to regrade these areas. Fortunately they are largely areas where the detritus can be contained and not contribute to sedimentation of watersheds.

Table 14. Planting spectrum, densities, spacing, and costs for four site priorities. Estimated minimum survival (50% of planting) for expected performance.

Priority	Spectrum	Survival Plant/A	Survival Spacing/O.C.	Planted Plant/A	Planted Spacing/O.C.	Costs Table	Costs Nev. For.[2]
			Minimum Planting				
1	Conifer	440	10	906	7	405	225
	Shrub	1750	5	3560	3.5	1602	890
	Cuttings[1]	4800	3	10900	2	2700	2700
	Totals	6990	2.5	15360	1.7	4707	3815
2	Conifer	440	10	900	7	405	225
	Shrub	1000	6.6	2000	4.7	900	500
	Cuttings	2400	4.25	4800	3	1200	1200
	Totals	3840	3.4	7700	2.4	2505	1925
3	Conifer	200	15	400	10.5	180	100
	Shrub	500	9.3	1000	6.6	450	250
	Cuttings	500	8.5	1000	6.6	250	250
	Totals	1200	6	2400	4.25	880	600
4	Conifer	200	15	400	10.5	180	100
	Shrub	500	9.3	1000	6.6	450	250
	Totals	700	7.9	1400	5.6	630	350
			Alternate Densities				
1	Conifer	440	10	900	7	405	225
	Shrub	1750	5	3560	3.5	1602	890
	Cutting	7200	2.5	15700	1.7	3900	3900
	Totals	9390	2.2	20160	1.5	5907	5015

Table 14. (continued)

2	Conifer	440	10	900	7	405	225
	Shrub	1200	6	2400	4.25	1100	600
	Cuttings	2400	4.25	4800	3	1200	1200
	Totals	4040	3.3	8100	2.3	2705	2025
3	Conifer	440	10	900	7	405	225
	Shrub	500	9.3	1000	6.6	450	250
	Cuttings	500	9.3	1000	6.6	250	250
	Totals	1440	5.5	2900	3.9	1105	725
4	(no change)						

Note: Grass hydroseeding: $700-800/acre, grass seed, fertilizer, wood fiber mulch. Grasses may be desirable on waterways. Lime (sugarbeet waste)= $12/ton FOB Sacramento Valley. 6-10 ton/acre for short term effects. Drayage and spreading must be added. Coarse limestone, special order for California 10-20 ton/acre required for long term effects.

1) Cuttings of willow calculated same cost commercial or Nevada State Honor Crews. No cost estimate received from Nevada Division of Forestry.

2) Plants (tubling or bare root) supplied by Nevada Division of Forestry. Planting by Honor Camp Crews.

Table 15. Estimated acreages to be planted at four densities (priorities). Priority 1 = critical disturbed areas, priority 4 = relatively stable, partially vegetated areas.

Site Description	Priority 1	Priority 2	Priority 3	Priority 4
Waste Pile				
North slope 2:1	5.5			
East facing slope 3:1		2.5		
West facing slope between crusher	1.5			
So., W., and N.W. perimeter		4.5		
Delta				
Perimeter and No. end		2		
Slope, delta to road	4			
Pit				
Regrade area (37%)	14			
Plantable slopes, ungraded		14		
Headwalls - no planting				
Spoils A				
Regraded depressions, channels, borrow		10		
Slopes ± 2:1 - 1:1		15		
"Saddle", so. end toward pit				15
Balance			75	
Spoil B				
Eroding areas E. of Road		10		
Balance			20	
Spoil C			15	
Totals	25	58	110	15

Table 16. Cost summary estimates for revegetation of main areas, Leviathan Mine, plants and labor.

Priority		Costs (Table)			
		Commercial		Nevada Crews & Plants	
No.	Acre	Unit $/A	Total	Unit $/A	Total
1	25	4707	117,675	3815	93,375
2	58	2505	145,290	1925	111,650
3	110	880	96,800	600	66,000
4	15	630	9,450	350	5,250
Totals			369,215		278,175
Alternate Densities 1-3					
1	25	5907	147,675	5015	125,375
2	58	2705	156,890	2025	117,450
3	110	1105	121,550	725	79,750
4	15	630	9,450	350	5,250
Totals			435,565		327,825

Table 17. Estimated costs, problem area revegetation: wattling, brush layering, extra planting.

Item	Lineal ft.	Area (acre)	Extra Planting	Wattling or Brush Layering Lineal ft. 20' o.c.	Lineal ft. 10' o.c.	Cost ($2/l.f.) 20' o.c.	Cost ($2/l.f.) 10' o.c.
Leviathan Creek	1500(x50')	2	10,000	3,750	7,500	7,500	15,000
Aspen Creek	500(x75')	1	5,000	2,000	4,000	4,000	8,000
Gullies (severe)	600(x50') to 850?	1	5,000	1,500	3,000	3,000	6,000
			20,000	7,250	14,500	14,500	29,000
Totals:			34,500 @ 20' o.c.		49,000 @ 10' o.c.		

Note: Wattling (or brush layering) at closer spacing would be much more effective. Actual spacing will be adjusted or varied as the final grading plans dictate.

Cost constraints for the total project will be a limiting factor, overall for the revegetation density that can be achieved. The greater density of planting that can be achieved, the greater the erosion control and the greater the evaporation and control of seepage.

The costs in Table 14 in the column "Nev. For." refer to estimated costs given by the Division of Forestry, Nevada Department of Conservation and Natural Resources. The Division of Forestry has expressed keen interest in both growing the required materials and doing the planting. They have the facilities and professional capabilities of supplying the plants, given proper lead time to collect seed, propagate and grow the plants. The project would be assured of stock grown from seed collected either near the site or from areas of similar climatic areas. Such assurence would probably not be possible from most commercial sources. Many of these species have large altitudinal and latitudinal ranges. Plants grown from seed collected from dissimilar growing sites may not perform as well as those produced from areas of similar climates. Nevada Division of Forestry's costs for preparing and planting willow cuttings will also probably be less than those of a commercial firms because of lower labor costs. The estimated commercial costs have been used because estimated costs have not yet been received from them. The unit costs will probably be near $ 0.15 - 0.18 rather than the $ 0.25 used here.

The success of revegetation on difficult sites can be limited by numerous adverse conditions. Improper planting, below normal precipitation, monor slope failures, frost heaving, rodent damage, and other hazards can reduce survival. The revegetation plan specifies that planting will be in sufficient numbers so that the final stands will be adequate after normal attrition. However losses are seldom uniformly distributed and excessive losses in any area may result in slope failures. When quasi-vegetational methods are used failure of small parts may jeapordize the entire system. It is important to repair these localized or weaknesses in plantings in the first years of a project. It is suggested that the following percentages of any phase of the project costs for this repair and maintenance:

year one - - - 15 to 20%

year two - - - 5 to 10%.

This will add 20 to 30% to the total revegetation portions of the project costs. These monies, if needed could be used where most needed as determined by project personnel.

VI. PILOT REVEGETATION STUDY

The Pilot Revegetation study will be carried out essentially as discussed in the bid proposal.

1. Four microsites are planned; one each as follows:

   Level site, old spoils,

   1:1 to 2:1 slopes with East, NE, or North aspect,

   1:1 to 3:1 slopes with South, SW, or West aspect,

   Regraded site with freshly exposed spoil.

2. The plant list will include introduced and native species, most of which have not been previously tested on the site. The Division of Forestry, Nevada Department of Conservation and Natural Resources is supplying some species from their nurseries and have made arrangements to obtain additional species from the U.S. Forest Service, Intermountain Experiment Station, Boise, Idaho. The list should be finalized by March 1 when inventories have been completed. For testing a wider variety of species, some may be used in quantities as low as 100 rather than the 200 proposed originally. Comparison of "tublings" (tube grown liners), quart containers and bare root stock with a few species.

3. Plots will be randomized so that valid comparisons can be made among species and treatments.

4. Labor will be supplied and supervised by the Nevada Division of Forestry (as well as supervision by the Brown and Caldwell Consultant).

5. Exact plot locations will be selected as project plans are finalized so that they will not be disturbed by construction activities.

6. Some grass plots will be included using species and cultivars which have proven useful at similar elevations.

7. Willow species native on site will be compared for relative rooting and survival on the different sites.

8. Plots will be monitored and data taken in the late summer of 1983 to be used in fine tuning the overall revegetation plan.

APPENDIX B

SITE EXPLORATION, TESTING, AND GEOLOGY

This appendix in in three sections as follows:

B1 -- Summary of United Stated Geological Survey (USGS) Drilling Exploration

B2 -- Geologic Field Mapping

B3 -- Results of Soils Testing

B4 -- Soil Permeability by the Hazen Approximation

B5 -- On-site Tests of Permeability

SECTION B1

SUMMARY OF U.S. GEOLOGICAL SURVEY DRILLING EXPLORATION

Drilling exploration at Leviathan Mine commenced June 23, 1982, using a CME all-terrain, hollow stem auger drill rig provided by Lawrence Drilling Company, Inc., of Redding, California. This rig is equipped with a four-inch, inside diameter, hollow stem to facilitate soil sampling down through the hollow stem without having to remove the drill stem each time.

Drilling continued at the mine through September 22, 1982. During the drilling exploration program, 59 borings were excavated and logged. Of this number, a total of 51 were provided with perforated casing to permit subsequent monitoring of groundwater levels and quality. Locations of all borings drilled are provided on Figure 2-20 in the text, while a summary of pertinent surface elevations and casing information for those borings to be used for groundwater monitoring is also provided in the text (see Table 3-7).

As can be noted on the logs of the drill holes, five different people were used to provide geologic logs of the borings. These people were Messrs. Joe Gonthier, Walt Rennick, Don Schaefer, and Greg Berggren of the U.S. Geological Survey (USGS); and Don Ford, driller for Lawrence Drilling Company, Inc.

where are drill logs?

Drill Hole Locations

Information as to locations of the drill holes were used in the exploration program is from the following sources:

1. Approximate locations provided by the USGS on the orthophoto project base map, for all holes drilled through August 20, 1982. This map was received in October 1982 and provided the approximate drill hole locations as mapped in the field by well logging personnel.

2. Surveyed locations provided by Resource Concepts, Inc., under contract to the USGS on a drawing with a coordinate system identical to that of the orthophoto project base map. This map, dated November 17, 1982, provides surveyed locations and elevations of casing for all borings used for groundwater monitoring. It was received in November 1982.

Drill Hole Summary

The 59 drill holes in the drilling exploration program were distributed on the site as follows:

Site Area	Number of Holes
Delta	12
Mine pit	10
Spoil tailings	10[a]
Landslide	7[b]
Waste dump	12
Upgradient/bedrock	8
	59

[a]Two of the holes listed for "Upgradient/bedrock" were drilled through the spoil tailings.
[b]Seven of the holes listed for "Spoil tailings" were drilled on into the landslide.

A summary of drill hole data is provided by site area in Table B1-1.

TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - DELTA AREA

DRILL HOLE No.[a]	APPOX. ELEV., ft.[b] PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.[c]	HOLE DEPTH ft.	APPROX.[d] PERF. CASING INTERVAL, ft
DH-9A	6890	6901	+11	52	47-52
DH-9B	6890	6900	+10	25	20-25
DH-9C	6890	6901	+11	15	10-15
DH-10A	6880	6893	+13	50	45-50
DH-10B	6880	6895	+15	25	20-25
DH-10C	6880	6894	+14	15	10-15
DH-11A	6880	6890	+10	55	50-55
DH-11B	6880	6890	+10	30	25-30
DH-11C	6880	6890	+10	15	10-15
DH-18A	6895	6896	+1	47	42-47
DH-18B	6895	6894	-1	25	20-25
DH-18C	6895	6895	0	15	10-15

a) Holes designated with "L" or "N" are for lysimeter or neutron probe only

b) Pre-mine elevations from 1940-photo based topographic map. Post-mine elevations are from survey data provided for this study. For holes with casing, elevation is surveyed elevation rounded to the nearest foot. For holes without casing, elevation is estimated from project topographic map based on surveyed location

c) Minus sign denotes pre-mine to post-mine soil removal.

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TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - PIT AREA

DRILL HOLE NO.	APPOX. ELEV., ft. PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.	HOLE DEPTH ft.	APPROX. PERF. CASING INTERVAL, ft
DH-2A1	7295	7058	-237	21	15-21
DH-2A2	7295	7058	-237	10	7-10
DH-2B1	7320	7067	-253	22	17½-22
DH-2C1	7420	7066	-354	31	26-31
DH-2C2	7420	7065	-355	15	10-15
DH-17A	7315	7100	-215	65	55-65
DH-17B	7335	7103	-232	70	54½-64½
DH-17C	7345	7128	-217	95	80-90
DH-26	7260	7107	-153	60	50-60
DH-27	7300	7097	-203	73	Dry Hole, no casing

TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - SPOIL TAILINGS AREA

DRILL HOLE NO.	APPOX. ELEV., ft. PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.	HOLE DEPTH - ft.	APPROX. PERF. CASING INTERVAL, ft
DH-23	7180	7322	+142	150	No Casing
DH-23A	7180	7322	+142	68½	58½-68½
DH-25	7330	7382	+52	115½	105-115
* DH-3AP	7040	7063	+23	118½	108½-118½
* DH-3B1	7105	7105	0	82	72-82
* DH-3B2	7105	7105	0	25	15-25
* DH-3CN	7095	7120	+25	51	blank casing
* DH-3CP	7095	7120			
* DH-19A	7050	7079	+29	82	72-82
* DH-19B	7050	7080	+30	40	30-40
** DH-22	7050	7151	+1	91½	77½-87½
** DH-24	7420	7435	+15	65	55-65

* Also listed as drill holes in Landslide Area.

** Also listed as drill holes in Upgradient/Bedrock Area

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TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - WASTE DUMP AREA

DRILL HOLE No.	APPOX. ELEV., ft. PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.	HOLE DEPTH ft.	APPROX. PERF. CASING INTERVAL, ft
DH-1AN	6975	7107	+132	117	80-100
DH-1AL	6975	7107	+132	100	No Casing
DH-1AP	6975	7107	+132	200½	116-156
DH-1BL	6955	7056	+101	60	No Casing
DH-1BN	6955	7056	+101	60	Blank Casing
DH-1BP	6955	7056	+101	136	96-136
DH-1CL	6975	7107	+132	62½	No Casing
DH-1CN	6975	7107	+132	60	Blank Casing
DH-1CP	6950	7055	+105	131	111-131
DH-14	7016	7038	+22	91	71-91
DH-15	6995	6992	-3	31½	19-31½
DH-16	6945	6991	+46	62	42-62

TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - UPGRADIENT/
BEDROCK AREA

DRILL HOLE No.	APPOX. ELEV., ft. PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.	HOLE DEPTH ft.	APPROX. PERF. CASING INTERVAL, ft
*USB-31	7312	7314	+2	157	No casing
*USB-32	7330	7333	+3	129	113½-128½
*USB-33	7295	7299	+4	122	80½-120½
DH-7	6860	6858	-2	163	143-163
DH-8	6805	6799	-6	135	125-135
DH-8A	6805	6799	-6	49	39-49
**DH-22	7150	7151	+1	91½	77½-87½
**DH-24	7420	7435	+15	65	55-65

* These holes were originally drilled by U.S. Borax and were reused by USGS in this study

** A small amount of fill in the Spoil Tailings Area overlies bedrock in these holes

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TABLE B1-1. SUMMARY OF DRILL HOLE DATA
LEVIATHAN MINE - LANDSLIDE AREA

DRILL HOLE NO.	APPOX. ELEV., ft. PRE-MINE	EXISTING	PRE-MINE TO EXISTING ELEV. Δ, ft.	HOLE DEPTH ft.	APPROX. PERF. CASING INTERVAL, ft
DH-4	6780	6794	+14	100	80-100
DH-5	6845	6854	+9	103	93-103
DH-5A	6845	6854	+9	31	21-31
DH-6	6875	6897	+22	32	12-32
DH-20	6695	6711	+16	32	22-32
DH-20A	6695	6710	+15	92	82-92
DH-21	6925	6942	+17	45	35-45
* DH-3AP	7040	7063	+23	118½	108½-118½
* DH-3B1	7105	7105	0	82	72-82
* DH-3B2	7105	7105	0	25	15-25
* DH-3CN	7095	7120	+25	51	Blank Casing
* DH-3CP	7095	7122	+27	90	80-90
* DH-19A	7050	7079	+29	82	72-82
* DH-19B	7050	7080	+30	40	30-40

* These holes are also listed as holes in the Spoil Tailings Area

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SECTION B2

GEOLOGIC FIELD MAPPING

At the request of the Brown and Caldwell/Geotechnical Consultants, Inc., study team, the California Regional Water Quality Control Board, Lahontan Region, initiated a geologic field mapping program at the mine. Field mapping and report preparation for this program consisted of two separate efforts and was conducted by the California Water Resources Control Board, Division of Technical Services. The first effort was reconnaissance mapping of the large active landslide conducted June 23 and 24, 1982. The second effort was detailed mapping of the mine, identification of rock units, and report preparation and was accomplished during August and September 1982. The following memoranda reports from Ms. Charlene Herbst are presented in this section.

1. July 6, 1982. Reconnaissance mapping of the large landslide.

2. October 18, 1982. Detailed mapping of the mine site.

3. January 25 and February 3, 1983. Refinements to October 18, 1982, mapping.

State of California

THE RESOURCES AGE

Memorandum

To : Mr. Gerard Thibeault
Lahontan RWQCB (7)
Victorville

Date : July 6, 1982

From : **STATE WATER RESOURCES CONTROL BOARD**
Division of Technical Services

Subject: LANDSLIDE INVESTIGATION, LEVIATHAN MINE, ALPINE COUNTY

On the afternoon of June 23 and on June 24, 1982, you, Gil Torres, and I visited the Leviathan Mine to map the lateral extent of the landslide north of the open pit. We also checked associated features such as scarps, cracks, ponded water, and seeps, in order to determine the causes of the initial and continuing movement and the depth of the slide.

On June 25, 1982, Gil Torres and I examined aerial photographs of the landslide taken in September 1954, September 1968, June 1975, and September 1980. The photos were examined to determine changes in the landslide features over time. Photos taken in 1940-41 were subsequently examined in Sacramento; photos taken June 1969 were not usable because of lack of photo overlap.

The main purpose of our field study was to determine the geometry of the slide. We understood the principal Regional Board concerns to be:

(1) Stabilization of the lower portion of the landslide to prevent damming of Leviathan Creek and subsequent accumulation of toxic fluids. Such fluids would be released as a slug if and when the dam failed.

(2) Elimination of or severe reduction in the volume of water collecting above and moving through the tailings at the head of the landslide. Such water picks up toxic elements from contact with the tailings before flowing into Leviathan Creek.

LANDSLIDE GEOMETRY AND HISTORY:

The landslide area is actually two landslides separated by a semi-stable area (see Attachment 1). The landslides differ in geometry and in the cause of instability. The total of all three areas is slightly over 100 acres.

Each area is described separately below. In standard landslide nomenclature, directions are designated in the same way as for rivers and streams. Left and right are designated as if the observer were standing at the head of the slide looking down toward the toe.

Upper Tailings Slump

The area designated as "upper tailings slump" includes all the area covered by tailings. There are two principal headwall scarps in this area, as well as

numerous smaller scarps. The horseshoe-shaped main scarp bounds the right flank of the landslide. The younger secondary scarp is 400 feet upslope of the main scarp and defines the crown and left flank of the slide. In addition, numerous smaller scarps cut the tailings, some having a similar sense of direction as the main scarp and some having a reverse sense, forming grabens.

The tailings slump area is bounded on the right side by Aspen Creek and on the left side by an unnamed natural drainage. These two drainages mark the lateral extent of the original tailing piles.

The surface of the tailings slump area is marked by scarps and benches. Some of the grabens contained ponds at the time of our visit; in others, water appeared to have dried up within the last few weeks. Two seeps were noted during our investigation. One was 200-300 feet downslope of the main scarp on the right side of the slide, and discharged 5-10 gpm. The second was actually a horizontal line of seeps at the base of the tailings on the right side, and discharged a total of between 5 and 10 gpm. Neither seeps nor standing water were found on the left side of the area.

The landslide appears to be a rotational slump. The main body of the slide appears to be totally located in the uncompacted tailings, and the zone of rupture appears to be at or near the base of the tailings. In 1940-41, prior to placement of tailings, the land surface was stable with no evidence of an older landslide which would have involved the ground below the tailings. The limited field investigation did not indicate a significant rise in the toe area. The toe(s) may never have been significant or may have been subdued by erosion or obscured by subsequent slumping. Since no clear lower boundary of the slump area was discerned during the brief field time available, I have placed the lower extent of the slump area at the base of the tailings.

The tailings slumps have evolved since the 1954 aerial photographs were taken. In 1954, what is now the head area appeared stable. The distribution of tailings in 1954 was the same as that in the 1968 photos except for the additional discharge and/or redistribution of tailings on the left side post-1954.

By 1968, the main scarp was well developed, and an incipient crack had formed along what is now the trace of the upper secondary scarp. By 1975, the upper scarp was conspicuous and many of the other small scarps had developed. The slide appears to be continuing its headward erosion toward the edge of the open pit. At the base, tailings are moving gradually downslope into the trees below; this movement is noticible when comparing 1968 and 1980 photos. Also, by 1954, changes had already been made in the upper drainage of Aspen Creek; the ultimate effect of these changes was to destablize the area near Leviathan Creek.

There are several apparent causes for the instability within the tailings. The tailings were never compacted and appear to have been placed at or near their angle of repose. The tailings were most probably destablized by precipitation

falling directly on the tailings and collecting between ridges of tailings on and near the future landslide. After slumping began, the grabens which formed also captured precipitation and further destablized the slope. The larger amount of water on the right side of the landslide may be due to the lnear tailings piles upslope that create troughs which capture precipitation. There are no linear piles upslope of the left side of the slide.

Central Soil Creep/Slump Area

The central area extends from the base of the tailings downslope to the asymmetrical arc which forms the headwall scarp of the lower landslide. It is relatively stable as shown by vertical trees and a lack of change in major features since 1954.

The area extends laterally from Aspen Creek on the right to a natural drainage on the left. On the right side of the area are two northwest-trending ridges, which dominate local topography. Due to lack of time, this ridge area was not traversed, nor was the boundary between this area and the upper tailings slump area defined.

Aspen Creek is rapidly downcutting its channel on the right side of the central area. This has destabilized the unconsolidated material near the creek, causing small scarps to form parallel to the creek bed. Some slumping has occurred on the left side of the central area as well, and one local failure removed part of an access road.

Little running water was noted in this central area, although three ponds are located in the lower middle, immediately above the headwall scarp of the lower landslide. More water may have been present in the area which we were not able to traverse.

In general, failures in the central area are local and shallow, involving only the upper few feet of soil. The mechanism of failure is slumping or soil creep and is probably triggered by either changing soil moisture conditions or by changing slope conditions, as with the Aspen Creek area. Because of the type of failure, there is no regional "slip plane" in this area.

Aerial photographs indicate the stability of this area. Most trees in the area are vertical; trees within a large landslide usually lean. A lineation (old road?) was visible in the 1954 photos about 300 feet below the base of tailings. This lineation is present, unchaged, in the 1968 through 1980 photos. The three depressions which now contain ponds have also been present at least since 1968.

Lower Translational Slide

The lower translational slide contains many of the features commonly associated with landslides. The asymmetrical main scarp is actually a series of small scarps in erodable soil; the scarps extend roughly from east to northwest downslope of the northernmost northwest-trending ridge. Because of the size of the headwall scarps, they are more easily recognizable in aerial photos than on the ground.

The landslide extends from Aspen Creek on the east to a small unnamed drainage on the west. The axis of greatest movement trends north-northwest, and the toe of the landslide extends into the Leviathan Creek channel. Continued movement of the toe has displaced the creek to the north against the northern mountain.

The surface of the slide is hummocky, with some transverse cracks on the flanks and radial cracks at the toe. Observers indicated that, over the last several months, there had been significant movement of the slide mass, perhaps on the order of several inches per week. Systematic measurements of the slide movement are not being made at present.

At the time of our visit, the right side of the landslide appeared to be saturated. Numerous seeps and meadow areas were present, especially near the toe. Significant seeps and marshy areas were present on the left side of the slide near the head. The water on the right side of the slide appears to be principally underflow from Aspen Creek. The source of the water near the head of the slide is probably precipitation, moving either over the land surface or within the soil zone.

The landslide movement appears to be translational, and primarily within the near-surface materials. This type of landslide moves along a near-planar surface with little rotation and very little disturbance in the displaced material. In the subject landslide, roads have been moved downslope with so little disturbance that amounts and differential rates of movement could have been determined from aerial photographs. Headwall scarps are not pronounced, and there is little or no uplift at the toe.

Because of the type of movement and the morphology of the displaced material, I believe the slide to be thin, perhaps 35 to 40 feet thick. The surface of the rupture may actually be a zone of rupture, thicker near Leviathan and Aspen Creeks where the potential for weathering has been greater.

The features of this landslide have developed rapidly. In 1954 aerial photographs, there is no evidence of instability, although several roads have been built across what is now the slide area. The open, generally treeless nature of the lower slopes suggests that it might have been a landslide in the distant past. The landslide was clearly visible in the 1968 aerial photographs. By 1968, the landslide had displaced Aspen Creek from its original channel and moved it to the east. The amount of displacement was not determined. Aspen Creek responded to the disturbance by flowing east and capturing a neighboring drainage. Since 1968, the position of the headwall scarp has shifted slightly, but the overall configuration of the landslide has remained the same. Offsets of the section of road across the landslide indicates continuing downslope movement.

The present cause of landslide movement appears to be primarily underflow from Aspen Creek which destablizes the landslide mass. The erosion of the toe by Leviathan Creek also helps destabilize the landslide. The initial causes of landslide movement are difficult to determine. As noted earlier, the configuration of the tailings piles did not change much from the 1954 to the 1968 aerial photo flights. I believe that failure was related to changes in the hydrologic regime of Aspen Creek, perhaps from improper installation of conduit at road crossings, from careless placement of tailings, or from another cause not now

apparent. The disturbance, whatever the cause, resulted in raising of the base level of the upper section of Aspen Creek. This, in turn, resulted in increased erosion in the creek channel as the creek tried to regain equilibrium. The increase in underflow appears to be related to these hydraulic changes.

GENERAL CONCLUSIONS:

As a result of our brief field inspection and subsequent office research, I have come to the following conclusions:

- Aspen Creek is the primary cause of movement of the translational slide. Disturbance of the Aspen Creek drainage sometime before 1954 or between 1954 and 1968 probably precipitated the movement. Continuing movement is probably due to a combination of Aspen Creek underflow and removal of toe material by Leviathan Creek.

- Slope movement in the upper tailings area began sometime between 1954 and 1968. Possible causes of continuing movement include the lack of compaction and over-steepened slopes of the original tailings piles and precipitation falling directly on tailings or collecting in depressions above and in the slide area. Recent aerial photographs indicate that the slopes have not yet reached an angle of repose and that the crown is continuing to receed. The main scarp will probably eventually intercept the pit area.

- The lower translational slide appears to be shallow, perhaps 35-40 feet thick.

- The upper slump area appears to be failing at or near the base of the tailings.

GENERAL RECOMMENDATIONS:

As a result of our brief field inspection and subsequent office research, I make the following recommendations:

- Some of the proposed drill hole sites need to be relocated to encounter the zone of rupture. Attachment 2, Figure 4.11, shows a generalized pattern for landslide borings (from Landslides - Analysis and Control, Special Report 176, Transportation Research Board, National Academy of Sciences). The drilling sites presently just above the translational slide should be moved into the landslide, as close to the axis of greatest movement as possible.

- Inclinometers should be installed in the boreholes. These will serve several purposes:

  - indicate differential vertical rates of movement in the landslide;

  - indicate seasonal changes in rates of movement; and

  - indicate the effectiveness of any control measures implemented in the landslide area.

In addition, the special casing required for the inclinometer instrument can be perforated so the bore holes can also serve as piezometers. Attachment 3 summarizes information on inclinometers received from the Slope Indicator Company, Seattle, Washington.

- The principal cause of the lower slope movement that threatens to dam Leviathan Creek is underflow from Aspen Creek. The best methods of reducing underflow would be relocation of the creek or re-routing of the creek through culverts or flumes. The creek is downcutting rapidly at present, so clay or other lining of the creekbed would probably not be effective.

- Precipitation in the tailings area destablizes the upper slopes, and contact of precipitation with tailings results in fluids with a pH of 4 to 5. The best method to reduce infiltration would be regrading of the upper slopes to eliminate depressions and stabilize slopes. The additional advantages of capping with low permeability material should be investigated.

Charlene Herbst

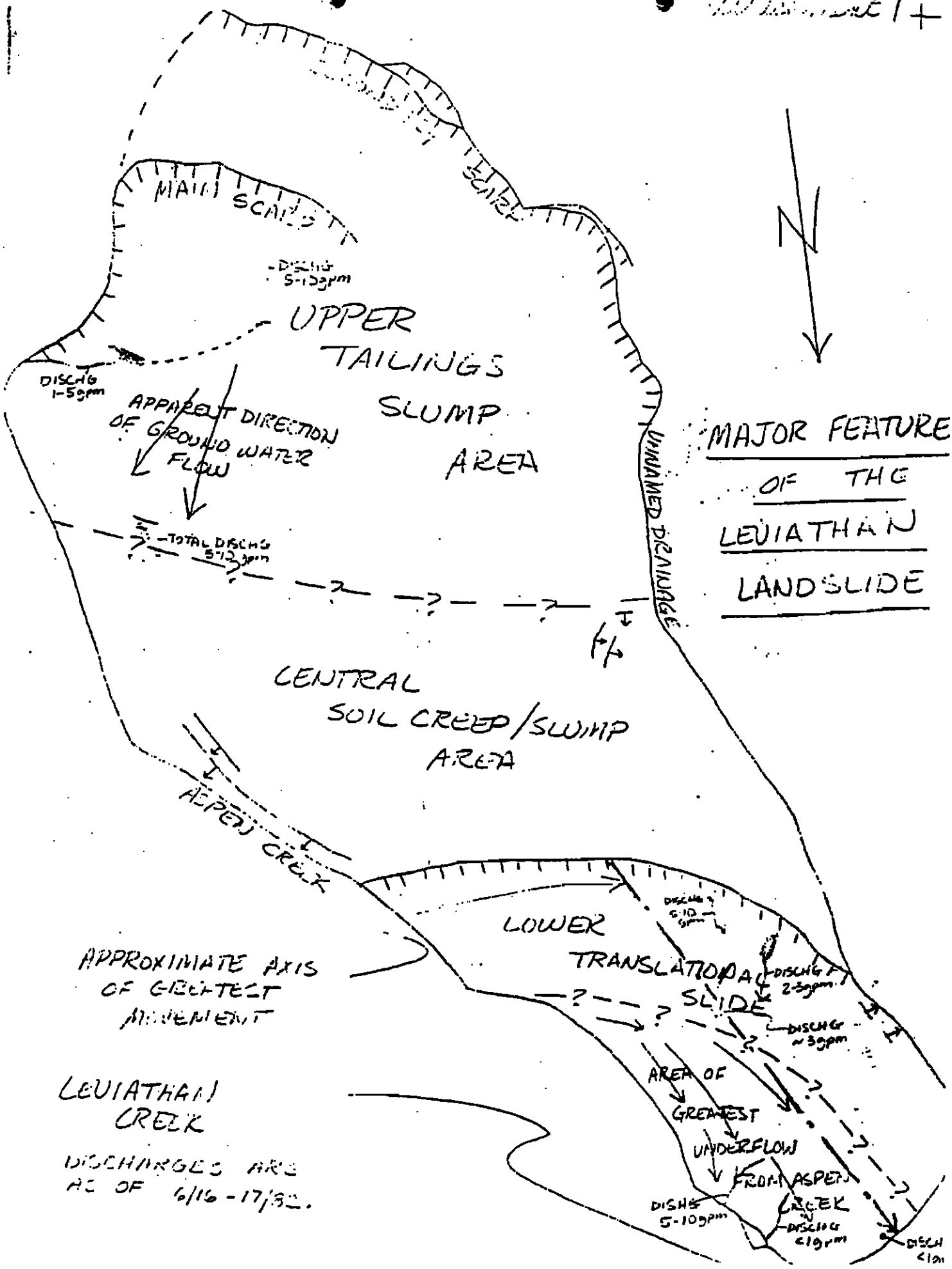
Charlene Herbst
Division of Technical Services

Attachments

cc: Gil Torres
Division of Technical Services

HERBST/paula
7/6/82

Attachment 1+



State of California THE RESOURCES AGENCY

Memorandum

10-108

Routed	Date
LKP	10/21
cc:	USGS
	[illegible]
	B+C

To : Roy C. Hampson
Executive Officer
Lahontan Regional Board

Attn: Jim Kuykendall

Date : October 18, 1982

RECEIVED
OCT 26 1982
BROWN AND CALDWELL

From : STATE WATER RESOURCES CONTROL BOARD

Subject: Geologic Mapping, Leviathan Sulfur Mine

The Division of Technical Services has completed the geologic mapping of the Leviathan Sulfur Mine which your Region requested. Attached is your copy of our final report. The report includes an overlay showing locations of seeps noted during the field work, and a geologic map at the scale of 1:2400 (1 map inch equals 200 feet on the ground). We have postponed drafting of the 1:1200 geologic maps (1"=100') until Brown and Caldwell provides us with materials to make up a topography-only base map.

If you have any questions about the report, please contact Charlene Herbst at 324-1252.

Robert S. Ford
Supervising Engineering Geologist
Division of Technical Services

Attachment

cc: Gerard Thibeault
Lahontan Regional Board

Bonnie Wolstoncroft
Office of the Chief Counsel

OCT 2 : 1982

GEOLOGY OF THE LEVIATHAN SULFUR MINE AND VICINTY

by

Charlene M. Herbst
John E. Sciacca

State Water Resources Control Board
Division of Technical Services

October 1982

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1. Geology of the Leviathan Sulfur Mine & Vicinity
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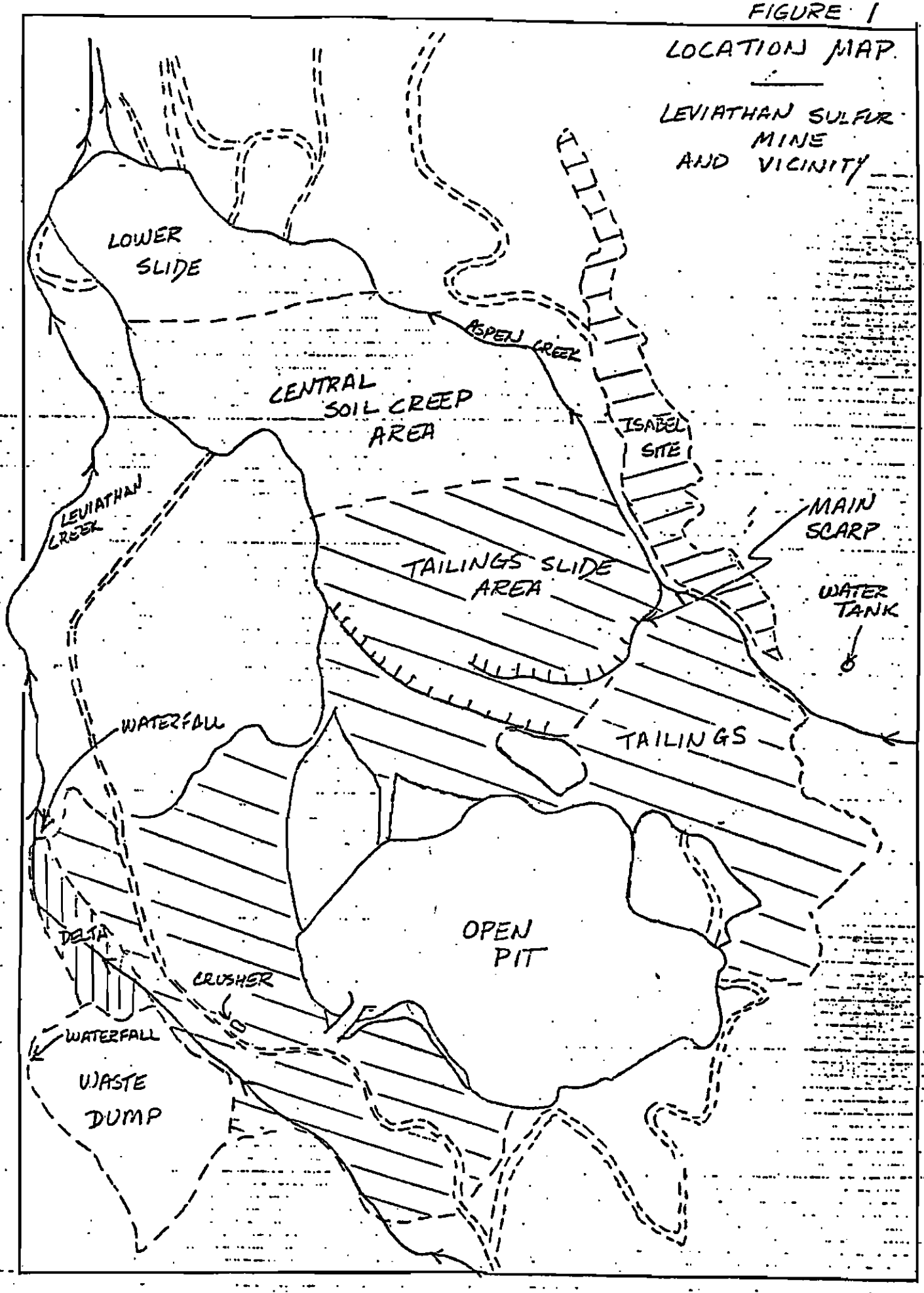
FIGURE 1

LOCATION MAP

LEVIATHAN SULFUR MINE AND VICINITY



I. Introduction

The field study of the geology of the Leviathan Mine area (Figure 1) was undertaken at the request of the Lahontan Regional Water Quality Control Board (LRWQCB). The geologic mapping was designed to help answer questions about the surface and subsurface site hydrology and provide information for the design of proposed engineering works.

During this study, rock units were identified and described in hand sample and thin section. Sulfides were noted, and identified when possible. The nature of rock permeability (primary versus fracture permeability) was noted.

Fault traces and contacts between rock units were located and plotted on 1:100 orthophoto maps with topography. This report includes cross-sections and the location of seeps and damp areas noted during field work.

Two individuals provided helpful information on the areal geology. David A. John, of the U.S. Geological Survey (USGS), provided much information on the geology of the Topaz Lake Quadrangle, both in the office and during a field visit to the mine. John S. Rapp, of the California Division of Mines and Geology, generously shared his insights into the petrology of the Relief Peak Formation.

II. Conclusions & Recommendations

Conclusions

A. Sedimentary rocks northwest of the waste dump strike roughly east-west, dip to the south and are indurated. Ground water movement down bedding planes into the materials beneath the pit from this area is therefore unlikely. Ground water could move along joint or fracture traces.

B. Sedimentary and volcanic rocks at the pit entrance also strike roughly east-west and dip to the north. Ground water could move down-dip in the sedimentary rocks and into materials beneath the pit. Pygmy meter measurements of flow in Leviathan Creek made by the USGS indicate no infiltration of surface water to ground water within the ±10% error limits of the meter.

?

C. Sedimentary units north of the pit generally dip to the north. Ground water movement down bedding planes from these units into the pit is unlikely. Ground water could move along fracture traces into the pit area.

D. In other areas around the mine, ground water occurrence and movement is restricted to fractures, joints, and some fault planes.

E. Sulfides which contain arsenic and other potential water contaminants have been found in significant amounts in silicified iron-stained breccia in the pit area, especially in rocks that are blue-black to dark blue on fresh surfaces, and in ore rock. Both rock types are present in most if not all artificial fill.

F. The sandy "talus" in the pit resulting from mining appears to have a high ground water storage capacity. Landslides in the pit area may also have a high storage capacity.

G. Landslides in the pit and the large composite landslide north of the pit seem to be seated in friable or altered sedimentary rock that is present at or very near the surface. This inherently weak unit was destabilized by mine operations and failed, probably along one of the fine-grained interbeds.

H. Most of the large landslides in the pit area appear to have stabilized. The debris flow on the west side of the pit and the slide in friable sandstone northwest of the pit entrance are active. Recent ground cracking is visible on the slope above the ore rock east of the pit entrance. If the pit were to be flooded and the toes of the large landslides saturated, the slides would probably reactivate.

I. Large rockfalls periodically occur at the eastern portion of the pit where the rock is extensively fractured and exposed as vertical walls. Slope failure will continue to occur in this area and should be taken into account in designing structures.

J. Much secondary calcite was noted in the study area: on joint faces in the biotite pyroxene hornblende andesite, coating pebbles in the sedimentary unit cut by a fault on the west edge of the pit, and along plant roots in soil developed on sandstone. The neutral (pH) quality of the ground water discharged from the landslide may be due to the calcite in the soil.

K. The ponded sediments which cover the bottom of the pit contain much clay and probably strongly inhibit vertical percolation of water. The large landslides in the pit area are composed of loose material and are probably permeable.

L. Leviathan Creek reportedly loses water between USGS Station 8 (at northern end of delta) and Station 10 (below the waterfall). Water loss could be due to percolation through alluvium into the underlying sandstone or to movement of water into the joint sets in biotite pyroxene hornblende andesite at the waterfall.

Recommendations

A. Any plan to use the pit to impound water is unadvisable unless there is sufficient storage in the reservoir to prevent overtopping of the dam if the landslides suddenly fail. Failure of the reservoir due to active displacement at the pit entrance must also be considered.

B. Fracture permeability tests should be made in the consolidated rocks around the pit to determine the rate of ground water movement.

C. In-place permeability tests in the landslides overlying Tunnel 5 and in the rock underlying the landslides (and adjacent to Tunnel 5) may help determine the source of the Tunnel 5 discharge.

D. Silicified iron-stained breccia and ore rock are not suitable for rip-rap because the sulfides in these rocks pose a threat to water quality. The quartz latite porphyry, any of the andesite units, or the basalt are unmineralized and would not affect water quality if used as rip-rap.

E. Water from the spring which supplies the ranch south of the mine should be analyzed to supply background ground water quality information.

III. Geologic Units

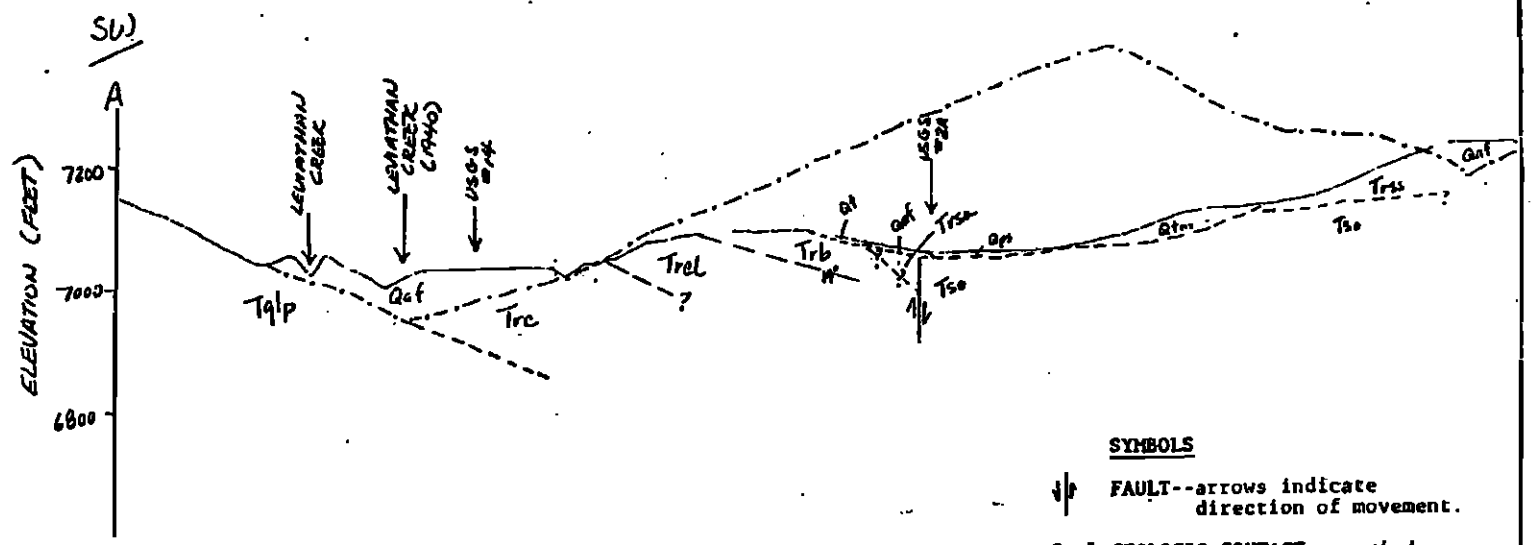
Geologic units in the study area consist of sedimentary, volcanic, and shallow intrusive igneous rocks. The sedimentary rocks noted in the study area are volcanoclastic sandstone, pebble conglomerates, silts, and lahars. Clasts, where present, were typically andesitic. The volcanic and shallow intrusive rocks are principally andesites, although one basalt unit was noted. These flows and intrusions overlie, underlie and intrude the sedimentary sequence and each other. The complexity of the relationships between rock units make correlations between units over long distances tenuous. The variety of rock units reflects the violence of volcanism in this area during the Tertiary (3-70 million years before present); the variations in dips on sedimentary units reflects irregularities in the paleotopography.

Rock units which may possess primary permeability are the Quaternary units (landslides and debris flow, alluvium, ponded sediments, artificial fill, talus, and talus resulting from mining), the lower sedimentary sequence, and the upper sedimentary sequence. All other rock units have only fracture permeability; these units are: basalt and basalt autobreccia, hornblende pyroxene andesite, ore rock, biotite pyroxene hornblende andesite, silicified breccia and iron-stained breccia, Leviathan Peak andesite, and quartz latite porphyry (Plate 1, Figure 2). Brief descriptions of the units are given here. More detailed descriptions are given in Appendix A.

Rock Units which may have Primary Permeability

The Quaternary units are unconsolidated natural and artificial deposits of gravel, sand, silt, clay, and rock fragments. Depending on the composition of these units at a particular location, they may transmit significant amounts of water.

The landslides and debris flows in the pit appear to be the result of oversteepening of slopes underlain by poorly consolidated sedimentary rocks during mining. The slide material is broken and may be very permeable. Some seeps were noted at the base of landslides (Plate 2).



CROSS-SECTION A-A'

LEVIATHAN SULFUR MINE AND VICINITY

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF TECHNICAL SERVICES

OCTOBER 1982

SYMBOLS

FAULT--arrows indicate direction of movement.

GEOLOGIC CONTACT--queried where uncertain.

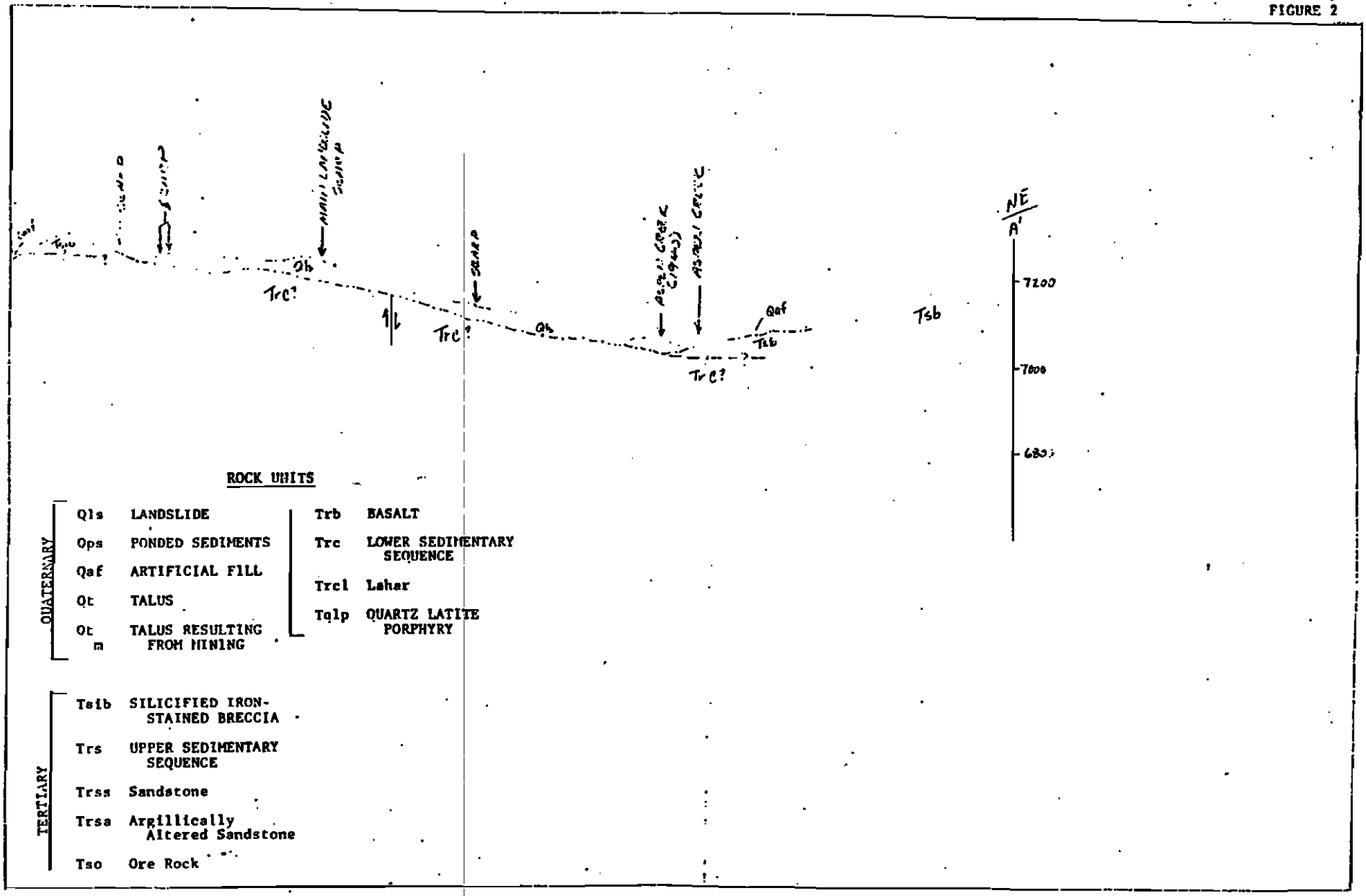
PREMINE TOPOGRAPHY--7/21/1940

0 200' 400'

SEE APPENDIX A FOR DETAILED DESCRIPTION OF ROCKS.

SEE PLATE 1 FOR LINE OF SECTION.

FIGURE 2


NE
A'
7200
7000
6800
Qb
Trc?
Trc?
Qb
Trc?
Qaf
Tsb
Tsb
ROCK UNITS
QUATERNARY
Qls LANDSLIDE
Ops PONDED SEDIMENTS
Qaf ARTIFICIAL FILL
Qt TALUS
Qt m TALUS RESULTING FROM MINING
Trb BASALT
Trc LOWER SEDIMENTARY SEQUENCE
Trcl Lahar
Tqlp QUARTZ LATITE PORPHYRY
TERTIARY
Tsib SILICIFIED IRON-STAINED BRECCIA
Trs UPPER SEDIMENTARY SEQUENCE
Trss Sandstone
Trsa Argillically Altered Sandstone
Tso Ore Rock

The large active composite landslide north of the pit appears to be in similar sedimentary rocks. Numerous seeps and springs are visible within the slides and at the toe of the lower slide.

Alluvium and ponded sediment are principally reworked artificial fill. The characteristics of each deposit varies with the source material, but these units are generally thin and their overall storage capacity for ground water is probably small.

Artificial fill overlies large sections of the study area. USGS holes 14, 15, and 16, opposite the pit entrance, encountered from 25 to 60+ feet of fill. Holes 3A, 3B, and 3C on the fill area north of the pit all encountered roughly 30 feet of fill before encountering sandstone. The fill is unconsolidated, and consists primarily of sandy clay with some boulders and occasional lenses of gravel-size material. Standing water several inches deep was observed at the Isabel Construction Company site one rainy day, suggesting low surficial permeability. Most water appears to move through the gravel layer.

Two types of talus were noted during the investigation. Natural blocky basalt talus mantles the west-facing slope west of the pit, above the road. This talus protects the underlying sandstone from erosion but has little if any ground water storage capacity. The sand-sized talus which has formed in the pit since the mining disturbance appeared moist at a depth of 6 to 8 cm in late August. This talus may have significant ground water storage capacity.

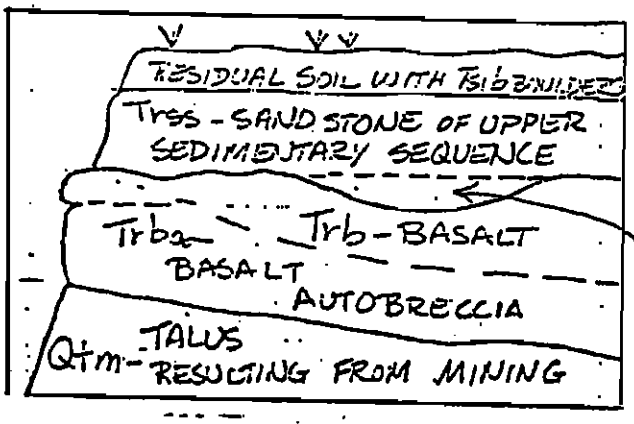
The lower sedimentary unit has been differentiated from the upper sedimentary unit by its position relative to the basalt and by the greater induration of the lower unit (Figure 3). The basalt may only divide the sequence locally -- in other areas, the sedimentary sequence probably could be considered as a single unit. A lahar or mudflow belonging to the lower unit is visible at the pit entrance. Lithic sandstones belonging to the lower sequence are poorly exposed above the road along the west side of the pit, and east and west of the large landslide along the former main road. Northwest of the waste dump and east of the large landslide, sandstones and pebbly sandstones of the lower unit show sedimentary structures.

The upper lithic sandstone is best exposed on the knob at the west edge of the pit. The sandstone is friable, very poorly sorted, usually damp, and contains some clay. A conglomerate

FIGURE 3

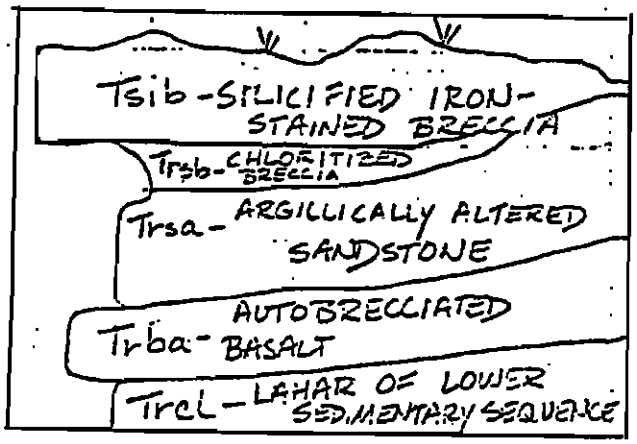
SCHEMATIC DIAGRAMS OF ROCK RELATIONS

LEVIATHAN SULFUR MINE AND VICINITY



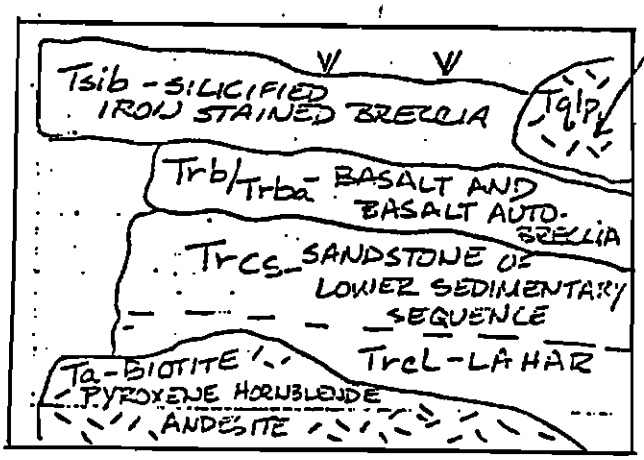
WEST SIDE OF PIT

BASAL CONGLOMERATE



NEAR AND AT PIT ENTRANCE

QUARTZ LATITE PORPHYRY



WEST OF WASTE DUMP

UNIT THICKNESSES NOT TO SCALE; INDICATES INTRUSIVE IGNEOUS ROCK.

belonging to the upper sedimentary sequence locally overlies the hornblende pyroxene andesite and contains clasts of the underlying andesite. A basal conglomerate fills an old channel beneath the sandstone on the west edge of the pit.

Where either the upper or lower sandstone is not covered by a cap of indurated rock such as basalt, the sandstone is very susceptible to landsliding. The sandstones and pebbly sandstones of the upper sequence probably have some permeability. The more indurated lower sequence probably has lower permeability. Lahars of both sequences may have some matrix permeability.

The upper sedimentary unit has been altered in the pit area, resulting in an argillically altered sandstone and breccia and a chloritized breccia. Samples from both units frequently feel moist in hand sample, but the high clay content of these units indicates that water would probably be retained rather than discharged.

The upper sedimentary unit also appears to grade into the main ore deposit. The ore deposit has only fracture permeability and is discussed in the following section.

Rock Units which may have Fracture Permeability

The rocks described in this section are silicified or mineralized sedimentary units, volcanic rocks, and shallow intrusive rocks. The relationship between these units is frequently unclear.

Quartz latite prophyry appears to be the least altered of the volcanic units. It is always surrounded by silicified breccia in the study area. It crops out as low blocks with well-developed joint sets. No mineralization was noted along joint faces.

Leviathan Peak andesite is seen only as platy angular float in the study area, although it does form resistant knobs outside the study area. The angular nature of the float suggests that the unit is very fractured beneath the surface. Locally, the unit has been argillically altered where in contact with the silicified breccia.

The silicified breccia is the uppermost unit in the pit area. There, it crops out as rounded hematite- and limonite-stained boulders. Elsewhere in the study area, it is visible only as

float (2 to 5 cm chips); chips from the noniron-stained portions of this unit whiten slopes sufficiently to make them conspicuous in aerial photographs. No joint sets or fracture patterns are present in the study area but the broken nature of the float suggests a high fracture permeability. In addition, the iron-stained portion of this unit in the pit area (rock is dark blue on fresh surface) contains elemental sulfur and fine-grained sulfides, including pyrite, marcasite, and arsenopyrite. When water moves through or is in contact with this unit, it can become mineralized from these sources.

Relict textures in the breccia unit suggest that it was originally a lahar, conglomerate or sedimentary breccia, subsequently silicified and mineralized. The Leviathan Peak andesite is locally argillically altered where in contact with the breccia. This suggests that fluids from one period of mineralization penetrated throughout the lahar because of its higher (matrix) permeability, but only penetrated a short distance into the andesite because of its lower (fracture) permeability.

Biotite pyroxene hornblende andesite crops out north and west of Leviathan Creek, forming resistant, highly jointed knobs. Locally, the joints are coated with calcite. This unit underlies much of the resistant ridge immediately north of Leviathan Creek at the toe of the lower slide. A knob of the andesite crops out along the abandoned road immediately south and west of the toe of the lower slide. The andesite appears to act as a control to landsliding in the toe area.

The ore rock appears to be the mineralized equivalent of the upper sedimentary sequence. It has relict sandstone and breccia texture, and has been pervasively replaced by native sulfur. This unit is the only one in the study area, besides the silicified iron-stained breccia, to contain large amounts of sulfides: oxidized and unoxidized pyrite as disseminated grains, bands, and irregular masses and aggregates of arsenopyrite. These sulfides could contaminate any water which comes in contact with them. The in-place ore rock may have some fracture permeability, although some fracture faces are coated with sulfur. More importantly, this unit, and the sulfur and sulfides it contains, are present in most if not all of the artificial fill in the study area.

Hornblende pyroxene andesite crops out only as angular float. Seeps and springs are present along faults cutting this unit. The domestic water supply of the ranch south of the mine comes from a spring along a fault in this unit. The angular nature of the float suggests that the andesite is highly fractured beneath the surface.

Basalt, locally autobrecciated, is visible in the pit entrance and on the knobs northwest of the pit. Calcite is widespread in autobreccia fractures on the west side of the pit indicating low fracture permeability in this area. The basalt flow northwest of the pit, above the road, has well-developed jointing and evaporite salt stains indicating water flow through fractures.

IV. Structure

Faulting

Faults of widely varying strike cut the study area (Figure 4). At least 3 distinct periods of faulting are represented. Much of the faulting appears to predate the mineralization. All faults are vertical or near vertical. Where a dip is not specified, the fault is assumed to be vertical.

The oldest faults are numbered 1 and 2 on Figure 4. Fault 1 trends east-west. It vertically offsets sandstone and basalt (south block upthrown); a portion of this fault may extend west into the biotite pyroxene hornblende andesite. Bladed calcite crystals along fractures and local alteration are present in the andesite in the vicinity of the projected fault.

Fault 2 is a pair of normal faults which trend northeast-southwest. They pass on either side of a small sandstone knob on the west side of the pit. The northwest fault of the pair dips 83° to the southeast. There is much calcite coating pebbles and fractures along the northwest fault. The northwestern block of the faults is upthrown. There is no clear evidence southwest of the waste dumps for Fault 2.

Faults 1 and 2 are offset by Fault 3, the most significant fault in the area. Fault 3 is visible in a roadcut east of the landslide area; here the fault has a dip of 84° to the east. The fault passes through a swale between two hills on the northwest edge of the pit. Faults 3 and 2 appear to have prevented the movement of sulfur and silicate mineralizing fluids into the block bounded by Fault 2 on the south and Fault 3 on the east. No cap rock or sulfur mineralization has been noted north of Fault 2 or west of Fault 3.

Fault 4 trends northwest-southeast with the northeast block upthrown. Because this fault offsets a silicified breccia-andesite contact, it appears to have a horizontal component of movement as well as a vertical component. At the southeast edge of the mapped fault trace is a spring. The relationship of Fault 4 to Fault 3 is obscured by debris in the pit.

Fault 5 trends northeast-southwest near the south gate. The sense of movement on this fault is unclear, but the spring which provides a domestic water supply to the ranch south of the mine is probably related to this fault.

Fault 6 is visible on the east side of the pit entrance. The fault extends along what is now the headwall scarp of a large landslide east of the pit entrance. It offsets Faults 1 and 2.

Fault 7 is an east-west trending fault which cuts the biotite pyroxene hornblende andesite, appears to vertically offset the baslat unit, and may be responsible for the large damp east-west trending swale east of the water tank. The relationship between this fault and Fault 4 is concealed by artificial fill and landslide debris. This fault passes through the horseshoe-shaped main scarp of the landslide in the mine tailings. The fault may have sheared the rocks along its trace that are now covered by fill. This would have made the rocks more prone to failure when loaded with fill. Fault 7 offsets Fault 6.

Bedding

Only a few of the sedimentary units in the area are well enough exposed for bedding and sedimentary structures to be visible. The bedding, where measurable, varies in dip in response to the irregular paleotopography.

West and northwest of the waste dump, beds of coarse-to-fine-grained sandstone, pebbly sandstone, and laminated silt of the lower sedimentary sequence strike roughly east-west and dip slightly to the south. At the pit entrance, altered sandstones and lahars of the upper sedimentary sequence strike roughly east-west and dip to the north. East and west of the landslide north of the pit, sandstone and pebbly sandstone beds dip to the north.

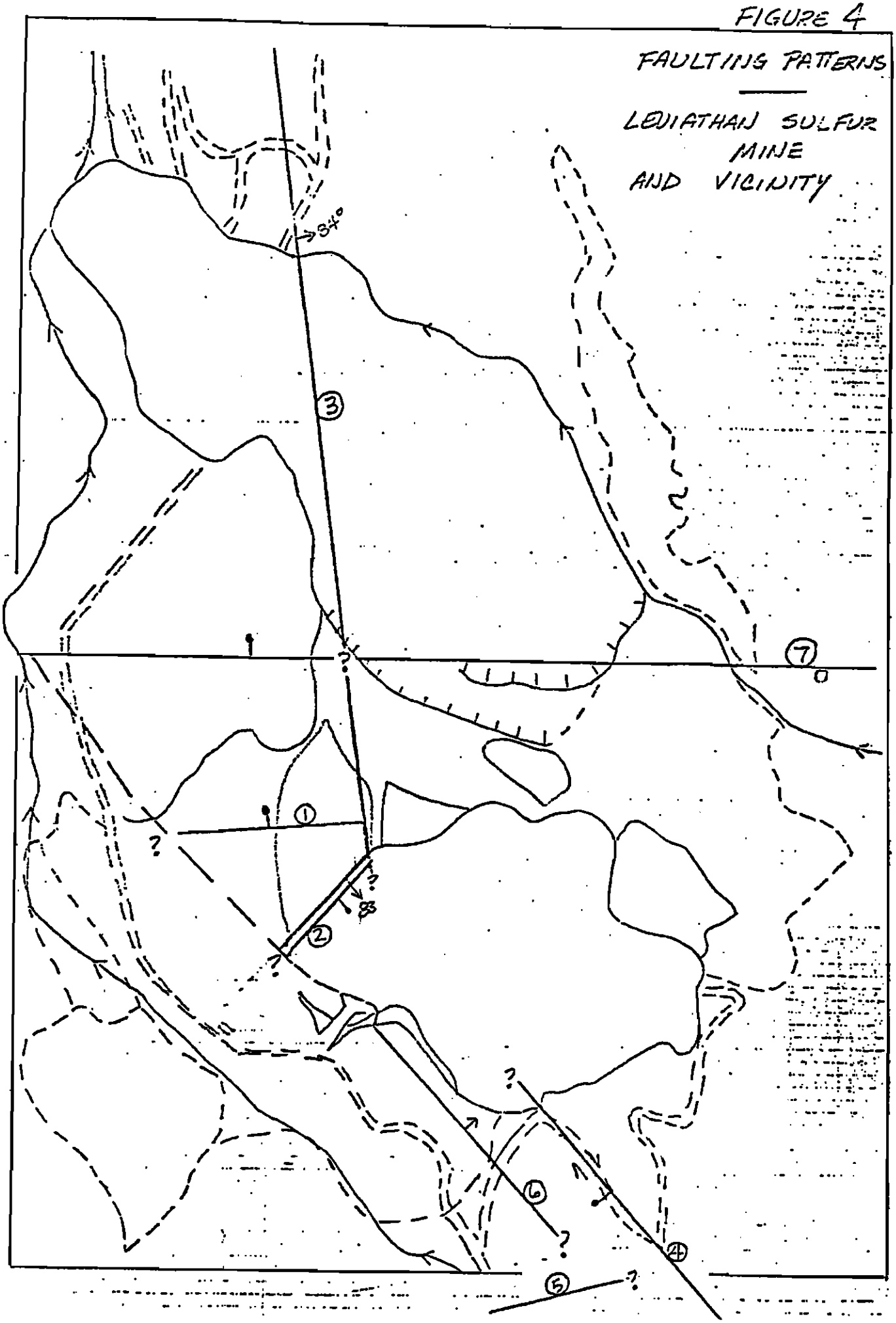
Joints and Fractures

Attitudes of joints and fractures vary widely within the study area. A common strike is 70°-80° east of north. This general strikes was noted on a small fracture on joints in silicified iron-stained breccia quartz latite prophyry, and biotite pyroxene hornblende andesite, and on bedding in unaltered and argillically altered sediments. The dips accompanying these strikes are dissimilar, ranging from shallow dips to the south to steep northerly dips.

FIGURE 4

FAULTING PATTERNS

LEVIATHAN SULFUR MINE AND VICINITY



V. Ground Water Hydrology

The area in and around the Leviathan Mine has a complex ground water system because of the discontinuities in the sedimentary rocks and the large percentage of rocks with only fracture permeability. In addition, faults enhance or impede ground water movement depending on absence or presence of clay or calcite along the fault surface(s).

The most important component of the ground water system in the area is probably the fractured volcanic and intrusive rocks which cover most of the study area. Unfortunately, the least is known about the "permeability" of these rocks. In-place fracture permeability tests are needed in these rock units. Each test only gives the fracture permeability in the immediate vicinity of the tested well; several tests need to be done in an area and the permeability values averaged to give some idea of the areal fracture permeability. Local water table conditions probably exist seasonally in the more permeable sedimentary units. In bedded sandstones or pebbly sandstones, ground water movement will be controlled by the attitude of bedding, the location of low permeability sediments, and the location of volcanic and intrusive igneous rocks. A seasonal "water table" may exist in the broken materials of the large pit landslides. Ground water was encountered during USGS drilling of the large landslide north of the pit.

Faults influence the movement of ground water through fractured rock and permeable sediments. Where the fault plane(s) are coated or cemented by calcite or clay gouge, little water movement can take place. The plane of Fault #2 (Figure 4) has been coated with calcite (see Chapter IV, Faulting). If no coating or sealing is present on the fault plane, it can conduct water just as a joint or fracture would. Permeability may be enhanced if rocks along the fault are shattered, creating more fracture permeability. Most faults in the study area are too poorly exposed to determine if such shattering has taken place.

The discharge from Tunnel 5 has been postulated to come wholly or in part from ground water. Movement of water from the sandstone northeast of the waste dump, except through joints, is unlikely because of the dip of bedding. For the same reason, movement of water

from the sandstone north of the pit also seems unlikely. Movement of water from fractured or jointed rock is possible but difficult to quantify. Percolation through the pit floor seems unlikely because of the clayey nature of the ponded sediments which cover the floor. Percolation through the more permeable sides of the pit, especially the flattened landslide slopes, seems possible. Percolation from Leviathan Creek along the dip of beds of the lower sedimentary sequence (now buried by fill) also is possible. Pygmy meter measurements by the USGS (accurate to ± 10%) indicate no loss of water along Leviathan Creek in this area.

Movement of the large composite landslide north of the pit is influenced by the amount of water in the sliding mass; water increases the weight of the mass and lubricates the slip surface(s). USGS drill holes 3A, 3B, and 3C all encountered ground water. With the exception of a perched table at a depth of 15 feet in 3B, ground water was encountered in materials beneath the fill at depths ranging from 35 to 106 feet. These water levels in sedimentary materials may represent a water table with an overall slope to the north. These data also suggest a lack of a continuous ground water surface within the fill materials.

No sursurface geologic or ground water elevation data are available for the central semi-stable part of the composite landslide. Local depressions in this area act as catchment basins for precipitation. The amount of movement of upslope ground water into this area is unknown.

No subsurface geologic or ground water elevation data are presently available for drilling done on the lower, very active landslide. Several ponds and numerous seeps and springs flow across the lower landslide (Plate 2). One possible source for this water is underflow from Aspen Creek. Pygmy meter measurements by the USGS (accurate to ± 10%) indicate no loss of water along Aspen Creek in this area. Ground water moving downslope from the upper slide area could contribute ground water to the lower landslide.

APPENDIX A

GEOLOGIC UNITS
LEVIATHAN SULPHUR MINE AND VICINITY

QUATERNARY UNITS

LANDSLIDES (Qls) and DEBRIS FLOW (Qdf)--

Landslides and debris flow in pit area are post-mining, on oversteepened slopes cut during the mining process. Landslides in pit appear stabilized; fresh ground cracks visible in slope above ore rock on northeast side of pit and in sandstone on west rim of pit. Debris flow in pit is active. Large landslides immediately north of pit in tailings and downslope are active. Both Qls and Qdf are composed of loose material and are probably permeable.

ALLUVIUM (Qal) and PONDED SEDIMENT (Qps)--

Alluvium composed of native material or reworked mine tailings. Ponded sediment has formed as a result of mining activities. Permeability may be high depending on sediment composition.

ARTIFICIAL FILL (Qaf)--

Generally composed of mine tailings but may include disturbed native materials in roadbeds. On wet day, several inches of standing water noted on Qaf near old Isabel Construction Company site; unit may not have high surface permeability.

TALUS (Qt) and TALUS RESULTING FROM MINING (Qtm)--

Naturally-occurring talus present on slopes outside the pit and artificial fill areas. Talus formed on oversteepened mined slopes mantles slopes within pit. Sand-sized talus on west side of pit may be highly permeable; appears to have high storage capacity.

TERTIARY UNITS

QUARTZ LATITE PORPHYRY (Tqlp)--

Well-indurated dark to white-grey weathering light blue-grey groundmass of very fine-grained plagioclase and quartz (70%) containing 2 to 5 millimeter plagioclase phenocrysts (20-25%) altering to clay ; euhedral biotite (5%) present along with prismatic hornblende phenocrysts with some slight flow alignment (1%); mafics altering. Tqlp may intrude Tlpa, but within study area, Tqlp is always in contact with Tsib/Tsb and never seen in contact with Tlpa, so exact relationship unknown. Unit well-jointed; may have some fracture permeability.

SILICIFIED BRECCIA (Tsb) and SILICIFIED IRON-STAINED BRECCIA (Tsib)--

Tsb is grey to white on fresh and weathered surfaces with streaky blue relict breccia texture; jasperoid appearance; locally contains kaolinite bodies; generally lacks sulfur and sulfide mineralization. Tsib is dark rust brown on weathered surfaces, red to blue-black on fresh surfaces; often jasperoid apperance; is more resistant rock, forming cornices; pervasively fractured. Free sulphur and abundant sulfides present in Tsib which is dark blue on fresh surfaces (within pit); locally contains blue-green copper mineral (chrysocolla); appearance varies--some examples:

Tsib on north side of pit: silicified iron-stained breccia and argillically altered silicified breccia (lahar?); argillically altered rock weathers peach. Both rock types show breccia texture, local flow banding on some light-colored sialic clasts. Breccia clasts average 1 to 20 cm, are subangular to rounded; matrix and clasts are of different compositions; clasts appear to be volcanic, range from andesite with relict texture to jasperoid; can be mineralized with sulfur, some sulfides (10-15%) (pyrite, marcasite, arsenopyrite) present, particularly in dark colored clasts.

Tsib west of Leviathan Creek: iron-stained, silicified breccia-type relict texture, clasts weather yellow-white, as compared to matrix, which weathers dark red; clasts angular to subrounded, 3 to 15 cm in size, relict andesitic texture in some clasts. May contain minor arsenopyrite. Also, some non iron-stained, more argillically altered breccia in same location. Calcite deposits present where water moves through fractures. No sulfur.

Age of Tsb/Tsib uncertain; Tsb in contact with altered Tlpa, Tsib or Tsb surrounds Tqlp whenever Tqlp present in study area. Units highly fractured but without persistant joint orientation. Most float rounded. No primary permeability but may have fracture permeability. Relict textures suggest unit origionally lahar, conglomerate, or sedimentary breccia, silicified and locally mineralized.

LEVIATHAN PEAK ANDESITE (Tlpa, Tlpaa)--

Porphyritic hornblende andesite with well-indurated red and light grey weathering red and grey glassy groundmass (40-50%) containing fine-grained and porphyritic plagioclase (45-50%), porphyritic hornblende (5-7%) and possible biotite (1%) phenocrysts. Seen only as angular float in study area; may have some fracture permeability. Locally argillically altered with relict hornblende phenocrysts, copper sulfide stains (bormite?) where in contact with Tsb (noted as Tlpaa on geologic map).

BIOTITE PYROXENE HORNBLENDE ANDESITE (Ta)--

Well-indurated red-brown weathering black glassy groundmass (60-65%) containing 20-30% flow-aligned tabular 1 to 3mm plagioclase phenocrysts with some iron-staining, twinning, and zoning, and hornblende (5-8%), pyroxene (5%), and biotite (1%) phenocrysts; groundmass shows some alteration to clay and may contain minor very fine grained dark grey opaque minerals; plagioclase locally altering to clay with extensive calcite replacement; pyroxenes replaced by chlorite. In some areas, calcite crystals present as vug linings with quartz crystals inside vugs. Locally copper sulfate stained (light blue-green). Locally flow banded. Slightly propylitized. Unit only seen in contact with sediments and, locally, underlying Trb. Locally jointed and/or fractured; may have fracture permeability.

UPPER SEDIMENTARY SEQUENCE (Trs)--

Interbedded fine- to coarse grained sandstones, pebbly sandstones, breccias, and lahars. Unit includes leached and bleached sandstone and kaolinite beds visible in pit. Also includes sandstones and breccias permeated with sulfur that comprise principal ore body.

Sandstone (Trss)--

Best exposed on west rim of pit: very fine to fine-grained poorly indurated lithic wacke, matrix poorly to moderately sorted, subangular, propylitically altered to green minerals; pebble conglomerates and granule beds with finer particles, contains 2 m by 7 m sized lenses of fine sandstone; fractures iron-stained with calcite rinds on pebbles, especially near fault. Sandstone at northwest edge of pit even less indurated; many fault scarps and incipient arcuate fractures present which have created or could create catchment basins for precipitation. Poor induration of this unit is a main contributor to landsliding in the pit area as most slides seem to originate in this unit or its altered equivalents. Unit unconformably overlies Trb and Trba on west side of pit with basal scour channel. Basal conglomerate consists of basalt (Trb) chunks (60%, angular to subangular) in iron-cemented matrix of fine to medium sand- sized rock fragments (40%). Possible primary permeability.

Lahar (Trsl)--

Angular to subrounded 5 to 25 cm clasts in tan ashy matrix. Matrix comprises 85-90% of rock (matrix supported). Clasts include Tra. In area east of pit, clasts average 2-15 cm with most 2-3 cm, angular to subangular. Locally slightly silicified, locally graded bedding, locally conglomeratic with more sandy matrix. Laterally discontinuous; only seen nonconformably overlying Tra. Possible matrix permeability.

Argillically Altered Sandstone (Trsa, Trsab)--
White to peach (iron-stained) argillically altered sandstone and breccia; locally shows conchoidal fracture, locally appears porous and may be permeable. Relict siltstone texture and possible fining-upward sequence immediately west of pit. Above is rock (clast?) with fluidal outline, relict andesitic texture (relict plagioclase phenocrysts) in punky white matrix. Permeability questionable because of high clay content. May have breccia texture (Trsab).

Chloritized Breccia (Trsb)--
Only found underlying Tsib. Matrix brown to green, waxy to greasy luster, soft, some slickensides, massive with no discernable grains. Some black, round, very fine grained opaque minerals. Representative clast altered to chlorite, clays, talc?; some minerals with fresher cores; only visible relict textures are volcanic with relict phenocrysts 1/2 to 2mm long and tabular to prismatic habit. Some minerals altered entirely to epidote with indistinct outlines. Minor iron staining along outside of clasts; clasts up to size in Tsib (1 to 20 cm); may be correlative to Tsib, differing in alteration and lacking flow banding. Permeability probably low because of high clay content.

Ore Rock (Tso)--
Consists of mineralized breccia (Tsob) and sandstone; may include mineralized tuff. Breccia is at least 20-30% sulfur (pervasive replacement); most clasts less than or equal to 6cm; unit contains very fine to fine-grained grey, brassy, and silver sulfides (up to 30%) (oxidized and unoxidized pyrite, disseminated and in very fine grained irregular masses, and arsenopyrite (?) in aggregates). Sandstone contains a maximum of 20% disseminated sulfur; sulfur also as fracture coatings. Sandstone generally contains fewer sulfides than breccia. Possible fracture permeability in both sandstone and breccia. Largest concentrations of sulfides in Tso are east of pit entrance in dark blue brecciated ore rock and west and opposite of pit entrance (fine grained, locally oxidized pyrite in patchesand seams).

HORNBLENDE PYROXENE ANDESITE (Tra)--

Strong flow banding, flow alignment of plagioclase and hornblende phenocrysts. Red to tan weathering, purplish-grey groundmass (60-70%) containing: 1-2 mm plagioclase phenocrysts (andesine) with weathering rinds and some albite twinning and zoning (25- 35%), orthopyroxene (10%), and minor hornblende (1-3%), and very minor, slightly altered biotite (1%). Most mafics have altered cores. Only scattered outcrops; usually present as angular float. May have fracture permeability. Locally altered to punky buff-colored rock with dark opalescent copper sulfide staining (no native sulfur) east of pit near silicified iron-stained breccia.

BASALT (Trb)--

Fine grained igneous rock, olive green to black on weathered surface, grey black on fresh surface; fine-grained plagioclase (labradorite) (45-50%) and clinopyroxene (5-7%) phenocrysts in glassy groundmass (40-50%). Pyroxenes replaced by chlorite, rimmed by magnetite. Calcite filling fractures; no sulfur mineralization; manganese oxide (dendritic) staining; locally autobrecciated with calcite cement on or in breccia fractures. Contact between autobreccia and basalt appears sheared with foliation subparallel to joints in basalt. Locally minor light turquoise-colored powdery copper minerals (chrysocolla ?), some hornblende altering to blue green mineral. Some pyroxene phenocrysts from 1-7mm long dispersed in rock. Forms cliffs and hills; locally is massive flow with wavy, blocky fracture and pervasive jointing; salt stains on joints indicate water flow through fractures. On west end of pit, unit is poorly indurated and grey-colored with 0.5-1 mm long altered plagioclase phenocrysts.

AUTOBRECCIATED BASALT (Trba)--

As above with autobreccia texture, spheroidal weathering.

LOWER SEDIMENTARY SEQUENCE (Trc)--

Interbedded very fine- to coarse-grained sandstone with pebbly sandstone and laminar siltstone interbeds, and lahars. Propylitically altered.

Sandstone Sequence (Trcs)--

Ridge west-southwest of pit entrance: poorly-sorted sequence of fine to very fine grained-sandstone with pebbly sandstone interbeds and laminar siltstone interbeds. Rock is moderately- to well-indurated, subangular to subrounded, green brown on fresh and weathered surfaces, with calcite underlying siltstone.

crystal lithic sandstone: medium to coarse grained volcanic lithic fragments with some quartz, plagioclase, hornblende, and pyroxene crystals; silica cemented; contains other fine to very fine grained beds, medium scale low angle crossbeds in sets up to 8 cm, outcrop principally laminar sandstone. Also laminar bedded red-brown to yellow-tan fine to very fine-grained sandstone in 2-5 cm thick beds with good parting, highly fractured.

pebble interbeds: comprise 10 to 20% of rock; interbeds up to 6 cm thick with subangular to subrounded pebbles up to 3 cm (isolated pebbles up to 8 cm), pebble lines and lenses laterally discontinuous.

shale interbeds: purple fresh and weathered surfaces with some iron stains, ripple marks, recumbant folds (soft sediment deformation) up to 7 cm thick.

hydrology: little primary permeability present in rock itself, but water movement possible along fractures and bedding planes. Rock appear similar to sandstone in pit except more indurated; variation could be result of propylitic alteration of stratigraphically different but lithologically similar sandstone.

Waterfall near waste dump: shale, weathering hard and blocky; sandstone, especiallypebblysandstone, weathering spheroidally, friable with hand.

pebbly sandstone: large, sub-rounded (60 cm by 30 cm) volcanic clast. In clast, all mafics altered to light green clay, contains fresh plagioclase phenocrysts (1 to 2 mm), with only minor saussuritization of plagioclase. Near top of the unit, sandstone and pebble conglomerate well indurated, indicating "baked" zone near contact with basalt, matrix green. May be equivalent of Trl. Overall induration of this unit much less than igneous units; tends to form topographic lows, appears to underlie large landslides north of pit. May have some primary permeability.

Lahar (Trcl)--

Near crusher building: Unsilicified breccia, 40% clasts, 60% matrix; clasts 3 to 25 cm; approximatly 95% volcanic; types noted: medium to light grey porphyritic hornblende andesite with phenocrysts up to 2 mm, averaging 1 1/2 to 2 mm; red silicified rock, angular to subrounded; andesite basalt clast, 6 cm, subrounded; two poorly indurated light grey very fine to fine grained sandstone clasts, 10 cm, angular to subangular, and 25 to 30 cm, angular to sub angular; some weathered rinds present on clasts; matrix fine grained light grey to white, may be amorphous and green, with

hornblende/pyroxene and biotite crystals. Matrix may be reddish on fresh surface, weathers spheroidally. Euhedral biotite alters to brown or brown green (chloritized). Also quartz, sericite, muscovite, with ashey matrix that alter to clay or zeolite. No fresh plagioclase. Rock is matrix supported with matrix and clasts of similar hardness but matrix is more fractured. May have some low matrix permeability.

Basal mudflow unit along waterfall near waste dump: 90% green ashy matrix composed of 60-65% glass with phenocrysts of plagioclase (30%), quartz (3-5%), biotite (1%), green amphibole (1%), and pyroxene (1%). Rock contains 10% volcanic clasts. Alteration includes rhodochrosite? (salmon veinlets), alteration of mafics (hornblende and pyroxene most altered), some alteration of plagioclase to clay, calcite replacement.

Induration of the above units can vary throughout the study area. Lower sedimentary sequence poorly exposed in vicinity of landslide north of pit. Where visible, is friable wacke with few pebble and gravel interbeds.

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State of California

Memorandum

To : Gerard Thibeault
Lahontan RWQCB (6)
Victorville

Date : JAN 25 1983

Subject : 1:100-SCALE GEOLOGIC MAPS OF LEVIATHAN SULFUR MINE, ALPINE COUNTY

From : STATE WATER RESOURCES CONTROL BOARD
Division of Technical Services

The 1:100-scale geologic maps have been completed. The base used was topography-only, and was completed in December. The State Board paid printing costs for the base; Brown & Caldwell personnel prepared the base for printing.

The geologic map is essentially the same as the 1:200-scale map which accompanied the October 1982 report. One significant change is the size of the landslide in artificial fill located at the north end of the delta area (see sheets 5 and 7). After inspection, the landslide was extended downslope; it now is mapped to within 100 feet of Leviathan Creek.

The landslide has the potential to dam Leviathan Creek, should the slide be de-stablized. Currently, the main road around the west side of the mine crosses the center of the slide; this probably contributes to the slide's instability.

Care should be taken when designing any embankments in this area, as for the previously proposed evaporation ponds. The landslide is not a suitable abutment. Saturation of the toe of the slide by impounded water could lead to failure of the landslide.

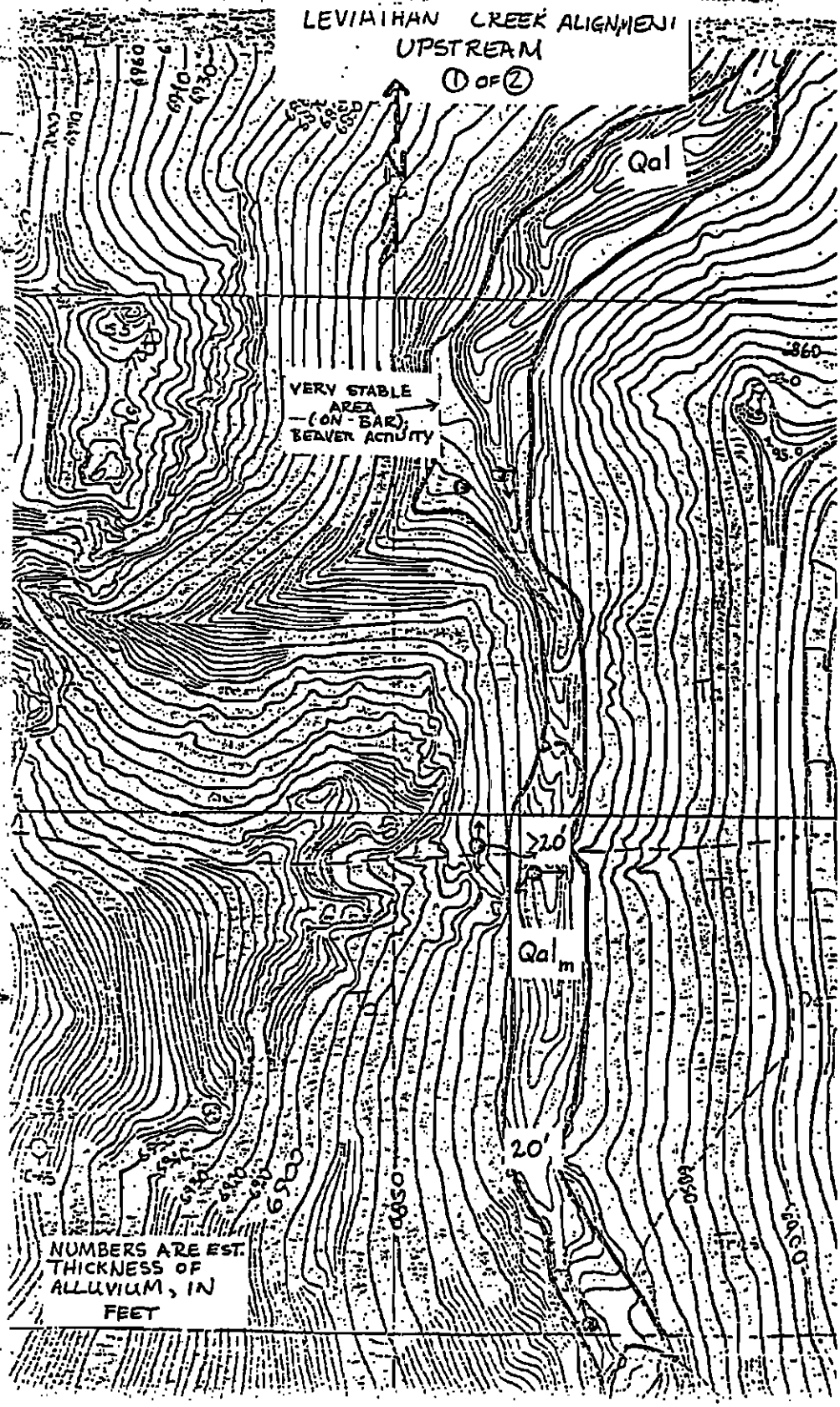
Charlene Herbst

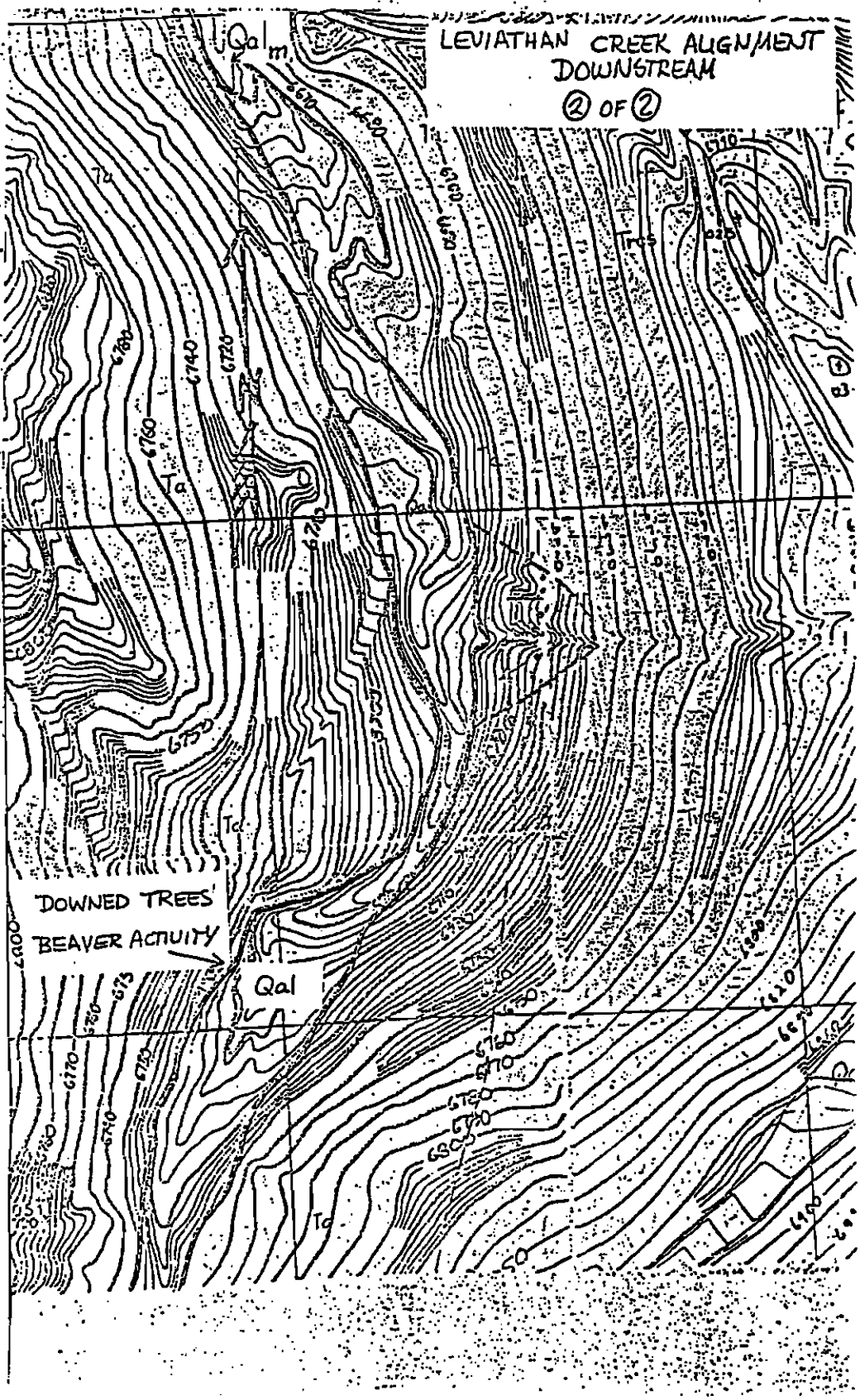
Charlene Herbst
Assistant Engineering Geologist
Hydrogeology Section

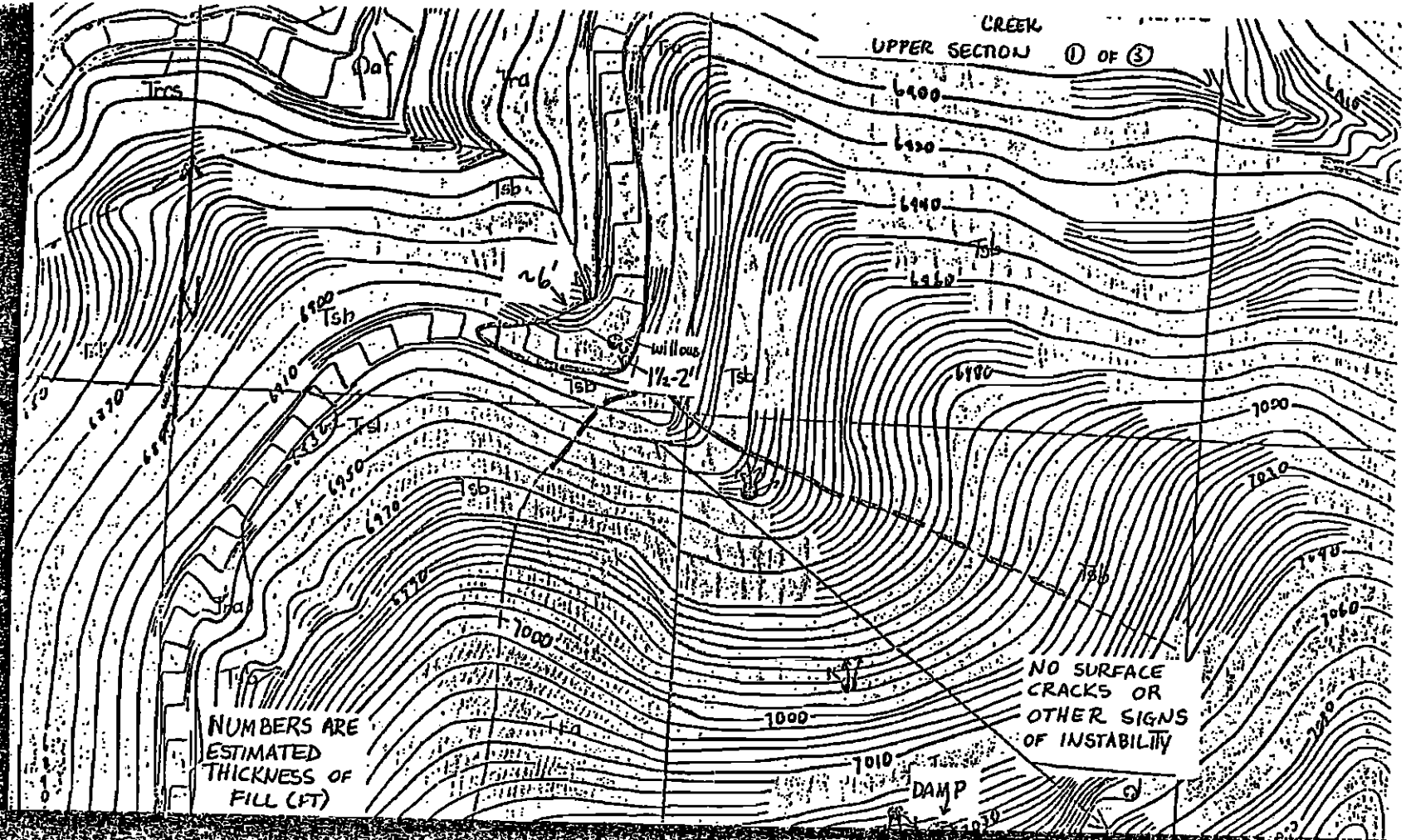
Enclosures

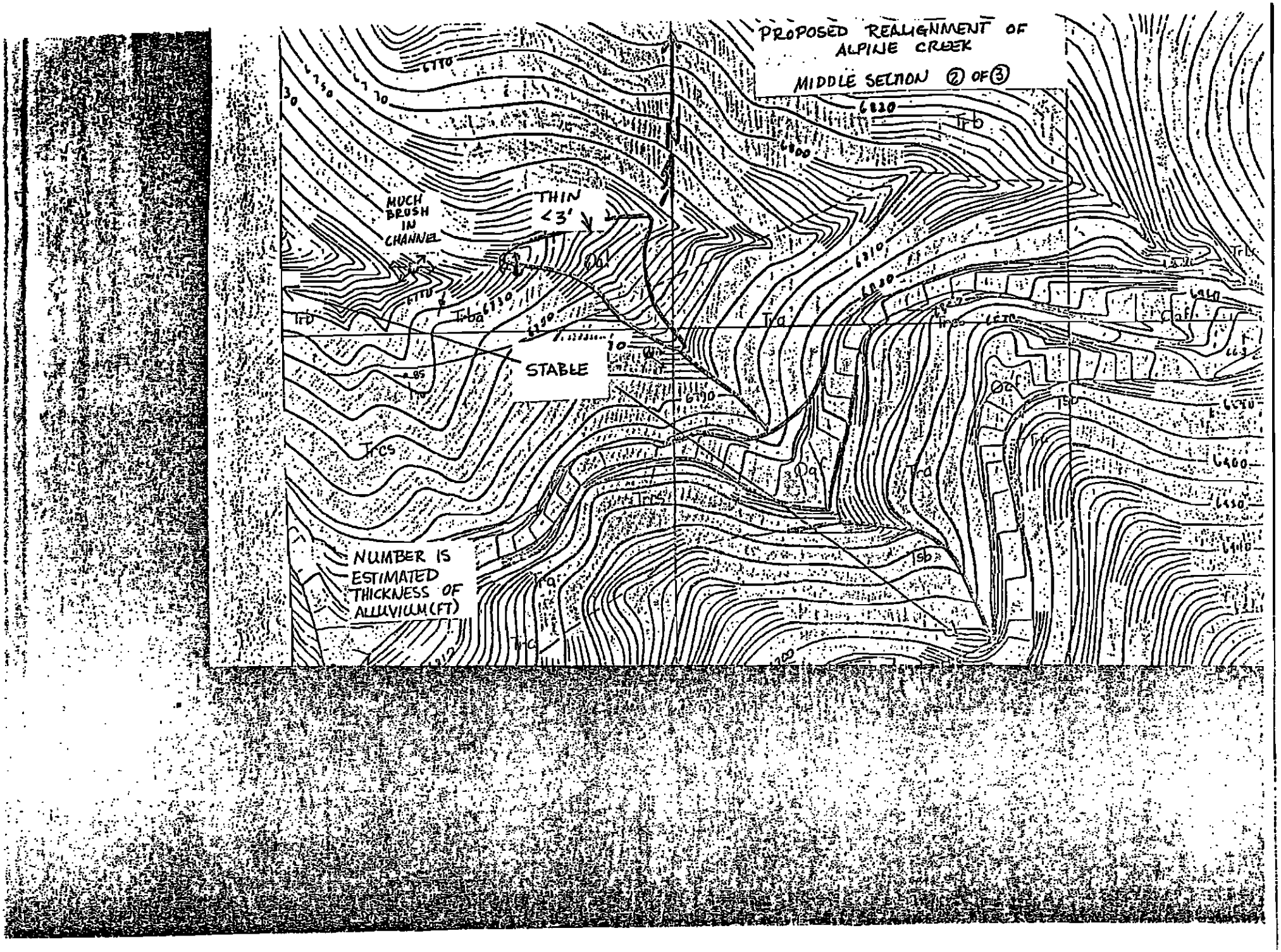
cc: Al Doyle
Brown & Caldwell
723 "S" Street
Sacramento, CA 95814

Richard Slade
Geotechnical Consultants
239 West Olive Avenue
Burbank, CA 91502


LEVIATHAN CREEK ALIGNMENT
UPSTREAM
① OF ②
Qal
VERY STABLE AREA (ON BAR), BEAVER ACTIVITY
≥20'
Qal m
20'
NUMBERS ARE EST. THICKNESS OF ALLUVIUM, IN FEET


LEVIATHAN CREEK ALIGNMENT
DOWNSTREAM
② OF ②
Qal
Ta
Td
DOWNED TREES
BEAVER ACTIVITY
Qal


CREEK
UPPER SECTION ① OF ③
Qaf
Trcs
Tra
Tsb
Tsl
~6'
willows
1½-2'
6400
6420
6440
6460
6480
6900
6910
6930
6950
6970
7000
7010
7020
7040
7060
NO SURFACE CRACKS OR OTHER SIGNS OF INSTABILITY
DAMP
NUMBERS ARE ESTIMATED THICKNESS OF FILL (FT)


PROPOSED REALIGNMENT OF ALPINE CREEK
MIDDLE SECTION ② OF ③
MUCH BRUSH IN CHANNEL
THIN <3'
STABLE
NUMBER IS ESTIMATED THICKNESS OF ALLUVIUM (FT)
6820
6800
6790
6780
6770
6760
6750
6740
6730
6720
6710
6700
6690
6680
6670
6660
6650
6640
6630
6620
6610
6600
Trb
Trd
Trc
Trcs
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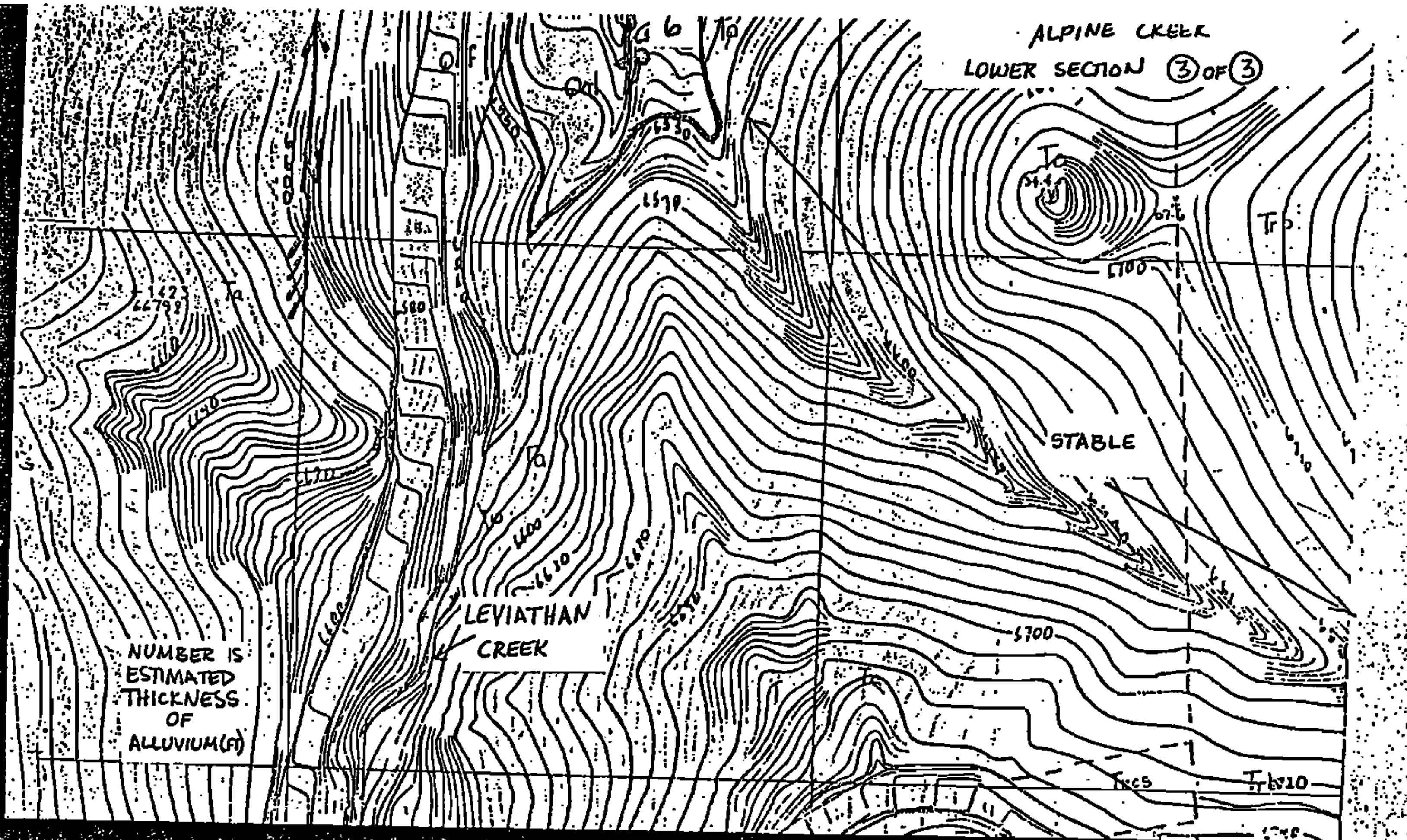
Trg
Qal
Qa
Qc
Isb


ALPINE CREEK
LOWER SECTION 3 OF 3
STABLE
LEVIATHAN
CREEK
NUMBER IS
ESTIMATED
THICKNESS
OF
ALLUVIUM(FT)
6700
6700

State of California

Memorandum

1. Al Doyle
2. Yount.

To : Gerard Thibeault
Lahontan RWQCB (6)
Victorville

Date : FEB 3 - 1983

Subject: SURVEY OF LEVIATHAN CREE AND PROPOSED ASPEN CREEI REALIGNMENT, LEVIATHAN SULFUR MINE

From : STATE WATER RESOURCES CONTROL BOARD
Division of Technical Services

This memo and attachments summarizes the conditions observed during our November 1982 survey of Leviathan Creek and the proposed Alpine Creek realignment. The geology shown on the attachments is the same as that on the 1:100 geologic map. The dark circles with arrows indicate the orientation of photo transparencies taken during the survey. These slides, and other slides taken during the summer 1982 field work, along with a location map, can be borrowed from this office.

Leviathan Creek (to Landslide)

Leviathan Creek from the Monitor Pass gate through the delta was not surveyed in December. Previous traverses have indicated that bedrock is exposed in the steep-sided creekbed near the gate. Thin alluvial deposits (not mapped as *Qal*) extend from the bedrock area to the point where the creek enters the artificial fill area. From this point to the delta area, the creek is eroding through fill. Alluvium composed of reworked fill is present in the delta area; the thickness is uncertain because of the number of events which took place in this area, including dumping of mine debris and construction of settlement basins. The alluvium is only distinguishable from the fill by its sedimentary structures, so the distinction is relatively unimportant.

The upper portion of the waterfall north of the delta is formed by a bedrock outcrop. The lower steep channel of the waterfall area resulted from downcutting of the creek through artificial fill.

Downstream from the waterfall, the alluvium filling the channel appears to be approximately 20 feet thick. It consists of reworked mine debris overlying natural alluvium in those areas marked Qal_m. Further downstream, the amount of mining debris decreases, and the creek appears to be in a natural state, except for the quality of the creek water. The amount of mining debris in the alluvium increases again as the toe of the landslide is approached. This accumulation of mining debris is probably related to episodic damming of the creek by the landslide.

A "semi-natural" creek channel has formed around the waste dump south of the delta. The southeast and southwest sides of the dump are banded by thin alluvial deposits. West of the dump, south-dipping cemented sandstones and pebble conglomerates are exposed in the channel.

If water is re-routed around the waste dump in an unlined channel, some erosion and undercutting of the waste dump with subsequent landslides should be expected. Little erosion should take place in bedrock channels, or on the creek banks composed of cemented sandstone, andesite, or other "hard" rocks. If the volume of water passing through the delta area and downstream does not change, the creek should change little if at all in these areas. Increased flow downstream from the delta would cause downcutting of the channel through the easily-eroded alluvium.

Proposed Aspen Creek Realignment

In general, the proposed realignment appears stable; there are no ground cracks or recent landslides. The area indicated by Richard Slade as a possible ancient landslide was examined; no signs of recent instability were visible, although a seep was noted in the area. Because of the rock type in the area (an andesite), a landslide seems unlikely. Frequently, however, ancient landslides have few if any surface indications, and their existence is confirmed only after failure.

The southernmost end of the Isabelle Construction Company site is on fill composed of mine debris; the fill thickens toward Alpine Creek. The fill is thin (less than one foot) at the northern end of the Isabelle site. Fill thicknesses on the upper leg of the switchback are noted on the attachment. Fill thicknesses on the lower leg are difficult to determine because of topography.

Some erosion would be expected if Aspen Creek were re-routed down this drainage. Because "hard" rocks are present in the proposed channel and the erodable sandstone (*Trcs*) is not, erosion should not be a serious problem.

Confluence of Leviathan and Proposed Realignment of Aspen Creek

The confluence area is underlain by alluvium locally at least six feet thick. The "new" Aspen Creek channel had a flow estimated at 25 gpm on November 4, 1982. The steep banks indicate erosion is taking place, at least seasonally. Some additional erosion in the "new" Aspen Creek Channel is probable when flows are increased and are year-round.

Charlene Herbst

Charlene Herbst
Assistant Engineering Geologist
Hydrogeology Sectin

Attachments

SECTION B3

RESULTS OF SOILS TESTING

Limited testing of soil samples obtained by the U.S. Geological Survey in the exploration program was conducted in the Geotechnical Consultants, Inc., soils laboratory.

GENERAL NOTES ON LABORATORY TESTING

"Undisturbed" samples received by the Geotechnical Consultants, Inc., laboratory were obtained by brass sampling liners in the following sizes:

1. 8-inch long by 2-3/4-inch outside diameter
2. 8-inch long by 2-1/2-inch outside diameter
3. 6-inch long by 2-inch outside diameter

The majority of these samples were of sizes with 2-1/2-inch and 2-inch outside diameters.

Visual examination of the samples showed that the liners, for the most part, were partially filled or in a loose state indicating disturbance. In most samples, it was difficult to differentiate the natural from the cave-in material. This condition was noted in an attachment to field logs dated August 22, 1982, in which it is stated that the brass liners were placed in the upper part of the sample barrel which led to partial samples. It was further noted that waste from one sampler shoe generally appeared to be more compact than the liner samples, possibly misleading the visual examination in the field by the logging personnel.

The quality of the soil samples, coupled with the overall complexity of the mine site, precluded accurate determination of engineering properties of the samples in the undisturbed state. Laboratory testing of samples was, therefore, limited to visual classification and moisture/density determinations, grain size distribution, compaction, and remolded direct shear and permeability tests.

TESTING

Moisture and Density Tests

The wet density of relatively intact samples was determined by weight/volume relationships. Moisture contents were then determined in accordance with ASTM D2216-80 on a representative portion of the sample and was considered the moisture content of the whole sample in order to determine the entire sample's dry density. The test results, together with visual classifications, are presented in Table B3-1.

Grain Size Distribution

Grain size distributions of samples representing certain mine elements were determined in accordance with ASTM D-422-66. Five of these included the use of an ASTM hydrometer to obtain the distribution of particle sizes smaller than 75 microns. The test results were utilized to verify soil classification and as an index to the material's other engineering properties. The results are presented on Figures B3-1 through B3-5, Grain Size Distribution Data. Figure B3-6 is a legend for test data figures.

Compaction Tests

Compaction tests were performed on two composite samples representing the spoil tailings area and the waste dump in order to evaluate their properties as engineered fills. Lack of bulk samples made it necessary to make up samples from the two areas representing different elevations. The tests were performed in accordance with ASTM D-1557, and the results are presented on Figures B3-7 and B3-8, Compaction Test Data.

Direct Shear Tests

Two sets of direct shear tests were performed on remolded specimens from the same composite samples as used in the compaction tests. These specimens were remolded to 90 percent of their relative compactions by rodding the soil in a one-inch ring. The desired normal load was then applied until the specimens came to equilibrium after which shear force was applied through a gear system at a constant rate of strain. Shear force, volume change, and deflection were monitored during the test.

The shear test results are presented on Figures B3-9 and B3-10, Shear Test Data.

Permeability Tests

Two constant-head permeability tests were performed on the two composite samples mentioned above on specimens remolded to 90 percent of their relative compaction in the same manner as in the direct shear tests. The specimens were jacketed in rubber membranes held on by "O" rings with top and bottom porous stones. They were then placed in cells and connected to top and bottom drainage lines. The cells were flooded and pressurized to form firm contact between membrane and ring as well as the top and bottom porous stones. Back pressures of low hydraulic gradient were then applied in steps to fully saturate the specimens. After approximately 100 percent saturation was obtained, a 2-pound-per-square-inch head was applied at the top of the specimens. Flow was then measured against time to obtain permeability.

The permeability test results thus computed gave the following values:

Waste dump	$K = 1.4 \times 10^{-5}$ cm/sec
Spoil tailings area	$K = 2.3 \times 10^{-5}$ cm/sec

The permeant used in the above tests was fresh water.

Because it is apparent from the permeability test results that the on-site materials do not meet requirements as an effective sealant, the following tests were performed to see if the addition of bentonite would effectively reduce permeability. The bentonite used is the Volclay Tablet type reduced to 50 mesh.

Atterburg Limits (ASTM D-423)

Liquid and plastic limit tests utilizing fresh water were performed on the waste dump material passing the No. 40 U.S. standard sieve by adding 5 and 10 percent by dry weight of pulverized bentonite. The results showed that the liquid limits had increased from "None Plastic" to 60 and 72, respectively. A leachate sample obtained from Adit No. 5 at Leviathan Mine was introduced to the 10 percent mix. This reduced the liquid limit from 72 to 62 showing an apparent deleterious effect on the mix. However, the relatively short duration of the test with the leachate does not satisfactorily show the effect of aging.

Further, the effect of the leachate on the pure bentonite tablets was compared with that of fresh water. Within a relatively short period, the tablets reacted with the leachate by breaking down into sand-size particles while, with fresh water, the tablets expanded into a gel form.

Further literature research showed that soil/bentonite leached with contaminated liquid would result in a loss of solids and an increase in consequent pore volume and soil permeability. Pore fluid substitution by a contaminated leachate leads to a smaller, double layer of partially bound water surrounding the hydrated clay platelets, reducing the effective size of the clay particles that clog the pore space between soil grains and thereby increasing the size of the effective flow channels in the soil skeleton and the permeability (Cherry, 1979).

However, conversation with a bentonite manufacturer suggests that with certain additives, the bentonite may be made resistant to the leachate. We have supplied the manufacturer with samples from the waste dump and spoil tailings area together with the leachate sample from Adit No. 5 for further study. The results will be reported as they become available as a supplement to this report.

REFERENCES

D'Appolonia, D. Slurry Trench Cut-off Walls for Hazardous Waste Isolation. In-house report by Engineered Construction International, Inc., Pittsburgh, Pennsylvania, 1980.

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U. S. Environmental Protection Agency. "Lining of Waste Impoundment and Disposal Facilities," SW-870. U.S. Environmental Protection Agency, Washington, D.C. 385 p. 1980.

GEOTECHNICAL CONSULTANTS, INC.

TABLE B3-1

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

JOB NO. B820 48 f
TESTED BY: JP/MA/
CHECKED BY: MA
DATE: 2-9-83

WASTE DUMP

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	Unified Soil Classification	MOISTURE CONT. %	DRY DENSITY (PCF)	REMARKS
1CP	80		(ML)	31	86	
1CN	50		siltstone	34	80	
1CP	120		"	37	84	
1AN	15		(ML)	39	69	
1AN	100		siltstone	32	79	
1BP	5		(ML)	47	87	
"	18		(ML)	39	74	
"	30		(ML)	39	87	
"	40		(ML)	34	83	
"	80		(ML)	27	101	
"	110		(SC)	35	80	

Sheet 1/9

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

TESTED BY: JL/MJ
CHECKED BY: J.S.
DATE: 2-9-83

WASTE DUMP

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	United Soil Classification	MOISTURE CONT. %	DRY DENSITY (PCF)	REMARKS
1BN	40		(ML)	33	83	
"	50		(ML)	34	79	
"	60		(ML)	30	88	
16	20		(GM)	39	80	
"	40		(ML)	25	82	
"	60		RC	22	98	
1 AP	25		(CL)	33	88	
"	38		(GC)	23	85	
"	70		(CL)	27	93	
"	90		(CL-SM)	22	87	
"	100		(CL)	30	87	
"	140		(CL-ML)	43	82	

Sheet 2/9

GEOTECHNICAL CONSULTANTS, INC.

TABLE B3-1, Contd.

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

JOB NO. B820d8A
TESTED BY: ma/JRH
CHECKED BY: ma
DATE: 2-9-83

SPOIL TAILINGS AREA (cont'd)

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	Unified Soil Class.	MOISTURE CONT. %	DRY DENSITY	REMARKS
23	10		(SM)	33	86	
	30		(CL-ML)	28	66	
	40		(GM)	41	93	
	50		(SM)	32	81	
	60		(Tuff?)	10	–	
	70		(SC)	16	106	
	80		(SC)	17	101	
	100		(GC)	22	93	
	120		(SC)	31	81	
23 A	20		(CL)	36	77	

TABLE B3-1, Contd.

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

JOB NO. 00040
TESTED BY: MA/JL
CHECKED BY: MA
DATE: 2-9-87

SPOIL TAILINGS AREA (CONT'd)

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	Unified Soil Class.	MOISTURE CONT. %	DRY DENSITY	REMARKS
22	20		(ML)	30	81	
	80		(SC)	22	98	

Sheet 4/9

GEOTECHNICAL CONSULTANTS, INC.

TABLE B3-1, Contd.

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

JOB NO. B82048
TESTED BY: MA/JF
CHECKED BY: MA
DATE: 2-9-83

SPOIL TAILINGS AREA

DH NO.	DEPTH (FT.)	DESCRIPTION / CLASSIFICATION	Unified Soil Classification	MOISTURE CONT. %	DRY DENSITY (PCF)	REMARKS
14	5		(GM)	39	74	
	10		(ML)	40	80	
	15		(ML)	30	78	
	20		(ML)	30	90	
	25		(ML)	30	88	
	30		(ML?)	34	89	
	40		(ML)	37	85	
15	15		(SM-SC)	24	100	
	25		(CL)	22	106	
16	20		(GM)	39	80	
	40		(ML)	25	82	
			PC	22	98	

Sheet 5/6

GEOTECHNICAL CONSULTANTS, INC.

TABLE B3-1, Contd.

JOB NO. 882048 A
TESTED BY: JR/RG/VL
CHECKED BY: MA
DATE: 2-9-83

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

MAIN LANDSLIDE (Includes spoil tailings overlying main landslide)

DH NO.	DEPTH	DESCRIPTION / CLASSIFICATION	Unified Soil Class.	MOISTURE CONT. %	DRY DENSITY (PCF)	REMARKS
3B	5		(GM)	36.7	—	
"	10		(GM)	21	84	
"	30		(ML)	30	74	
"	50		(GM)	53	—	
3C	5		(GM)	29	72	
"	15		(ML/GM)	45	—	
"	30		(ML)	30	—	
"	40		(ML)	42	72	
19	10		(ML)	56	—	
"	20		ML (~~CL~~)	38	76	
	30		(ML)	46	—	
	40		(ML)	48	—	

Sheet 6/9

GEOTECHNICAL CONSULTANTS, INC.

Table B3-1, Contd.

JOB NO. B82048-A
TESTED BY: ma/JL/
CHECKED BY: ma
DATE: 2-9-83

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

MAIN LAND SLIDE (cont'd)

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	Unified Soil Class.	MOISTURE CONT. %	DRY DENSITY	REMARKS
5A	25		(SM)/(GC)	27	92	
"	30		SM	9	—	
6	10		(GP)	55	—	
"	15		(ML)	54	68	
"	25		(ML)	71	—	
20	10		(ML) (OL)	48	70	
"	15		(ML)	40	84	
"	20		(ML)	40	75	
"	25	Greasy-like wood fragments.		—	—	
20A	30		(CL)	32	87	
	40		(SC)	31	88	
	[illegible]		(ML-SM)	31	89	

Sheet 7/9

TABLE B5-1, Cont'd.

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

TESTED BY: JL/MA/
CHECKED BY: MA
DATE: 2-9-83

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	United Soil Class.	MOISTURE CONT. %	DRY DENSITY	REMARKS
7	10		Slough	17	–	
8	5		(ML)	20	–	
"	10		(ML)	26	91	
"	15		(ML)	22	97	
"	20		(ML)	26	–	
						Sheet 8/9

GEOTECHNICAL CONSULTANTS, INC.

TABLE B3-1, Contd.

SUMMARY OF MOISTURE CONTENT & DRY DENSITY

JOB NO. B82048 A
TESTED BY: Ma/JR/
CHECKED BY: Ma
DATE: 2-9-83

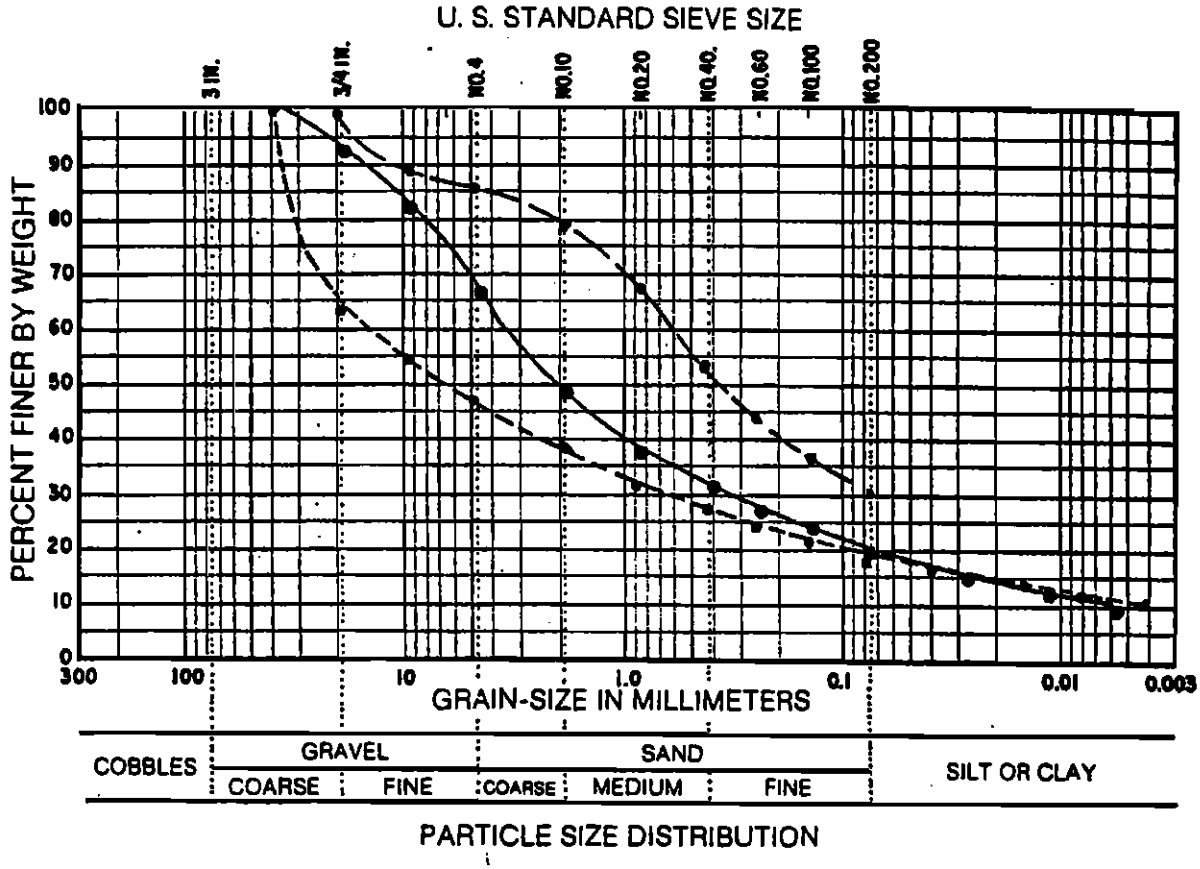
MAIN LAND SLIDE (cont'd)

DH NO.	DEPTH (FT)	DESCRIPTION / CLASSIFICATION	MOISTURE CONT. %	DRY DENSITY (PCF)	REMARKS
21	21-22	(ML)	24	89	
"	22-23	(SM)	19	100	
"	23-24	(SM?)	42	—	
"	24-25	CL/SM	28	92	
"	25-26	(SM)	18	90	
"	26-27	(GM)	14	112	
"	27-28	(GM)	17	—	
"	28-29	(GM)	16	98	
"	29-30	(GM)	18	—	
"	33-34	(GM)	11	—	
"	34-35	(GM)	11	—	

FIGURE B3-1

B82048A

GRAIN-SIZE DISTRIBUTION DATA

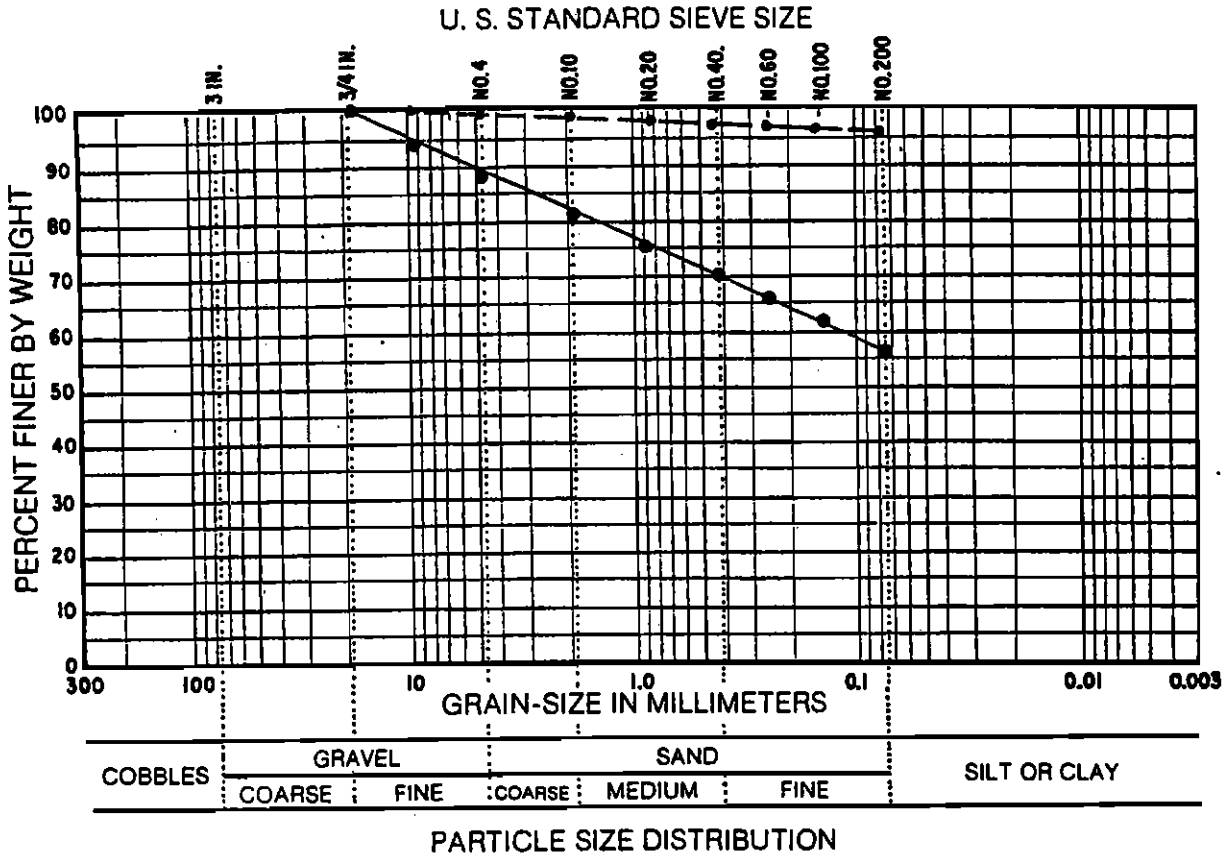


LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-1AN @ 10 ft.	WASTE DUMP			GRAVELLY SAND (SM)
— — —	DH-1BP @ 10 ft.	WASTE DUMP			SILTY SAND (SM)
- - - - -	DH-1CP @ 5 ft.	WASTE DUMP			SANDY GRAVEL (SP)
.....					

FIGURE B3-2

B82048A

GRAIN-SIZE DISTRIBUTION DATA

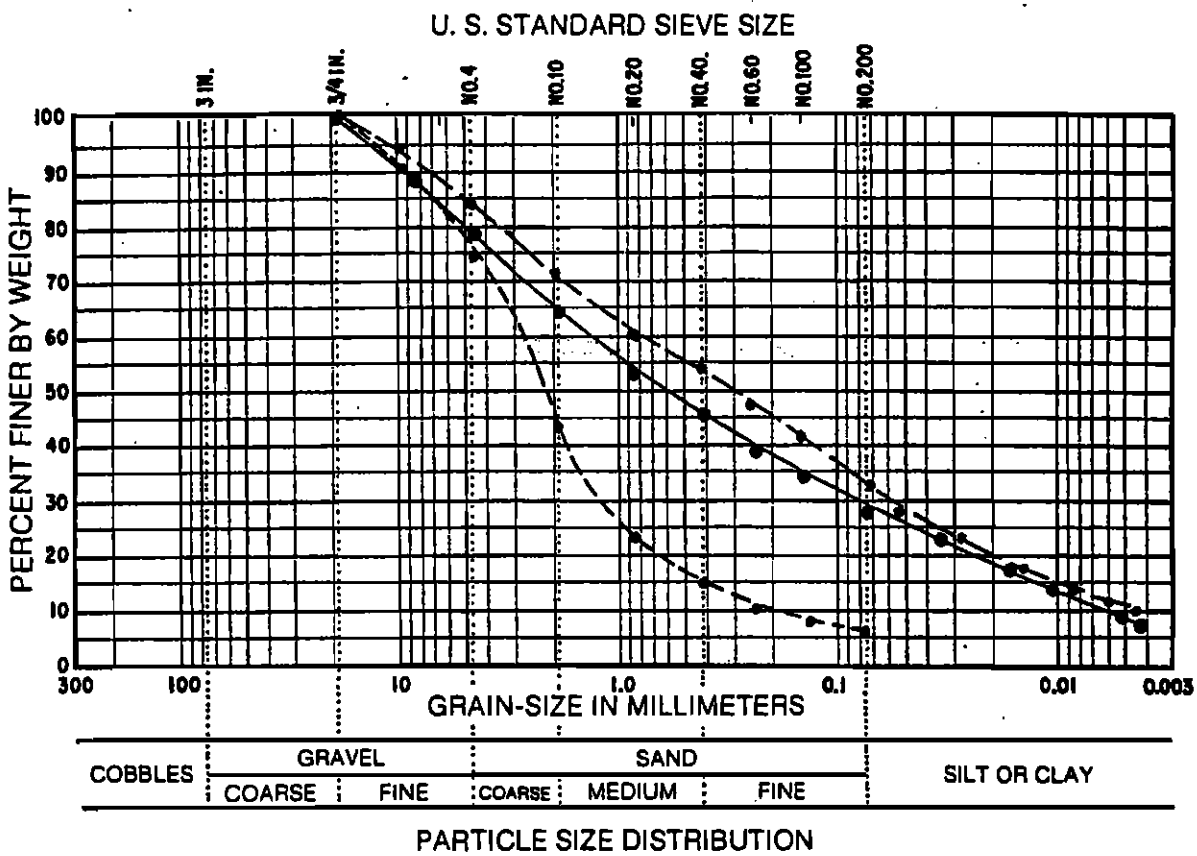


LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-2C1 @ 10 ft.	OPEN PIT			SANDY CLAY (CL)
— — —	DH-2C1 @ 20 ft.	OPEN PIT			SILTY CLAY (CH)
- - - - -					
.....					

B82048A

FIGURE B3-3

GRAIN-SIZE DISTRIBUTION DATA

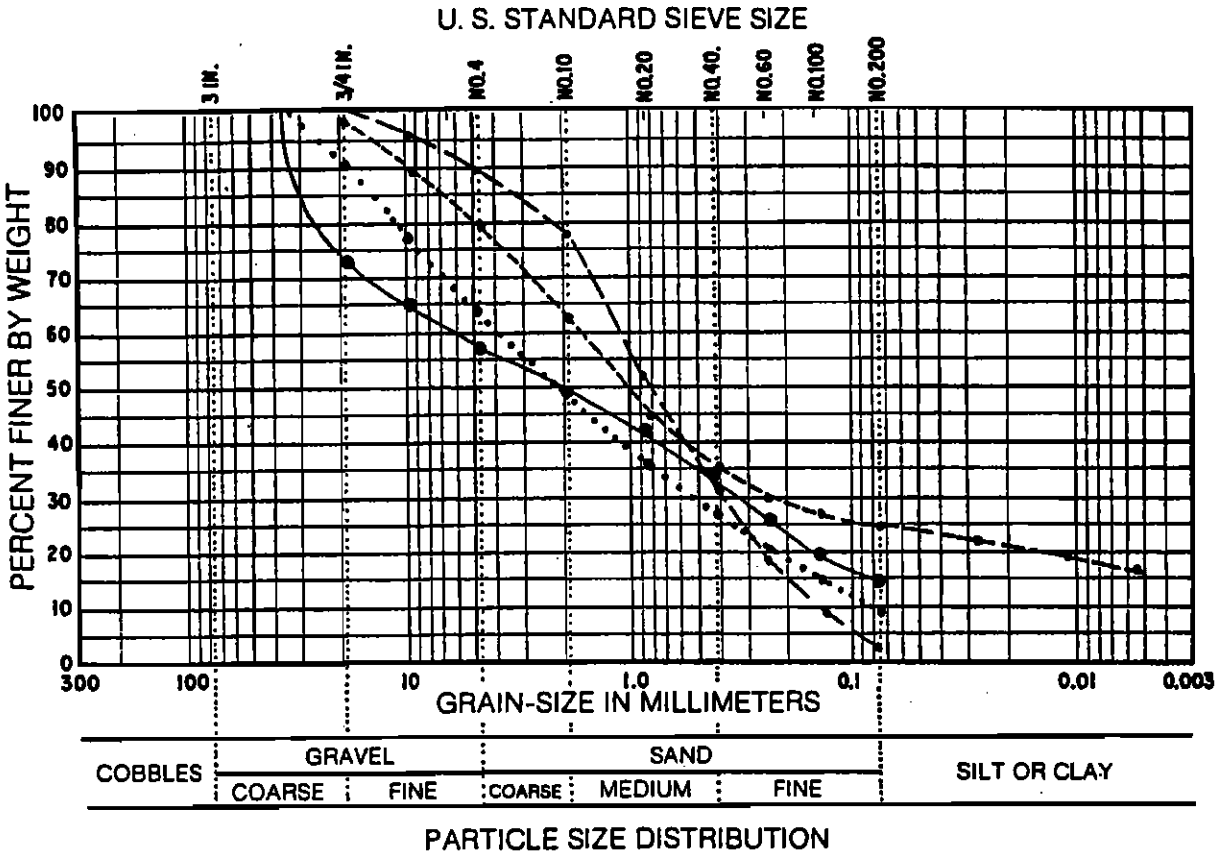


LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-15 @ 5 ft.	SPOILS PILE			SILTY SAND (SM)
— — —	DH-16 @ 40 ft.	SPOILS PILE			SILTY SAND (SM)
- - - - -	DH-16 @ 60 ft.	SPOILS PILE			GRAVELLY SAND (SP)
.....					

FIGURE B3-4

B82048A

GRAIN-SIZE DISTRIBUTION DATA



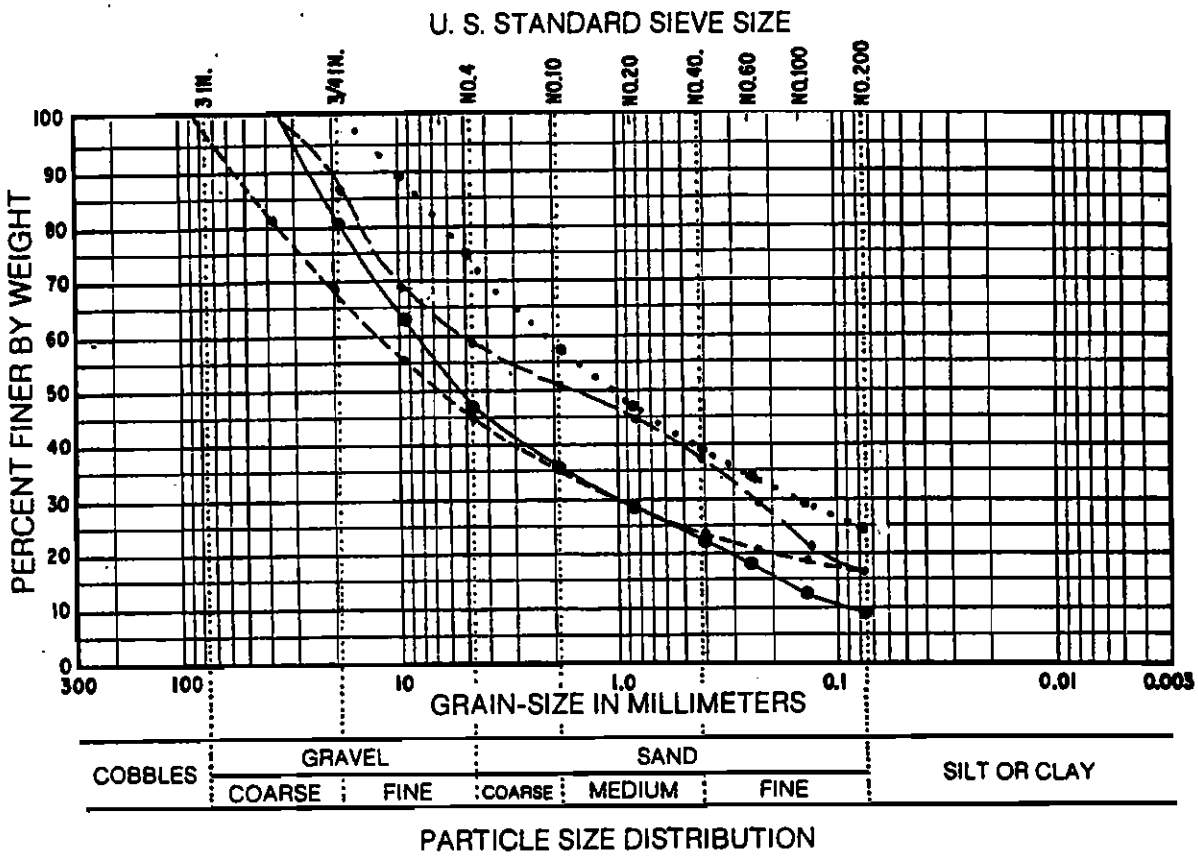
PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-3C @ 15 ft.	MAJOR SLIDE			SANDY GRAVEL (GW)
— — —	DH-4 @ 40 ft.	MAJOR SLIDE			SAND (SP)
- - - - -	DH-5 @ 30 ft.	MAJOR SLIDE			SILTY SAND (SM)
·····	DH-6 @ 5 ft.	MAJOR SLIDE			GRAVELLY SAND (SW)

FIGURE B3-5

B82048A

GRAIN-SIZE DISTRIBUTION DATA



LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-1AP @ 15 ft.	MAJOR SLIDE			SANDY GRAVEL (GP)
— — —	DH-3B @ 5 ft.	MAJOR SLIDE			SANDY GRAVEL (GW)
- - - - -	DH-3B @ 10 ft.	MAJOR SLIDE			SANDY GRAVEL (GW)
·····	DH-3B @ 50 ft.	MAJOR SLIDE			GRAVELLY SAND (SW)

FIGURE B3-6

LEGEND TO TEST DATA

SYMBOLS

△ ▲ ← GRANULAR SOIL

○ ● ← COHESIVE SOIL OR ROCK

● ← TEST AT SATURATED MOISTURE CONTENT

○ ← TEST AT MOISTURE CONTENT AS INDICATED

⊕ — WATER ADDED DURING TEST

ABBREVIATIONS

DH-16	—	DRILL HOLE NUMBER
TP - 12	—	TEST PIT NUMBER
@ 7'	—	DEPTH BELOW GRADE IN FEET
(SM)	—	SOIL TYPE EXPRESSED IN LETTER SYMBOL OF UNIFIED SOIL CLASSIFICATION SYSTEM
AL (45/10)	—	ATTERBERG LIMITS (LIQUID LIMIT / PLASTICITY INDEX)
M	—	MOISTURE CONTENT IN PERCENT OF DRY WEIGHT
D	—	DRY DENSITY IN POUNDS PER CUBIC FOOT
OPT. M	—	OPTIMUM MOISTURE CONTENT IN PERCENT OF DRY WEIGHT
MAX. D	—	MAXIMUM DRY DENSITY IN POUNDS PER CUBIC FOOT
RC	—	RELATIVE COMPACTION IN PERCENT OF MAXIMUM DRY DENSITY
t_x	—	TIME IN MINUTES FOR x PERCENT CONSOLIDATION

M and D: AT WHICH TEST WAS INITIATED

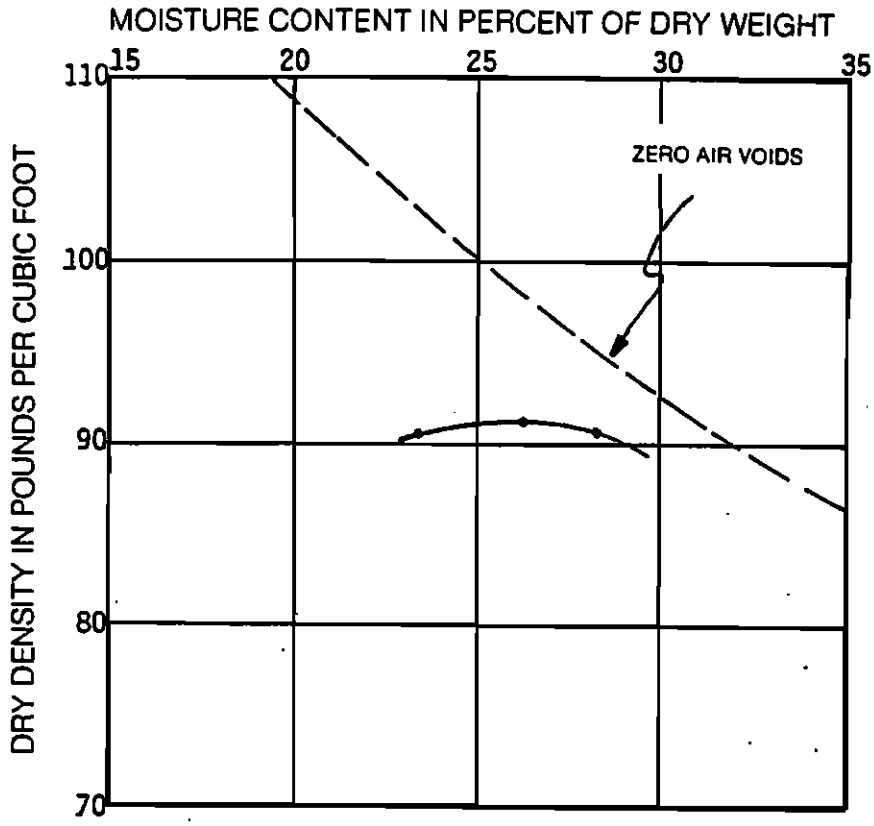
TYPE OF SAMPLE TESTED

N	—	UNDISTURBED NATURAL SOIL
F	—	UNDISTURBED COMPACTED FILL SOIL
R	—	SOIL REMOLDED IN LABORATORY

FIGURE B3-7

B82048A

COMPACTION TEST DATA



LOCATION

BORING OR TEST PIT : WASTE DUMP
DEPTH, IN FEET
REPRESENTATIVE FOR COMPOSITE SAMPLE

SOIL CLASSIFICATION

GRAIN SIZES IN PERCENT OF DRY WEIGHT
SAND (RETAINED ON No. 200 SIEVE)
FINES (PASSING No. 200 SIEVE)
ATTERBERG LIMITS, IN PERCENT OF DRY WEIGHT
LIQUID LIMIT
PLASTICITY INDEX
SOIL TYPE AND DESCRIPTION SANDY SILT

COMPACTION PROPERTIES

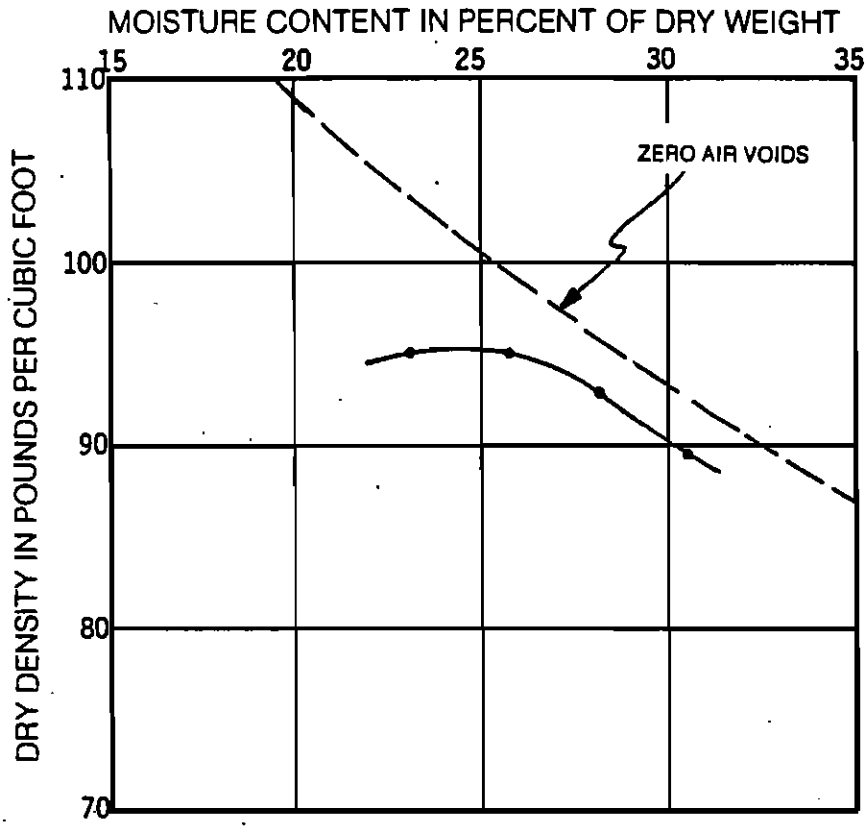
METHOD OF COMPACTION
ASTM STANDARD TEST METHOD D-1557 EQUIVALENT TO A.A.S.H.O. SOIL COMPACTION TEST T180
(1/30 CUBIC FOOT MOLD, 10 POUND HAMMER FALLING 18 INCHES, 25 BLOWS PER LAYER)

OPTIMUM MOISTURE CONTENT, IN PERCENT OF DRY WEIGHT 26.0
MAXIMUM DRY DENSITY, IN POUNDS PER CUBIC FOOT 92.0

FIGURE B3-8

B82048A

COMPACTION TEST DATA



LOCATION

BORING OR TEST PIT — SPOIL TAILINGS AREA
DEPTH, IN FEET
REPRESENTATIVE FOR — COMPOSITE SAMPLE

SOIL CLASSIFICATION

GRAIN SIZES IN PERCENT OF DRY WEIGHT
SAND (RETAINED ON No. 200 SIEVE)
FINES (PASSING No. 200 SIEVE)
ATTERBERG LIMITS, IN PERCENT OF DRY WEIGHT
LIQUID LIMIT
PLASTICITY INDEX
SOIL TYPE AND DESCRIPTION — SANDY SILT

COMPACTION PROPERTIES

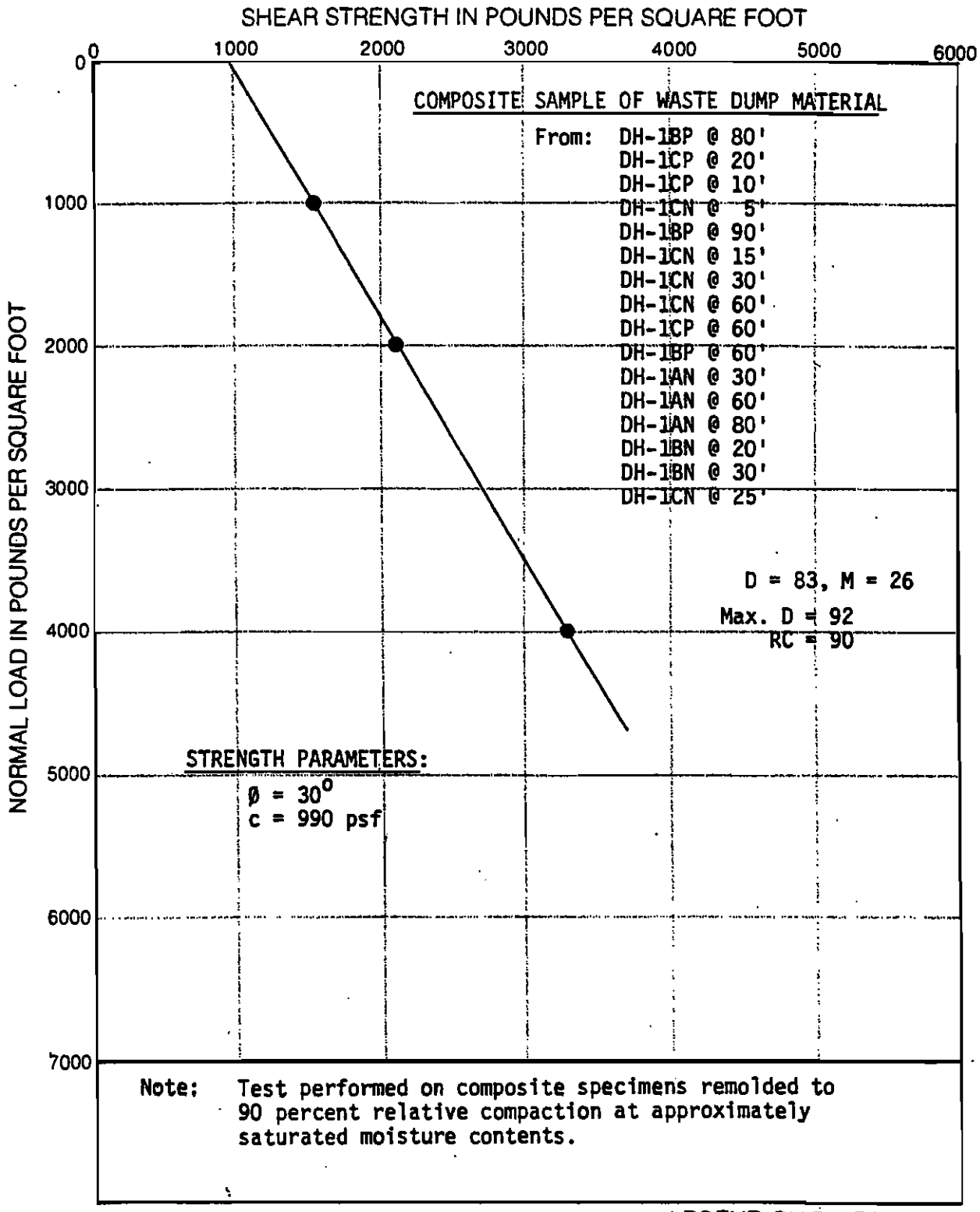
METHOD OF COMPACTION
ASTM STANDARD TEST METHOD D-1557 EQUIVALENT TO A.A.S.H.O. SOIL COMPACTION TEST T180
(1/30 CUBIC FOOT MOLD, 10 POUND HAMMER FALLING 18 INCHES, 25 BLOWS PER LAYER)

OPTIMUM MOISTURE CONTENT, IN PERCENT OF DRY WEIGHT — 25.0
MAXIMUM DRY DENSITY, IN POUNDS PER CUBIC FOOT — 95.5

FIGURE B3-9

B82048A

SHEAR TEST DATA



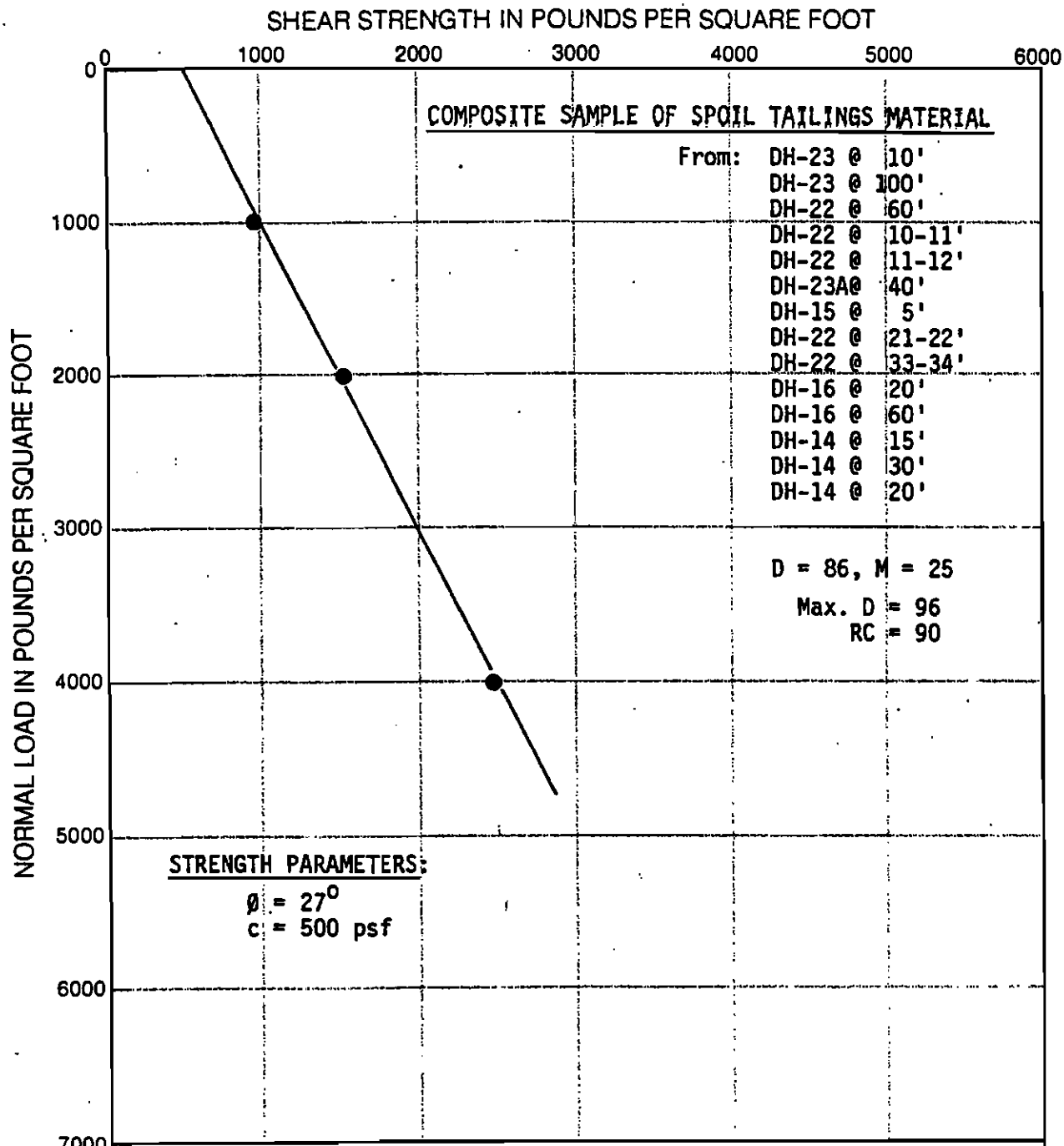
Note: Test performed on composite specimens remolded to 90 percent relative compaction at approximately saturated moisture contents.

LEGEND ON PLATE A—

FIGURE B3-10

B82048A

SHEAR TEST DATA



Note: Test performed on composite specimens remolded to 90 percent relative compaction at approximately saturated moisture contents.

LEGEND ON PLATE A—

SECTION B4

SOIL PERMEABILITY BY THE HAZEN APPROXIMATION

As a tool to help define the magnitude of permeability at the project site, we have made use of the Hazen approximation. This tool provides an empirical relationship between grain size and permeability.

Because most soil materials are comprised by a wide variety of grain sizes, it is important to determine which particle size is the controlling factor for permeability. The Hazen approximation proposes that this controlling particle size is known as the effective size of the soil. The approximation defines the effective size as the grain size such that only 10 percent of the sample by weight has a finer grain size.

In general, the approximation formula is $k\ CD_{10}^2$, where K is the coefficient of permeability in centimeters per second, D_{10} is the effective grain size in centimeters, and C is a constant of proportionality ranging generally between 100 and 150.

The following tabulation presents the results of Hazen approximation calculations for the grain size distribution curves performed in the soils laboratory of Geotechnical Consultants, Inc.

Mine region	Drill Hole No.	Sample depth, feet	Unified soil classification group symbol	Hazen approximation of permeability (cm/sec)
Landslide	DH-1AP	15	GP	6×10^{-3}
	-4	40	SP	3×10^{-2}
	-6	5	SW	5.5×10^{-3}
Spoil Tailings A	DH-15	5	SM	3×10^{-5}
	-16	40	SM	2×10^{-5}
	-17	60	SW	3.5×10^{-2}
Waste dump	DH-1AN	10	SM	3.5×10^{-5}
	1CP	5	GM	1.7×10^{-5}

The magnitude of these Hazen permeability approximations for specific grain size distribution curve testing of select samples can be grossly compared to the results of variable-head permeability tests conducted by Resource Concepts, Inc., in

November and December 1982 in most of the on-site drill holes. Direct correlation is not practical, in part, because their tests represent insitu, down-hole tests. As a result, their tests are representative of the specific perforated interval in each drill hole tested which, in many instances, is within bedrock and not in fill materials. Thus, even though the particular boring lies within the waste dump area, for example, their test results may be more indicative of the bedrock beneath the waste dump fill material.

In general, however, their results show permeability values ranging approximately as follows:

Landslide:	2×10^{-3} (DH-21), to 1 to 4×10^{-4}, to 4 to 8.5×10^{-5} (DH-8,8A) cm/sec
Spoil Area A:	1 to 8.5×10^{-4} cm/sec
Waste dump:	4 to 7×10^{-4} cm/sec

SECTION B5

ON-SITE TESTS OF PERMEABILITY

The results of on-site tests of permeability conducted by Resource Concepts for the U.S. Geological Survey are shown in Table B5-1.

PROVISIONAL RECORD
SUBJECT TO REVISION

TABLE B5-1

Results of the Analysis of Permeability
by Variable Head Tests
(U.S. Navy, Bureau of Yards and Docks)
for the Leviathan Mine
November 16, 17 and 18, 1982

PIEZOMETER TUBE	STATIC WATER LEVEL* (ft)	SHAPE FACTOR 'F'	PERMEABILITY (in./min)	REMARKS
USB-31	121.50	615.096	0.044	Alt Method
USB-32	40.75	288.340	0.013	
USB-33	27.58	615.096	0.012	
1AP	127.00	615.096	0.017	Alt Method
1CP	83.67	358.183	0.009	
2A1	1.50	131.780	0.165	
2A2	1.67	97.796	0.220	
2B	11.00	124.814	0.002	
2C1	20.50	133.508	0.0002	
2C2	7.00	133.508	0.007	
4	51.33	133.508	0.004	
7	47.58	133.508	0.003	
8	69.08	133.508	0.002	
8A	24.00	133.508	0.001	
9A	4.17	133.508	0.004	
9B	1.00	133.508	0.012	
9C	1.42	133.508	0.013	
10A	0.00	133.508	0.012	Flowing
10B	0.08	133.508	0.036	Flowing
10C	0.88	133.508	0.039	Flowing
11A	0.88	133.508	0.004	
11B	0.25	133.508	0.003	Alt Method
11C	1.88	133.508	0.0001	
14	32.42	358.183	0.007	
15	17.50	248.299	0.003	
17A	50.33	214.389	0.005	
17B	44.46	133.508	0.006	
17C	73.08	133.508	0.008	
18A	0.00	133.508	0.043	Flowing
18B	0.25	133.508	0.003	
18C	0.79	133.508	0.0004	
21	39.17	133.508	0.052	
22	67.83	133.508	0.006	
B-24	51.00	133.508	0.011	
B-25	98.25	133.508	0.016	

* Measurements from top of pipe

PROVISIONAL RECORD
SUBJECT TO REVISION

Recieved 12/27

TABLE 2

Results of the Analysis of Permeability by Variable Head Tests (US Navy, Bureau of Yards and Docks) for the Leviathan Mine

December 15, 1982

PIEZOMETER TUBE	STATIC WATER LEVEL* (ft)	SHAPE FACTOR "F"	PERMEABILITY "k" inches/min	REMARKS
5A	22.17	133.508	0.128	
6	7.25	133.508	0.019	
3AP	102.13	214.389	0.011	
3B1	25.00	214.389	0.016	
3B2	21.92	---	---	Not enough water depth
19A	26.63	214.389	0.018	
19B	19.00	214.389	0.020	
20	2.75	133.508	0.003	
20A	44.88	133.508	0.009	
3CP	47.88	214.389	0.003	

* measurements from top of pipe

PROVISIONAL RECORDS SUBJECT TO REVISION

APPENDIX C

PROJECT AREA WILDLIFE

The project area wildlife species list presented in this appendix is reproduced from the Final Environmental Assessment Environmental Impact Report for California Silver Zaca Mine Expansion, June 1982. The Zaca Mine project area lies approximately 5 miles to the west of the Leviathan site and at approximately the same elevation.

TABLE 22.

WILDLIFE SPECIES LIST FOR THE PROJECT AREA

MAMMALS	
Artiodactyla	
Mule deer	Odocoileus hemionus
Carnivora	
Coyote	Canis latrans
* Mountain lion	Felis concolor
* Bobcat	F. rufus
* Pine marten	Martes americana
* Striped skunk	Mephitis mephitis
* Shorttail weasel	Mustela erminea
* Longtail weasel	M. frenata
* Spotted Skunk	Spilogale gracilis
* Badger	Taxidea taxus
Black bear	Ursus americanus
* Red Fox	Vulpes vulpes
Chiroptera	
* Big brown bat	Eptesicus fuscus
* Little brown myotis	Myotis lucifugus
* Long-legged myotis	M. volans
Insectivora	
* Dusky shrew	Sorex monticolus
* Trowbridge shrew	S. trowbridgii
Vagrant shrew	S. vagrans
Lagomorpha	
* Snowshoe hare	Lepus americanus
Blacktail jackrabbit	L. californicus
Mountain cottontail	Sylvilagus nuttalli
Rodentia	
California ground squirrel	Citellus beecheyi
Golden-mantled squirrel	C. lateralis
Townsend ground squirrel	C. townsendi
* Porcupine	Erethizon dorsatum
Least chipmunk	Eutamias minimus
* Long-eared chipmunk	E. quadrimaculatus
* Northern flying squirrel	Glaucomys sabrinus
Yellowbelly marmot	Marmota flaviventris
Mountain vole	Microtus montanus
Bushytail woodrat	Neotoma cinerea
Deer mouse	Peromyscus maniculatus
* Pinyon mouse	P. truei
California mole	Scapanus orarius
Western gray squirrel	Sciurus griseus
Chickaree	Tamiasciurus douglasi
Mountain pocket gopher	Thomomys monticola
REPTILES	
Sauria	
* Northern alligator lizard	Gerrhonotus coeruleus
Boidae	
* Rubber boa	Charina bottae
Colubridae	
Western yellow-bellied racer	Coluber constrictor
* California mountain kingsnake	Lampropeltis zonata
Coachwhip	Masticophis flagellum
Gopher snake	Pituophis melanoleucus
Western terrestrial garter snake	Thamnophis elegans
Iguanidae	
* Sagebrush lizard	Sceloporus graciosus
Western fence lizard	S. occidentalis
Teiidae	
* Western whiptail	Cnemidophorus tigris
Viperidae	
* Western rattlesnake	Crotalus viridis
AMPHIBIANS	
Bufonidae	
* Western toad	Bufo boreas
Hylidae	
* Pacific treefrog	Hyla regilla
Ranidae	
* Mountain yellow-legged frog	Rana mucosa
BIRDS	
Alaudidae	
* Horned lark	Eremophila alpestris
Motacillidae	
* Red-tailed hawk	Buteo jamaicensis

* Designates species whose ranges overlap the study area but were not observed or evident.

TABLE 22.

WILDLIFE SPECIES LIST FOR THE PROJECT AREA

Cathartidae	
Turkey vulture	Cathartes aura
Caprimulgidae	
Common nighthawk	Chordeiles minor
Poor-will	Phalaenoptilus nuttallii
Corthudae	
* Brown creeper	Certhia familiaris
Charadriidae	
Killdeer	Charadrius vociferus
Columbidae	
Band-tailed pigeon	Columba fasciata
Mourning dove	Zenaidura macroura
Corvidae	
Scrub jay	Aphelocoma coerulescens
Steller's jay	Cyanocitta stelleri
Pinyon jay	Gymnorhinus cyanocephala
Clark's nutcracker	Nucifraga columbiana
Black-billed magpie	Pica pica
Falconinae	
Prairie falcon	Falco mexicanus
Sparrow hawk	F. sparverius
Fringillidae	
Sage sparrow	Amphispiza belli
Cassin's finch	Carpodacus cassinii
Green-tailed towhee	Chlorura chlorura
* Dark-eyed junco	Junco hyemalis
Oregon junco	J. oreganus
Song sparrow	Melospiza melodia
* Lincoln's sparrow	M. lincolnii
Fox sparrow	Passerella iliaca
Black-headed grosbeak	Pheucticus ludovicianus
Rufous-sided towhee	Pipilo erythrophthalmus
Brewer's sparrow	Spizella breweri
White-crowned sparrow	Zonotrichia leucophrys
Hirundinidae	
Violet-green swallow	Tachycineta thalassina
Icteridae	
Redwing blackbird	Agelaius phoeniceus
Brewer's blackbird	Euphagus cyanocephalus
Bullock's oriole	Icterus bullockii
Brown-headed cowbird	Molothrus ater
Paridae	
Black-capped chickadee	Parus atricapillus
Mountain chickadee	P. gambeli
Common bushtit	Psaltriparus minimus
Parulidae	
Audubon's warbler	Dendroica auduboni
Yellow warbler	D. petechia
MacGillivray's warbler	Oporornis tolmiei
* Nashville warbler	Vermivora ruficapilla
Wilson's warbler	Wilsonia pusilla
Phasianidae	
Mountain quail	Oreortyx pictus
Picidae	
Red-shafted flicker	Colaptes cafer
* Lewis woodpecker	Melanerpes lewis
* White-headed woodpecker	Picoides albolarvatus
* Downy woodpecker	P. pubescens
Hairy woodpecker	P. villosus
* Williamson's sapsucker	Sphyrapicus thyroideus
Yellow-bellied sapsucker	S. varius
Sittidae	
White-breasted nuthatch	Sitta carolinensis
Pygmy nuthatch	S. pygmaea
Strigidae and Tytonidae	
* Saw-whet owl	Aegolius acadicus
* Long-eared owl	Asio otus
Great horned owl	Bubo virginianus
* Flammulated owl	Otus flammeolus
Sylviidae	
* Blue-gray gnatcatcher	Polioptila caerulea
* Golden-crowned kinglet	Regulus satrapa
Tetraonidae	
Blue grouse	Dendragapus obscurus
Thraupidae	
Western tanager	Piranga ludoviciana
Trochilidae	
Black-chinned hummingbird	Archilochus alexandri
Calliope hummingbird	Stellula calliope

* Designates species whose ranges overlap the study area but were not observed or evident.

TABLE 22.

WILDLIFE SPECIES LIST FOR THE PROJECT AREA

Troglodytidae	
• Rock wren	*Salpinctes obsoletus*
• Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
• Winter wren	*T. troglodytes*
Tyrannidae	
Western wood pewee	*Contopus sordidulus*
• Dusky flycatcher	*Empidonax oberholseri*
• Gray flycatcher	*E. wrightii*
• Olive-sided flycatcher	*Nuttallornis borealis*
• Say's phoebe	*Sayornis saya*
Turdidae	
• Hermit thrush	*Hylocichla guttata*
Swainson's thrush	*H. ustulata*
Townsend's solitaire	*Myadestes townsendi*
Mountain bluebird	*Sialia currucoides*
Western bluebird	*S. mexicana*
Robin	*Turdus migratorius*
Vireonidae	
Warbling vireo	*Vireo gilvus*
• Solitary vireo	*V. solitarius*

• Designates species whose ranges overlap the study area but were not observed or evident.

APPENDIX D

U.S. GEOLOGICAL SURVEY SURFACE AND GROUNDWATER MONITORING DATA

This appendix presents a summary of water quality monitoring data provided by the U.S. Geological Survey (USGS) from their water quality program conducted from February 1981 through November 1982. The actual water quality data are available for review upon request at the office of the California Regional Water Quality Control Board, Lahontan Region, in South Lake Tahoe.

Surface Water Quality Data

Figure D-1 shows the locations of all the surface water quality stations monitored by the USGS. Table D-1 summarizes all of the available data for the key stations.

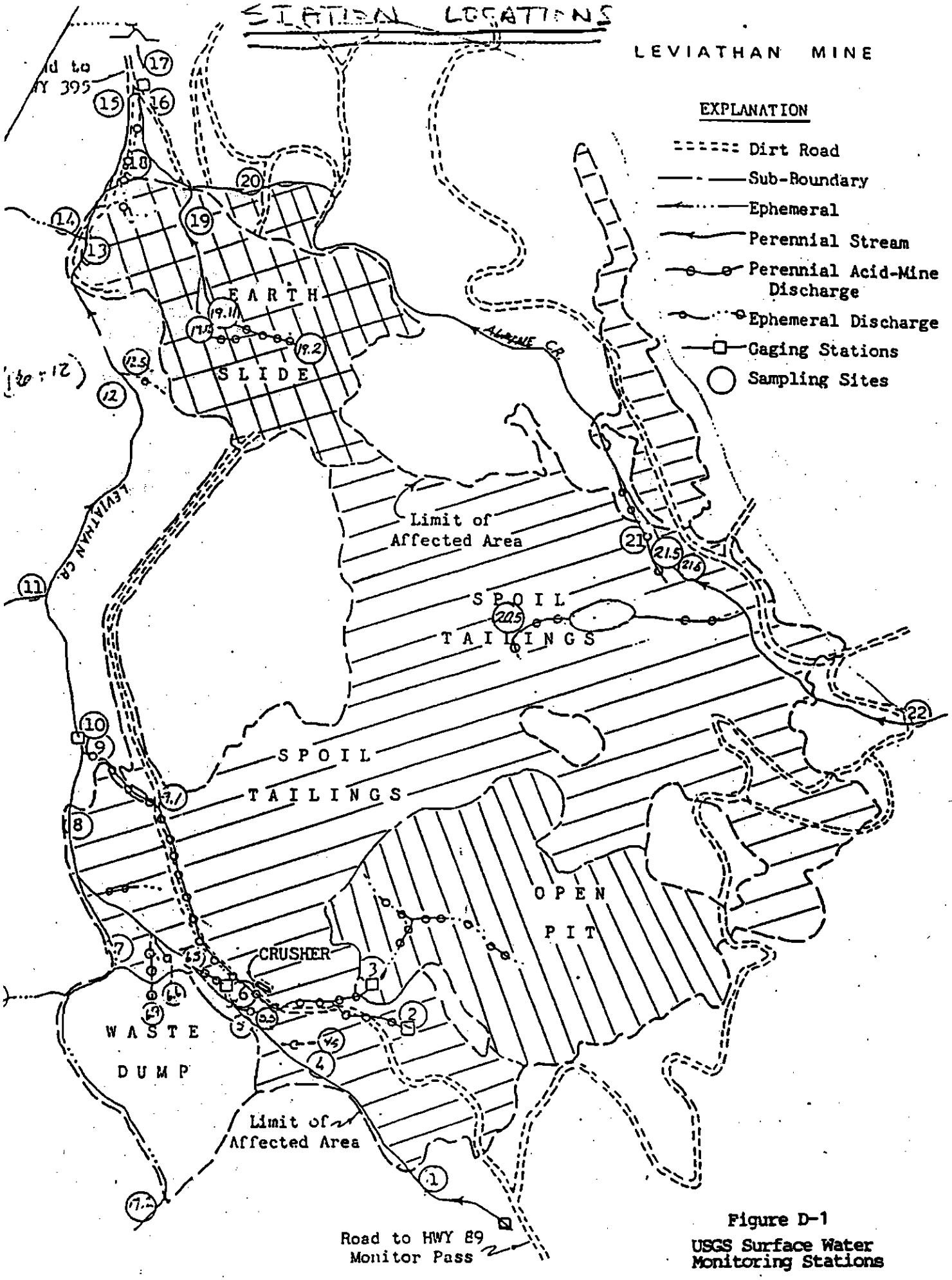


Figure D-1
USGS Surface Water Monitoring Stations

TABLE D-1 DATA SUMMARY - SURFACE WATER

SAMPLING DATES - 1981

STA	PARAM	2-17	2-26	3-3	3-19	3-31	4-7	4-8	4-14	4-21	4-22	5-14	5-15	6-10	6-11	7-7	7-8	8-25	8-26	9-15	9-17	10-8	10-9	10-15	10-21	11-12	11-18	12-2	12-3	12-4	12-10	12-11
1	FLOW	✓	✓	—	✓	—	✓	—	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	—	—	—	✓	—	✓	✓	—	—	—
	TEMP	✓	✓	—	✓	—	✓	—	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	—	—	—	✓	—	✓	✓	—	—	—
	SPCOND	✓	✓	✓	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	—	—	—	✓	—	✓	—	—	—	—
	pH	—	✓	✓	✓	—	✓	—	✓	✓	—	—	✓	✓	—	✓	—	✓	—	—	—	✓	—	—	—	✓	—	—	—	—	—	—
	ACIDITY	—	—	—	✓	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	—	✓	—	—	—	✓	—	—	—	✓	—	✓	—	—	—	—
	METALS	—	—	—	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	—	✓	—	—	—	✓	—	—	—	✓	—	✓	—	—	—	—
2	FLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	✓	—	—	—	—
	TEMP	✓	✓	—	✓	—	✓	✓	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	✓	—	—	—	—
	SPCOND	✓	✓	—	✓	✓	✓	✓	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	✓	—	—	—	—
	pH	✓	—	—	✓	—	✓	✓	✓	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	✓	—	—	—	—
	ACIDITY	—	—	—	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	—	—	—	✓	—	—	—	—	—	—
	SULFATES	—	—	—	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	—	✓	—	✓	—	✓	—	—	—	✓	—	—	—	—	—	—
	METALS	—	—	—	✓	—	✓	—	—	—	—	—	—	—	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	—	—	—	—	—
3	FLOW	—	—	—	✓	—	✓	—	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	✓	—	✓	—	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—
	pH	—	—	—	✓	—	✓	—	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—
	ACIDITY	—	—	—	✓	—	✓	—	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	✓	—	✓	—	—	✓	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—
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4	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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	ACIDITY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	METALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	METALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	✓	—	—	✓	—	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	✓	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	✓	—	—	✓	—	—	—
	pH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	✓	—	—	—
	ACIDITY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—	—	—	—
	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—	—	—	—
	METALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—	—	—	—
7	FLOW	—	—	—	✓	—	✓	—	—	✓	✓	—	—	✓	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	✓	—	✓	—	—	✓	—	—	—	✓	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
	pH	—	—	—	✓	—	✓	—	—	✓	✓	—	—	✓	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
	ACIDITY	—	—	—	✓	—	✓	—	—	✓	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	✓	—	✓	—	—	✓	✓	—	—	✓	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
	METALS	—	—	—	✓	—	✓	—	—	✓	✓	—	—	✓	✓	—	—	✓	—	✓	—	✓	—	—	—	—	—	—	—	—	—	—
8	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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9	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	pH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	ACIDITY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	METALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—
	pH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	—	—
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11	FLOW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	pH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	ACIDITY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	METALS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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	TEMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SPCOND	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	pH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	ACIDITY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	SULFATES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table

TABLE D-1 (CONTINUED)

SAMPLING DATES - 1981

STA	PARAM	2-17	2-26	3-3	3-10	3-31	4-7	4-8	4-14	4-21	4-22	5-14	5-15	6-10	6-11	7-7	7-8	8-25	8-26	9-15	9-17	10-6	10-7	10-15	10-21	11-12	11-16	12-2	12-3	12-4	12-10	12-11
13	FLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	ACIDITY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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TABLE D-1 (CONTINUED)

SAMPLING DATES - 1982

STA	PARAM.	1-27	1-29	2-1	2-3	2-5	2-8	2-12	2-15	2-19	3-5	3-8	3-12	3-23	3-24	3-25	3-26	4-6	4-15	4-16	4-26	4-27	4-28	4-29	4-30	5-6	5-12	5-25	5-26	5-27	5-28	6-1	6-2	6-4	6-11	6-15	6-16	6-17	7-15	7-21	7-22	7-27	8-11	8-26	10-4	10-5	10-6	10-18	10-21
1	FLOW	✓		✓						✓	✓	✓	✓				✓			✓					✓			✓				✓					✓		✓	✓			✓	✓			✓		✓	
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	Sulfates											✓				✓					✓													✓														

TABLE D-1 (CONTINUED)

SAMPLING DATES - 1982

STA	PARAM.	1-27	1-25	2-1	2-3	2-5	2-8	2-12	2-18	2-19	3-5	3-9	3-11	3-23	3-24	3-25	3-26	3-29	4-1	4-5	4-15	4-20	4-21	4-22	4-23	4-28	5-6	5-12	5-25	5-26	5-27	5-28	6-1	6-2	6-3	6-4	6-5	6-15	6-16	6-17	7-15	7-21	7-22	7-27	8-11	8-25	9-1	9-10	10-6	10-11	10-18	10-21
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	TEMP											✓										✓												✓				✓			✓							✓				
	SP.COND											✓										✓												✓				✓			✓							✓				
	pH											✓										✓												✓				✓			✓							✓				
	Acidity											✓										✓												✓																			
	Sulfates											✓										✓												✓																			
	Metals																																																				
16	FLOW											✓			✓							✓												✓				✓			✓					✓			✓				
	TEMP											✓			✓							✓												✓				✓			✓					✓			✓				
	SP.COND											✓			✓							✓												✓				✓			✓					✓			✓				
	pH											✓			✓							✓												✓				✓			✓					✓			✓				
	Acidity														✓							✓																								✓							
	Sulfates											✓			✓							✓												✓												✓							
	Metals														✓																															✓							
17	FLOW				✓					✓	✓	✓		✓	✓							✓		✓				✓	✓			✓		✓	✓			✓				✓				✓		✓	✓				✓
	TEMP				✓						✓	✓			✓							✓		✓				✓				✓		✓	✓			✓				✓				✓	✓	✓				✓
	SP.COND				✓						✓	✓			✓							✓		✓				✓				✓		✓	✓			✓				✓				✓	✓	✓				✓
	pH				✓						✓	✓			✓							✓		✓								✓		✓				✓				✓				✓		✓				
	Acidity											✓			✓							✓		✓										✓												✓							
	Sulfates				✓							✓			✓							✓												✓												✓							
	Metals				✓										✓							✓							✓																								
22	FLOW																																							✓		✓				✓				✓		
	TEMP																																							✓		✓				✓				✓		
	SP.COND																																							✓		✓				✓				✓		
	pH				✓																																			✓		✓				✓				✓		
	Acidity																																													✓						
	Sulfates																																													✓						
	Metals																																													✓						
25	FLOW				✓					✓				✓	✓					✓			✓					✓					✓					✓				✓				✓		✓				✓
	TEMP									✓					✓					✓									✓				✓					✓				✓				✓		✓				
	SP.COND				✓					✓					✓								✓										✓					✓				✓				✓		✓				
	pH				✓					✓					✓								✓										✓					✓				✓				✓		✓				
	Acidity														✓								✓																							✓							
	Sulfates				✓										✓								✓																							✓							
	Metals														✓							✓	✓						✓																		✓							
26	FLOW					✓									✓								✓						✓									✓				✓				✓			✓				
	TEMP					✓									✓								✓															✓				✓				✓			✓				
	SP.COND					✓									✓								✓															✓				✓				✓			✓				
	pH					✓									✓								✓															✓				✓				✓			✓				
	Acidity														✓								✓																							✓							
	Sulfates					✓									✓								✓																							✓							
	Metals														✓								✓						✓																		✓							

Groundwater Quality Data

Figure 2-27 shows the location of groundwater sampling wells established by the U.S. Geological Survey. Table D-2 summarizes the monitoring frequency of these wells.

TABLE D-2. SUMMARY OF USGS WELL MONITORING DATA

well #	20-00	25-00	22-00	8-1	9-1	12-1	15-1	16-1	17-1	19-1	23-1
1BP					●						
1BN											
1AN											
1AP					●						
1CN											
1CP					●						
2B				●				●			
2A1				●					●		
2A2				●					●		
2C1				●					●		
2C2				●					●		
3B1					●						
3B2					●						
3CP					●						
3CN											
3AP					●						
4						●		●			
5											
5A										●	
6										●	
7						●					
8										●	●
8A										●	●
9A						●		●			
9B						●		●			

well #	20-00	25-00	22-00	8-1	9-1	12-1	15-1	16-1	17-1	19-1	23-1
9C						●		●			
10A						●		●			
10B						●		●			
10C						●		●			
11A						●		●			
11B						●		●			
11C						●		●			
14				●							
15									●		
16					●			●			
17A					●			●			
17B					●			●			
17C					●			●			
18A						●		●			
18B						●		●			
18C						●		●			
19A					●						
19B					●						
20						●					
20A						●					
21							●				
22					●						
H-23											
H-24					●						

TABLE D-2 (CONTINUED)

well #	10-20	10-25	10-26	11-8	11-9	11-12	11-15	11-16	11-17	11-19	11-23
H-25					•						
VSB-31		•									
VSB-32		•									
VSB-33	•										

SHALLOW GROUNDWATER FLOW IN THE VICINITY OF THE OPEN PIT AT THE LEVIATHAN MINE

(Prudic and Hammermeister, 1984)

Table 1.--Summary of flow calculations

Flow table	Area		Gradient		K (ft/s)	Flow (ft^3/s)	Rate (acre-ft/yr)
	Width (ft)	Thickness (ft)	ΔH (ft)	ΔL (ft)			
Q1	250	25	100	250	4×10^{-6}	.010	7.2
Q2	400	25	100	200	4×10^{-6}	.020	14.4
Q31	450	25	100	250	4×10^{-6}	.018	13.0
Q41	480	25	100	360	4×10^{-6}	.013	9.4
Q51	400	25	50	260	4×10^{-6}	.008	5.8
Q61	520	25	50	240	4×10^{-6}	.011	7.9
Q71	400	25	50	240	4×10^{-6}	.008	5.8
Q81	240	25	50	280	4×10^{-6}	.004	2.9
Q32	400	25	100	230	4×10^{-6}	.017	12.3
Q42	440	25	100	320	4×10^{-6}	.014	10.1
Q10	210	25	50	190	3×10^{-5}	.041	29.5
Q11	200	25	50	280	3×10^{-5}	.027	19.4

TABLE 8.--Summary of inflows and outflows from the open-pit area of Leviathan Mine

Inflow and outflow	Discharge (acre-ft/yr)
Shallow ground-water flow into the adit from upslope recharge areas in the southern portion of the open pit.	21.5
Shallow ground-water flow into the northern portion of the open pit from upslope recharge areas.	44.6
Shallow ground-water flow out of the open-pit area beneath the mouth of the open pit.	48.9
Total average measured discharge from the mine adit.	43
Total estimated surface discharge from the mouth of the open pit.	30

HYDROLOGIC DATA FOR LEVIATHAN MINE AND VICINITY OF ALPINE COUNTY, CALIFORNIA, 1981-1983

(Hammermeister and Waimsley, 1985)

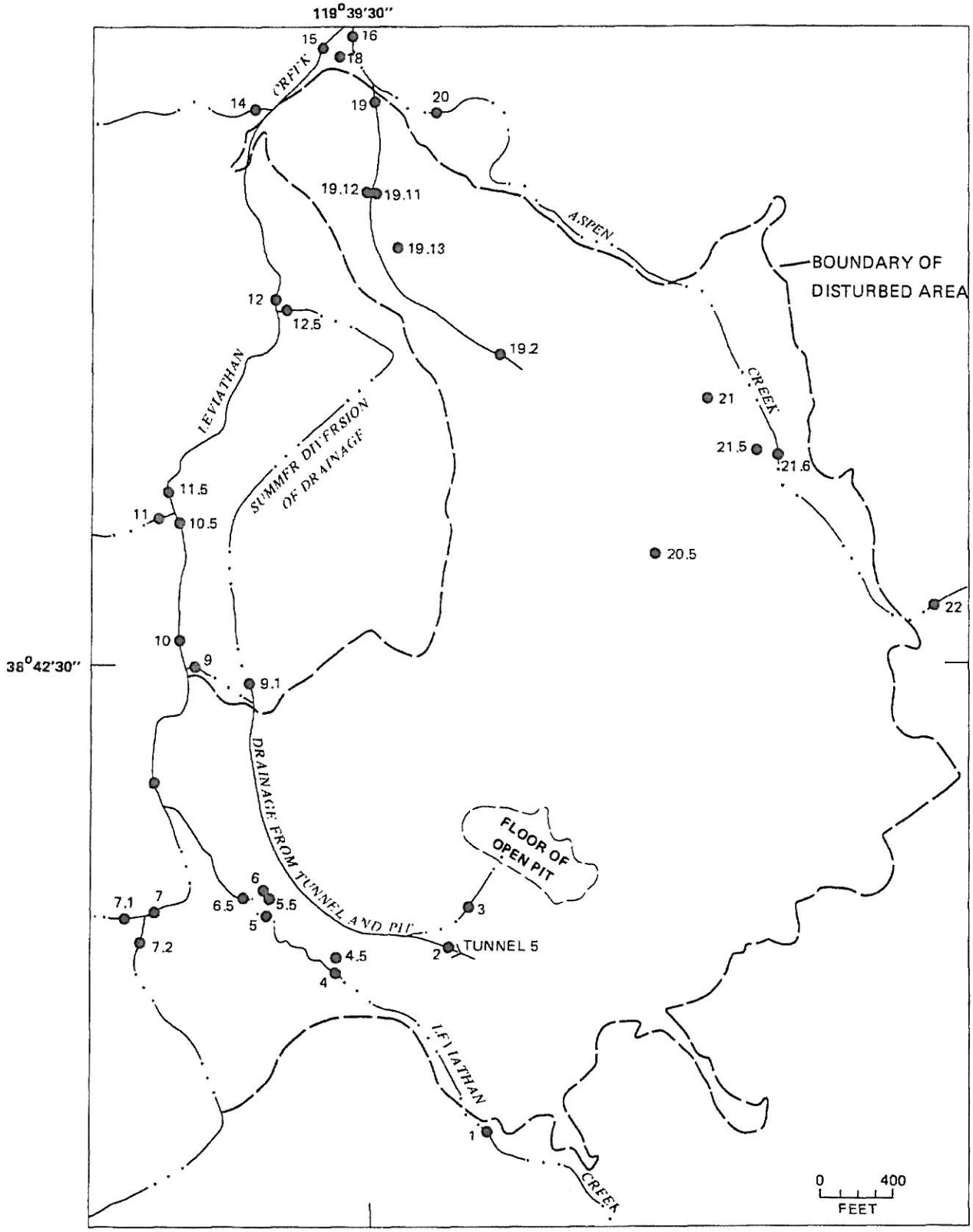


FIGURE 3.--Surface-water sampling sites in the mine area. Site numbers correspond with those in table 1.

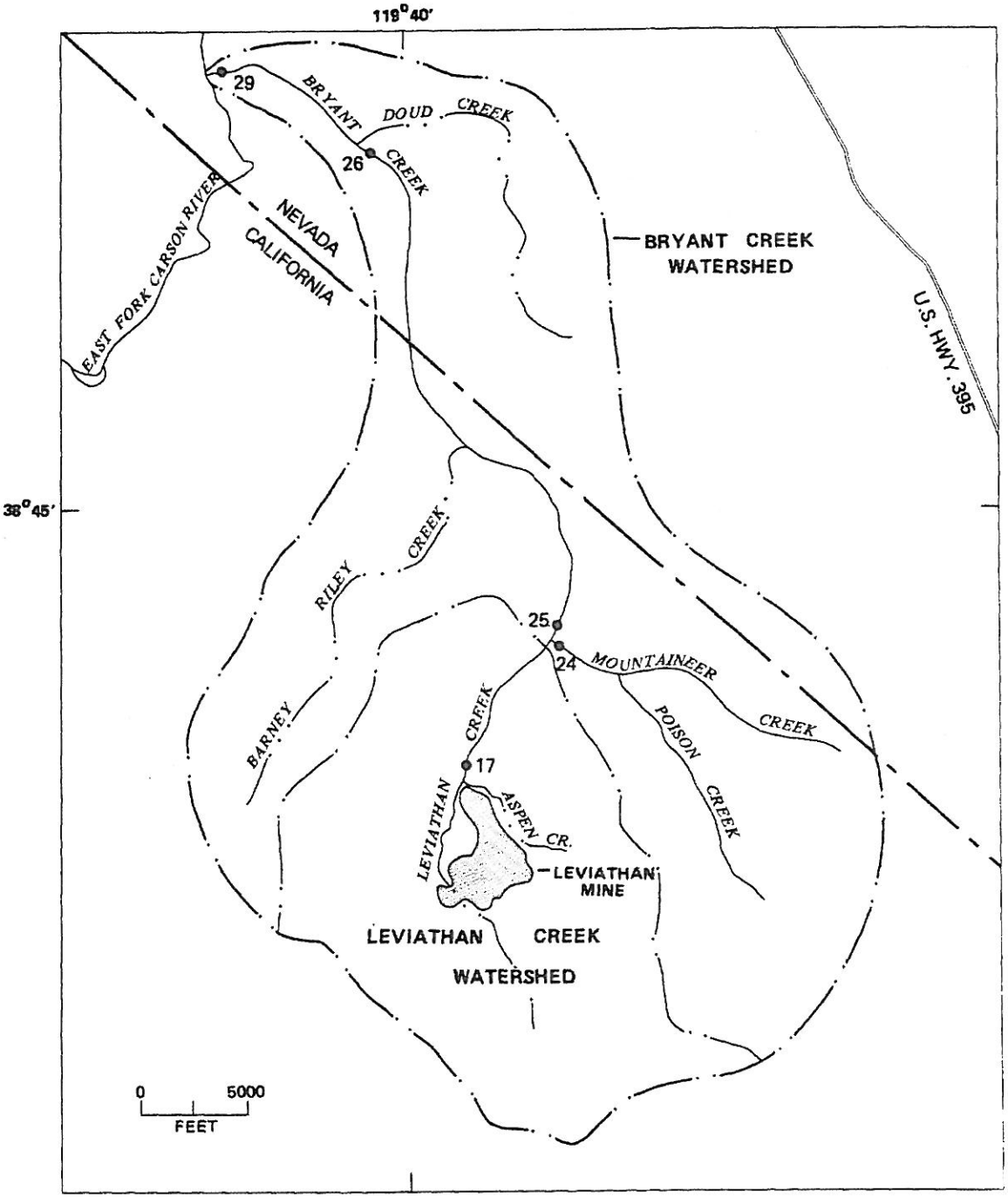


FIGURE 4.--Surface-water sampling sites downstream from the mine area. Site numbers correspond with those in table 1.

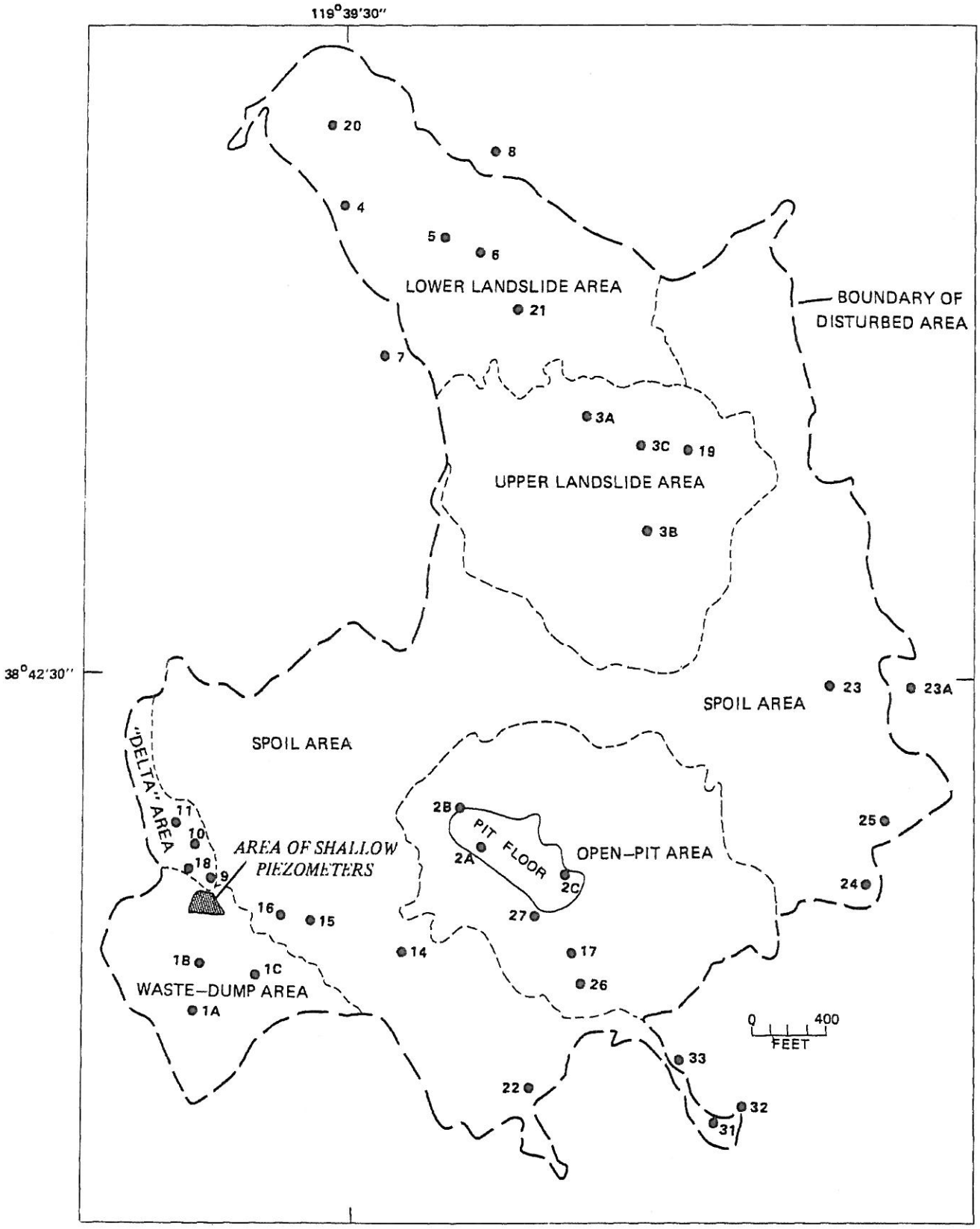


FIGURE 5.--Test holes drilled with the CME-750 rig, and shallow piezometers at base of waste dump. Test-hole numbers correspond with those in table 81; piezometers are listed in table 82.

TABLE 1.--Surface-water sampling sites

Site number	Gaging-station number	Description
1	10308783	Leviathan Creek above Leviathan Mine
2	10308784	Seep at Leviathan Mine tunnel 5
3	10308785	Drainage from Leviathan Mine open pit
4	--	Leviathan Creek between sites 1 and 5
4.5	--	Intermittent seep entering Leviathan Creek below site 4
5	--	Leviathan Creek above site 5.5 in gully next to tailings dump
5.5	--	Seep 50 feet southeast of site 6
6	10308787	Seep below crusher adjacent to Leviathan Creek above delta area
6.5	--	Leviathan Creek 50 feet below inflow from site 6
7	10308786	Intermittent stream along northwest side of Leviathan Mine tailings dump
7.1	--	Intermittent stream from west above site 7
7.2	--	Intermittent stream along west side of tailings dump
8	--	Leviathan Creek at north end of delta below inflow from site 7
9	--	Drainage from pit and tunnel
9.1	--	Summer diversion of drainage from pit and tunnel on road above site 9
10	10308788	Leviathan Creek below inflow from pit and tunnel
10.5	--	Leviathan Creek above eastward-draining stream
11	--	Eastward-draining stream (informally known as 4-L Creek)
11.5	--	Leviathan Creek below eastward-draining stream
12	--	Leviathan Creek above south side of slide and below summer diversion of pit and tunnel drainage
12.5	--	Summer diversion of drainage from pit and tunnel
14	--	Intermittent stream entering Leviathan Creek opposite toe of slide
15	--	Leviathan Creek above Aspen Creek
16	--	Aspen Creek above Leviathan Creek
17	10308790	Leviathan Creek below Aspen Creek
18	--	Seep entering Aspen Creek from lower slide area
18.1	--	Discharge flowing down west toe of slide, 70 feet from base
18.2	--	Above pond at base of west toe
19	--	Seep entering Aspen Creek (drains central lower part of slide)
19.05	--	Discharge just above fallen tree, 160 feet below and northwest of site 19.11
19.11	--	North fork of seep of site 19 below temporary road and 8-inch PVC culvert on slide
19.12	--	South fork of seep of site 19 below temporary road and twin 8-inch PVC culvert on slide

TABLE 1.--Surface-water sampling sites--Continued

Site number	Gaging-station number	Description
19.13	--	Seep from slide above concrete water-tank remnant at old trailer-park site
19.14	--	South fork of discharge on center of slide, 70 feet southwest of concrete structure, where discharge reemerges
19.15	--	South branch of south fork of discharge as it reemerges, 30 feet southeast of site 19.14
19.16	--	South fork of discharge, where it percolates into ground 60 feet above site 19.14
19.17	--	North fork at fallen tree; 70 feet above site 19.13
19.18	--	Between sites 19.17 and 19.2 in saturated meadow area
19.2	--	Drainage from pond on central part of slide
20	--	Aspen Creek above 2-foot corrugated metal pipe at loop road near north-central part of slide
20.5	--	Seep from north side of pit rim, above ponds in overburden south of Aspen Creek
21	--	Seep from contact between overburden and slide opposite old town site
21.5	--	Seep from north edge of slide across Aspen Creek from center of old town site
21.6	--	Aspen Creek above inflow from site 21.5
22	--	Aspen Creek above 1.5-foot corrugated metal pipe adjacent to large steel water tank
24	--	Mountaineer Creek above confluence with Leviathan Creek
25	10308794	Bryant Creek below confluence of Leviathan and Mountaineer Creeks
26	10308800	Bryant Creek above Doud Creek
29	--	Bryant Creek above East Fork Carson River

TABLE 81.--Location, altitude, depth, and perforated interval for test holes drilled with CME-750 rig

Test-hole number	Location coordinates[1]		Altitude of top of casing[1] (feet above sea level)	Depth (feet below top of casing)	
	North	East		Total	Approximate perforated interval
			Upgradient from mine		
22	385726.000	2669197.070	7,151.20	91.5	77.5-87.5
23	—	—	[2]7,322	150	Dry hole; no casing
23A	387894.963	2670701.382	7,322.71	68.5	58.5-68.5
24	386875.208	2670928.497	7,434.68	65	55-65
25	387220.009	2671002.310	7,382.40	115.5	105-115
31	385609.787	2670196.177	7,314.43	157	Not cased below 127
32	385683.916	2670312.205	7,333.25	129	113.5-128.5
33	385931.611	2669994.926	7,298.65	122	80.5-120.5
			Waste-dump area		
1A	386114.081	2667387.667	7,106.98	200.5	116-156
1AN	386113.572	2667393.225	7,107.09	117	Blank casing to 100
1AL	—	—	--	100	No casing
1B	386366.660	2667433.713	7,054.95	136	96-136
1BN	386366.508	2667424.504	7,055.64	60	Blank casing to 60
1BL	—	—	--	60	No casing
1C	386285.048	2667722.547	7,055.69	131	111-131
1CN	386285.361	2667715.709	7,055.96	60	Blank casing to 60
1CL	—	—	--	62.5	No casing
			Open-pit area		
2A1	386997.285	2668883.175	7,057.61	21	15-21
2A2	387000.317	2668883.933	7,058.08	10	7-10
2B1	387202.853	2668758.878	7,067.37	22	17.5-22
2C1	386878.052	2669364.226	7,065.63	31	26-31
2C2	386880.610	2669364.891	7,065.08	15	10-15
17A	386491.650	2669326.669	7,100.00	65	55-65

TABLE 81.--Location, altitude, depth, and perforated interval for test holes drilled with CME-750 rig--Continued

Test-hole number	Location coordinates[1]		Altitude of top of casing[1] (feet above sea level)	Depth (feet below top of casing)	
	North	East		Total	Approximate perforated interval
17B	386484.686	2669441.493	7,102.84	70	54.5-64.5
17C	386477.488	2669547.423	7,128.42	95	80-90
26	--	--	[2]7,107	60	50-60
27	--	--	[2]7,097	73	Dry hole; no casing
		Between open pit and waste dump			
14	386440.360	2668472.652	7,037.77	91	71-91
15	386598.262	2668007.534	6,992.00	31.5	19-31.5
16	386621.402	2667792.160	6,990.76	62	42-62
		Delta area			
9A	386796.279	2667454.105	6,901.33	52	47-52
9B	386796.457	2667459.366	6,900.35	25	20-25
9C	386796.789	2667464.368	6,900.55	15	10-15
10A	386989.599	2667351.441	6,893.33	50	45-50
10B	386985.898	2667351.819	6,894.51	25	20-25
10C	386981.791	2667352.803	6,893.66	15	10-15
11A	387112.655	2667248.603	6,889.51	55	50-55
11B	387117.887	2667248.052	6,889.07	30	25-30
11C	387117.205	2667212.045	6,889.48	15	10-15
18A	386878.160	2667321.350	6,895.00	47	42-47
18B	386874.842	2667319.501	6,894.11	25	20-25
18C	386871.910	2667317.647	6,895.03	15	10-15
		Upper landslide area			
3A	389303.166	2669345.127	7,062.55	118.5	108.5-118.5
3B1	388691.265	2669720.916	7,105.11	82	72-82
3B2	388686.649	2669719.280	7,105.43	25	15-25
3C	389131.196	2669636.062	7,121.86	90	80-90
3CN	389135.967	2669628.699	7,119.98	51	Blank casing to 51

TABLE 81.--Location, altitude, depth, and perforated interval for test holes drilled with CME-750 rig--Continued

Test-hole number	Location coordinates[1]		Altitude of top of casing[1] (feet above sea level)	Depth (feet below top of casing)	
	North	East		Total	Approximate perforated interval
3CL	--	--	--	50	No casing
19A	389140.055	266996.863	7,079.12	82	72-82
19B	389138.399	2669992.240	7,080.35	40	30-40
		Lower landslide area			
4	390339.338	2667990.891	6,794.03	100	80-100
5	390201.274	2668583.482	6,853.90	10.3	93-103
5A	390197.165	2668579.687	6,854.30	31	21-31
6	390105.792	2668753.565	6,897.10	32	12-32
7	389546.829	2668260.202	6,857.77	163	143-163
8	390676.355	2668797.613	6,799.05	135	125-135
8A	390670.910	2668800.116	6,799.20	49	39-49
20	390783.581	2667975.097	6,710.68	32	22-32
20A	390794.487	2667985.325	6,710.02	92	82-92
21	389704.135	2668814.630	6,941.97	45	35-45

[1] Data from Resource Concepts, Inc., Carson City, Nev. Location coordinates are based on those of DWR (California Department of Water Resources) survey points PP3C and PP4C, which in turn are tied to the California State Coordinate System. Altitudes are based on that of DWR survey point PP3C, except as indicated (footnote 2).

[2] Altitude estimated from topographic map prepared by California Regional Water Quality Control Board (scale, 1:100).

TABLE 82.--Depth, altitude, and water-level data for shallow piezometers at base of waste dump

Piezometer (row and number)	Land-surface altitude (feet above sea level)	Depth (feet below land surface)	Piezometric head (feet above bottom of hole)			
			5/13/82	5/18/83	6/24/83	8/6/83
1-2	6,908.98	7.69	3.24	2.94	2.40	1.66
1-2	6,908.98	3.53	0	0	0	0
1-3	6,908.91	16.62	13.55	12.94	12.43	12.90
1-4	6,908.79	7.69	3.37	3.50	2.56	1.76
1-5	6,908.81	12.75	9.15	8.36	7.84	7.50
1-6	6,908.75	3.60	0	0	0	0
1-7	6,908.75	6.24	1.68	1.01	.80	.16
1-8	6,908.80	7.77	3.60	3.01	2.52	1.65
1-9	6,908.91	5.72	.76	.42	0	0
2-1	6,905.58	9.21	7.91	—	7.10	6.18
2-2	6,905.60	6.33	4.19	4.32	3.48	3.00
2-3	6,905.65	12.70	4.21		10.47	3.50
2-4	6,905.61	7.69	5.78	5.47	5.06	4.22
2-5	6,905.46	14.13	12.34	12.07	11.69	11.30
2-6	6,905.51	3.72	1.43	1.18	.79	.30
3-1	6,902.84	7.90	8.10	—	7.55	6.34
3-2	6,902.67	4.00	4.00	—	3.62	.37
3-3	6,902.71	9.73	9.55	—	8.91	8.00
3-4	6,902.71	5.88	5.23	—	4.64	3.37
4-1	6,899.63	6.71	6.70	6.50	6.27	5.03
4-2	6,899.49	4.40	4.41	3.65	3.22	3.07
4-3	6,899.12	4.36	4.40	3.80	3.43	2.93
4-4	6,899.80	9.32	9.30	8.50	8.38	7.52
5-1	6,899.25	3.85	3.85	—	4.33	—
5-2	6,899.19	6.93	6.90	—	5.70	—
5-3	6,899.20	9.80	9.80	—	4.50	—

TABLE 83.—Water-level and field water-quality data for test holes drilled with CME-750 rig

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
1A	11-09-82	126.53	5.4	740	—	—	
1B	11-09-82	85.20	4.5	1,600	6.0	—	
	04-06-83	63.70	3.9	1,400	7.0	0.10	
1C	11-09-82	73.20	4.4	1,400	7.0	—	
	04-06-83	66.60	4.1	1,300	8.0	0.10	
2A1	11-08-82	1.57	2.0	13,000	10.0	—	
	11-17-82	1.51	2.1	12,000	10.0	—	
	04-06-83	0.31	1.9	13,000	8.5	0.11	
2A2	11-08-82	1.90	2.2	6,800	10.0	—	
	11-17-82	1.68	2.4	5,900	9.0	—	
	04-06-83	0.45	1.9	12,000	8.5	0.13	
2B	11-08-82	10.80	6.3	2,200	8.0	—	
	11-16-82	10.91	5.9	2,200	9.0	—	
	04-06-83	8.95	5.9	1,000	7.0	0.10	
2C1	11-08-82	10.70	4.1	8,600	8.0	—	
	11-17-82	10.91	3.8	9,400	8.5	—	
	04-06-83	9.00	3.6	8,600	10.0	0.25	
2C2	11-08-82	6.70	4.5	4,500	7.0	—	
	11-17-82	6.80	4.2	5,400	7.5	—	
	04-06-83	4.20	4.1	4,200	8.2	0.28	
3A	11-09-82	100.50	7.1	600	8.5	—	
	12-15-82	102.13	7.2	590	8.0	—	
	04-08-83	102.50	—	—	—	—	Some blockage at 20 ft

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
3B1	11-09-82	24.02	4.1	1,300	8.0	—	
	11-17-82	25.00	4.0	1,300	7.5	—	
	04-08-83	24.50	4.0	1,500	8.5	—	
3B2	11-09-82	20.50	4.2	730	—	—	
	11-17-72	21.92	4.2	860	7.5	—	
	04-08-83	19.30	4.3	620	8.0	—	
3C	11-09-82	48.00	6.1	1,300	9.0	—	
	11-17-82	47.86	6.3	900	8.5	—	
	04-08-83	56.0	6.0	1,600	7.5	—	
4	11-12-82	50.50	6.9	520	—	—	
	11-16-82	51.23	6.3	540	7.0	—	Blockage at 59.4 ft
	12-15-82	51.50	7.5	470	7.0	—	
	04-08-83	45.1	6.8	460	8.5	—	
5	04-08-83	58.3	6.6	1,800	8.0	—	Blockage at 72.5 ft 10/83
5A	11-19-82	21.25	5.4	1,300	8.0	—	
	12-15-82	22.17	5.6	1,200	7.5	—	
6	11-19-82	6.77	4.1	2,200	7.5	—	
	12-15-82	6.83	4.2	2,200	8.0	1.5	
7	11-12-82	45.67	5.7	2,800	9.5	—	
	04-08-83	45.90	7.8	420	9.5	—	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
8	11-19-82	68.50	6.6	510	7.5	—	
	11-23-82	68.32	7.3	520	8.0	—	
	04-08-83	62.8	6.4	540	9.0	—	
8A	11-19-82	21.40	6.9	—	7.5	—	
	11-23-82	21.74	7.6	600	8.0	—	
	04-08-83	21.8	6.3	580	8.5	—	
9A	11-12-82	3.64	5.1	3,800	—	—	
	11-16-82	4.35	5.3	3,100	8.5	—	
	11-29-82	5.90	5.8	3,000	—	—	
9B	11-12-82	1.15	4.6	4,500	—	—	
	11-16-82	1.15	4.3	4,100	8.0	—	
	11-29-82	2.0	4.7	4,400	—	—	
9C	11-12-82	1.17	3.8	4,900	—	—	
	11-16-82	1.51	3.4	5,000	8.0	—	
10A	11-12-82	0.50	6.0	2,200	—	—	
	11-16-82	flowing	5.7	2,000	9.5	—	
	11-29-82	flowing	6.2	1,400	8.5	—	
10B	11-12-82	flowing	5.1	2,400	—	—	
	11-16-82	flowing	4.9	2,300	9.5	—	
10C	11-12-82	0.45	5.5	2,800	—	—	
	11-16-82	flowing	5.4	3,000	9.5	—	
11A	11-12-82	0.57	5.9	2,100	—	—	
	11-16-82	3.55	5.6	2,100	8.0	—	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
11B	11-12-82	0.23	4.9	5,500	—	—	
	11-16-82	2.29	4.7	6,100	7.0	—	
11C	11-12-82	1.84	4.9	4,800	—	—	
	11-16-82	1.13	4.8	4,800	8.0	—	
14	10-26-82	32.13	2.6	5,400	—	--	
	04-06-83	27.7	3.0	5,400	11.0	0.08	
15	11-17-82	17.54	4.0	3,900	8.0	—	
16	11-08-82	50.12	4.0	2,900	7.0	—	
	11-16-82	51.24	4.0	3,100	7.0	—	
	04-06-83	49.73	4.1	2,700	7.0	0.12	
17A	11-08-82	50.40	2.5	4,100	—	—	
	11-17-82	50.59	2.6	3,800	11.0	—	
17B	11-08-82	46.00	6.2	2,800	—	--	
	11-17-82	45.95	6.0	3,000	8.0	—	
17C	11-08-82	80.00	4.4	2,600	—	--	
	11-17-82	72.53	4.2	3,000	11.0	—	
18A	11-12-82	0.23	4.8	2,300	—	--	
	11-16-82	flowing	4.2	2,300	7.0	—	
	11-29-82	flowing	4.5	2,200	7.0	—	
18B	11-12-82	0.14	4.5	—	—	--	
	11-16-82	0.20	4.2	2,900	7.0	—	
	11-19-82	0.83	4.3	3,400	7.0	—	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
18C	11-12-82	0.76	6.1	3,300	—	—	
	11-16-82	1.74	5.4	3,200	7.0	—	
	11-29-82	1.65	5.5	3,100	7.0	—	
19A	11-09-82	24.90	4.6	2,500	9.0	—	
	12-15-82	26.25	5.1	1,900	7.5	—	
19B	11-09-82	18.90	4.0	2,600	9.0	—	
	12-15-82	19.00	3.8	2,500	8.0	—	
20	11-12-82	2.91	6.6	1,700	—	—	
	12-10-82	2.80	6.6	1,400	5.0	0.9	
	04-08-83	2.40	6.7	1,400	7.5	—	
20A	11-12-82	45.31	6.7	660	—	—	
	12-10-82	45.00	6.9	480	7.5	0.9	
	04-08-83	40.6	6.5	680	8.5	—	
21	11-15-82	39.10	6.9	2,050	6.0	—	
	12-15-82	39.21	7.0	1,700	7.0	—	
	04-08-83	39.1	6.8	1,700	7.0	—	Blockage at 66.2 ft
22	11-08-82	67.57	7.3	610	6.0	—	
	04-06-83	66.5	6.7	890	—	0.05	
23A	11-15-82	50.49	6.2	1,600	5.0	—	
	12-17-82	50.92	6.3	1,000	5.5	—	
24	11-08-82	50.54	7.0	850	7.0	—	
	12-17-82	51.17	7.0	660	6.0	—	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
25	11-09-82	98.03	4.6	1,400	7.0	—	
	12-17-82	97.90	4.3	1,500	5.0	—	
26	11-08-82	84.42	1.8	18,000	7.0	—	
	11-17-82		1.8	22,000	13.0	—	
31	10-25-82	122.05	6.4	300	—	--	
32	10-25-82	40.37	5.1	360	—	--	
	04-06-83	39.4	4.4	300	—	0.20	
33	10-20-82	27.31	5.4	460	—	--	

TABLE 84.--Field water-quality data for water from shallow piezometers at base of waste dump

[Sample dates: row 1, July 7, 1982; rows 2-5, July 1, 1982]

Piezometer (row and number)	Water temperature (°C)	pH (units)	Specific conductance (umhos/cm)
1-1	—	3.3	2,200
1-2	(a)	(a)	(a)
1-3	—	3.3	2,600
1-4	—	3.2	2,400
1-5	—	3.5	2,200
1-6	(a)	(a)	(a)
1-7	—	2.9	2,600
1-8	8.3	2.9	2,900
1-9	—	(a)	(a)
2-1	10.0	2.6	2,700
2-2	11.0	2.6	2,600
2-3	9.0	3.1	2,300
2-4	10.0	2.4	2,800
2-5	9.4	3.1	2,300
2-6	(a)	(a)	(a)
3-1	10.0	2.7	2,500
3-2	11.0	2.6	2,600
3-3	9.3	2.7	2,600
3-4	12.0	2.8	3,100
4-1	12.0	3.3	3,300
4-2	9.7	3.0	3,400
4-3	(a)	(a)	(a)
4-4	8.5	3.0	3,100
5-1	12.5	3.7	2,200
5-2	10.0	3.3	3,300
5-3	8.5	3.2	3,300

[a] Piezometer dry at time of measurements.

TABLE 85.--Analyses of water samples from piezometers drilled with CME-750 rig

Analyses	Piezometer I.D.										
	1A	1B	1C	2A1	2A2	2C1	2C2	3B1	3C	4	5A
	Date Sampled										
	11-09-82	11-09-82	11-09-82	11-17-82	11-17-82	11-17-82	11-17-82	11-09-82	11-09-82	11-16-82	11-19-82
Acidity as H mg/l	2.8	12	2.8	194	70	170	0.6	4.1			6.2
pH (Lab) units	5.4	3.2	4.2	2.1	2.8	3.3	4.4	4.1		7.3	5.8
pH (Field) units	5.4	4.5	4.4	2.1	2.4	3.8	4.2	4.1	6.1	6.3	5.4
Specific Conductance (Field) umhos/cm	740	1600	1400	12000	5900	9400	5400	1300	1300	540	1300
Specific Conductance (Lab) umhos/cm	941	1720	1400	10800	5050	10900	5720	1510		487	1180
Water Temp. °C		6.0	7.0	10.0	9.0	8.5	7.5	8.0	9.0	7.0	8.0
Aluminum mg/l	1.6	25	9	770	270	760	130	32	< 0.1	< 0.1	0.4
Arsenic ug/l	150	130	11	33000	8400	22000	110	31	23	11	2
Barium ug/l	26	14	18	36	33	30	25	32	38	35	18
Beryllium ug/l	3	5	5	29	20	68	55	< 0.5	0.9	< 0.5	< 0.5
Cadmium ug/l	5	6	3	310	68	240	30	< 1	1	< 1	< 1
Calcium mg/l	72	140	150	310	350	390	410	250	150	11	170
Chloride mg/l	2.1	1.4	3.4	< 0.1	2.9	34	2.0	2.1		3.5	4.9
Chromium ug/l	< 10	10	< 10	2500	930	870	40	10	< 10	< 10	< 10
Cobalt ug/l	88	140	170	6600	1400	7500	2400	5	35	14	3
Copper ug/l	10	10	< 10	180	110	420	130	< 10	< 10	< 10	40
Iron (Fe^{+2}+Fe^{+3}) mg/l	70	230	140	240	870	2600	960	.021	29	.11	.010
Lead ug/l	10	< 10	< 10	< 50	< 30	< 50	< 30	10	< 10	< 10	< 10
Lithium ug/l	30	32	36	270	160	700	650	30	44	34	35
Magnesium mg/l	14	25	29	120	95	360	400	80	53	2.9	39
Manganese ug/l	5000	7800	13000	12000	12000	28000	62000	4000	7200	190	820
Molybdenum ug/l	< 10	< 10	< 10	< 50	< 30	< 50	< 30	< 10	10	< 10	< 10
Nickel ug/l	200	500	200	18000	5200	16000	5800	500	< 100	< 100	< 100
Silica mg/l	32	38	23	120	120	110	59	16	24	18	39
Sodium mg/l	11	13	19	60	34	680	26	46	34	80	34
Strontium ug/l	460	350	100	4700	2800	6400	380	2500	740	110	1100
Sulfate mg/l	380	990	840	11000	4800	13000	5400	930		69	660
Thallium ug/l	4	5	10	45	60	140	11	13	< 1	< 1	6
Vanadium ug/l	16	86	23	2300	850	1400	210	< 6	< 6	< 6	< 6
Zinc ug/l	100	310	590	3000	1600	8900	3400	27	91	12	58

TABLE 85.--Analyses of water samples from piezometers drilled with CME-750 rig--Continued

Analyses	Piezometer I.D.										
	6	7	8	8A	9A	9B	9C	10A	10B	10C	14
	Date Sampled										
	11-19-82	11-12-82	11-23-82	11-23-82	11-16-82	11-16-82	11-16-82	11-16-82	11-16-82	11-16-82	10-22-82
Acidity as H mg/l	4.1	2.0			14	40	56		7.0	2.6	110
pH (Lab) units	4.3	5.6	7.1	8.2	4.8	3.6	3.5	4.4	4.7	5.5	3.4
pH (Field) units	4.1	5.7	7.3	7.6	5.3	4.3	3.4	5.7	4.9	5.4	2.6
Specific Conductance (Field) umhos/cm	2200	2800	520	600	3100	4100	5000	2000	2300	3000	5400
Specific Conductance (Lab) umhos/cm	2280	2770	512	570	3170	4520	4800	1900	2280	2840	6010
Water Temp. °C	7.5		8.0	8.0	8.5	8.0	8.0	9.5	9.5	9.5	
Aluminum mg/l	29	0.1	< 0.1	< 0.1	1.1	68	160	< 0.1	6.5	200	580
Arsenic ug/l	< 1	700	5	12	87	270	4900	5	600	59	8
Barium ug/l	21	26	110	120	16	9	12	21	13	8	29
Beryllium ug/l	4.8	2	< 0.5	< 0.5	0.6	18	26	< 0.5	3	< 1.5	27
Cadmium ug/l	3	5	< 1	< 1	10	24	47	3	< 3	< 3	300
Calcium mg/l	370	180	35	26	340	440	430	300	310	510	390
Chloride mg/l	1.8	11	3.9	2.5	4.5	2	1.8	2.9	3.7	3.4	3.9
Chromium ug/l	10	< 10	< 10	< 10	10	30	210	10	20	10	50
Cobalt ug/l	360	280	< 3	< 3	1000	1100	3200	290	230	69	10000
Copper ug/l	310	10	< 10	10	10	40	50	< 10	< 30	< 30	6800
Iron (Fe^{+2}+Fe^{+3}) mg/l	.410	80	.017	.004	380	910	980	52	150	120	1200
Lead ug/l	< 30	10	< 10	< 10	40	< 30	< 30	10	60	< 30	< 30
Lithium ug/l	95	50	26	30	65	170	190	45	66	180	190
Magnesium mg/l	98	14	12	17	92	190	160	74	99	110	100
Manganese ug/l	16000	4400	130	31	34000	35000	31000	13000	6500	29000	68000
Molybdenum ug/l	< 30	< 30	10	< 10	< 10	< 30	30	< 10	< 30	< 30	< 30
Nickel ug/l	600	1000	< 100	< 100	1300	4000	8300	400	600	400	22000
Silica mg/l	40	11	17	16	23	27	110	25	37	11	130
Sodium mg/l	24	370	55	70	130	40	40	28	34	38	37
Strontium ug/l	1400	2200	730	900	2800	1600	1500	3300	2200	410	4600
Sulfate mg/l	1600	1500	150	110	2200	4100	4500	1200	1600	2000	7000
Thallium ug/l	11	11	< 1	< 1	22	33	120	1	< 1	7	62
Vanadium ug/l	< 18	13	< 6	< 6	50	270	470	< 6	42	< 18	460
Zinc ug/l	540	560	26	12	400	740	1900	41	98	110	2200

TABLE 85.--Analyses of water samples from piezometers drilled with CME-750 rig--Continued

Analyses	Piezometer I.D.										
	15	16	17A	17B	17C	20	21	23A	24	25	26
	Date Sampled										
	11-17-82	11-16-82	11-17-82	11-17-82	11-17-82	11-12-82	11-15-82	11-15-82	11-08-82	11-09-82	11-17-82
Acidity as H mg/l	55	17	45		15					0.2	275
pH (Lab) units	3.9	3.8	2.7	6.4	3.9	7.7	7.7	6.9	7.2	4.9	1.6
pH (Field) units	4.0	4.0	2.6	6.0	4.2	6.6	7.0	6.2	7.0	4.6	1.8
Specific Conductance (Field) umhos/cm	3900	3100	[illegible]	[illegible]	3000	[illegible]	[illegible]	[illegible]	850	1400	22000
Specific Conductance (Lab) umhos/cm	4830	3100	2950	3180	3140	1740	1870	1490	910	1620	18000
Water Temp. °C	8.0	7.0	11.0	8.0	11.0		6.0	5.0	7.0	7.0	13.0
Aluminum mg/l	150	24	190	0.1	100	<0.1	<0.1	<0.1	<0.1	1	1100
Arsenic ug/l	1	56	16000	270	320	11	2	2	8	2	35000
Barium ug/l	23	15	13	29	16	70	33	23	35	14	44
Beryllium ug/l	18	11	7	<0.5	26	0.9	0.7	<0.5	<0.5	8	28
Cadmium ug/l	77	9	70	1	9	<1	<1	1	<1	4	230
Calcium mg/l	450	430	74	700	460	250	370	66	130	200	99
Chloride mg/l	2.8	1.6	1.8	7.2	1.5	7.7	4.3	74	20	5	<0.1
Chromium ug/l	80	10	590	10	50	<10	10	<10	<10	<10	3200
Cobalt ug/l	3700	790	2100	210	530	6	<3	32	42	220	8400
Copper ug/l	410	50	350	<10	1800	20	<10	<10	<10	1200	5500
Iron (Fe^{+2}+Fe^{+3}) mg/l	860	340	530	15	54	.13	.059	2.2	2	5.1	2200
Lead ug/l	<30	50	<30	<10	<30	<10	<10	<10	<10	<10	100
Lithium ug/l	150	150	58	86	140	6	43	43	43	54	310
Magnesium mg/l	170	97	23	110	100	83	58	17	18	55	46
Manganese ug/l	19000	23000	4600	25000	40000	180	140	1200	3500	6100	5200
Mercury ug/l											
Molybdenum ug/l	<30	<30	<30	<10	<30	<10	<10	<10	<10	<10	<100
Nickel ug/l	8000	2400	5800	200	1500	<100	<100	<100	<100	100	24000
Silica mg/l	92	41	89	14	51	58	39	39	34	45	150
Sodium mg/l	58	23	23	28	54	47	21	220	25	10	22
Strontium ug/l	3800	970	1700	1500	1400	80	2900	890	390	670	4900
Sulfate mg/l	4600	2300	2500	1600	2600	840	890	520	200	40	14000
Thallium ug/l	53	30	220	3	18	<1	<1	2	<1	5	6000
Vanadium ug/l	160	58	470	<6	<18	<6	<6	<6	<6	<6	2900
Zing ug/l	11000	710	1100	250	1400	21	17	52	59	500	45000

TABLE 85.--Analyses of water samples from piezometers drilled with CME-750 rig--Continued

Analyses	Piezometer I.D.		
	31	32	33
	Date Sampled		
	10-[illegible]-82	10-[illegible]-82	10-[illegible]-82
Acidity as H mg/l		0.2	
pH (Lab) units	7.4	4.5	6.3
pH (Field) units	6.4	5.1	5.4
Specific Conductance (Field) umhos/cm	[illegible]	[illegible]	460
Specific Conductance (Lab) umhos/cm	253	300	387
Water Temp. °C			
Aluminum mg/l	<0.1	1	<0.1
Arsenic ug/l	8	3	4
Barium ug/l	91	46	76
Beryllium ug/l	<0.5	<0.5	3
Cadmium ug/l	<1	<1	2
Calcium mg/l	23	21	33
Chloride mg/l	2.1	1.9	1.5
Chromium ug/l	<10	<10	<10
Cobalt ug/l	9	24	9
Copper ug/l	<10	20	20
Iron (Fe^{+2}+Fe^{+3}) mg/l	.033	.85	.21
Lead ug/l	<10	40	<10
Lithium ug/l	27	32	26
Magnesium mg/l	7.9	3.2	9.2
Manganese ug/l	49	250	480
Molybdenum ug/l	<10	<10	<10
Nickel ug/l	<100	<100	<100
Silica mg/l	55	73	80
Sodium mg/l	12	15	23
Strontium ug/l	320	240	320
Sulfate mg/l	22	120	140
Thallium ug/l	<1	2	<1
Vanadium ug/l	<6	<6	<6
Zinc ug/l	12	130	73

TABLE 86.--Data from hydraulic-conductivity tests on piezometers drilled with CME-750 rig

[August 16-18, 1982, except as indicated]

Test-hole number	Length of perforated interval (feet)	Piezometric head before test (feet above bottom of hole)	Hydraulic conductivity (feet per day)
1A	40	73.50	[a]2.0
1C	20	47.33	1
2A1	6	19.50	19
2A2	3	8.33	26
2B1	4.5	11.00	.2
2C1	5	10.50	.02
2C2	5	8.00	.8
3A	10	[c]16.37	1.3
3B1	10	[c]57.00	1.9
3C	10	[c]42.12	.4
4	20	48.70	.5
5A	10	8.83	16
6	20	24.75	2.3
7	20	115.42	.4
8	10	65.92	.2
8A	10	25.00	.1
9A	5	47.83	.5
9B	5	24.00	1.4
9C	5	14.58	1.6
10A	5	50	[b]1.4
10B	5	25	[b]4.3
10C	5	15	[b]4.7
11A	5	54.12	.5
11B	5	29.75	.4
11C	5	13.12	.01
14	10	58.58	.8
15	12.5	14.00	.4
17A	10	14.67	.6
17B	10	25.54	.7
17C	10	21.92	1
18A	5	47	[b]5.2
18B	5	24.75	.4
18C	5	14.21	.05
19A	10	55.37	2.2
19B	10	21.00	2
20	10	[c]29.25	.4
20A	10	[c]47.12	1
21	10	5.83	6.2
22	10	23.67	.7
24	10	14.00	1.3
25	10	16.75	1.9
31	30	35.5	[a]5.3
32	15	88.25	1.6
33	40	94.42	1.4

[a] Alternative method used to calculate hydraulic conductivity (see text).

[b] Piezometer flowing before test.

[c] December 15, 1982.

TABLE 87.—Data from hydraulic-conductivity tests on shallow piezometers at base of waste dump

[Row 1, May 17, 1982; row 2, May 18, 1982; rows 3 and 4, June 25, 1982; row 5, June 28, 1982]

Piezometer (row and number)	Length of perforated interval (feet)	Piezometric head before test (feet above bottom of hole)	Hydraulic conductivity (feet per day)
1-1	0.5	2.92	0.11
1-2	.5	dry	—
1-3	3.3	12.86	.1
1-4	.5	3.20	.8
1-5	3.3	8.31	[a].5
1-6	.5	dry	—
1-7	.5	.80	[a]1.0
1-8	.5	3.20	[a]1.8
1-9	.5	.36	2.3
2-2	.5	4.32	.8
2-4	.5	5.47	.5
2-5	1.7	11.69	[a].2
2-6	.5	1.18	.1
3-1	.5	7.53	.1
3-2	.5	3.63	.6
3-3	.5	8.91	[a].06
3-4	.5	4.65	[a].05
4-1	.5	6.27	.6
4-2	.5	4.23	[a].05
4-3	.5	3.46	[a].04
4-4	.5	8.39	.5
5-1	1.7	4.05	.08
5-2	1.7	5.72	.2
5-3	1.7	4.52	.4

[a] Alternative method used to calculate hydraulic conductivity (see text).

TABLE 88.--Water content and bulk density of cores from test holes drilled with CME-750 rig

Test-hole number	Depth (feet below land surface)	Water Content (by weight)	Bulk Density (grams/cm^3)
IA	5	(a)	(a)
	10	(b)	(b)
	15	.43	1.0
	20	.35	1.31
	25	.32	1.5
	30	.26	1.43
	38	.30	1.33
	50	.26	(c)
	60	.23	1.39
	70	.34	1.37
	80	.25	1.45
	90	.28	1.2
	100	(b)	(b)
IAN	5	0.34	1.27
	10	(a)	(a)
	15	.34	1.33
	20	.44	(c)
	25	.29	1.81
	30	.20	1.2
	40	.33	1.5
	50	.22	2.13
	60	.28	1.58
	70	.40	1.53
	80	.23	1.57
	90	.44	(c)
	100	.34	1.61
IAL	20	0.36	1.48
	40	(b)	(b)
	60	.39	1.09
	80	.18	1.38
	100	.40	1.09
IB	5	0.31	1.62
	10	.23	(c)
	18	.38	1.30
	30	.41	1.32
	40	.28	(c)
	60	.34	1.1
	80	.38	1.3
	90	.35	1.78
	110	.29	1.67

TABLE 88.—Water content and bulk density of cores from test holes drilled with CME-750 rig--Continued

Test-hole number	Depth (feet below land surface)	Water Content (by weight)	Bulk Density (grams/cm^3)
IBN	5	0.13	1.7
	10	.39	1.18
	15	.37	1.1
	20	.40	1.15
	25	.21	1.4
	30	.33	1.3
	40	.35	1.2
	50	.32	1.7
	60	.29	1.42
IBL	20	0.22	1.26
	40	.26	1.19
	60	.29	1.02
IC	5	0.47	1.54
	10	.43	(c)
ICN	10	0.38	1.27
	15	.38	1.02
	20	.43	1.18
	25	.40	1.94
	30	.37	1.00
	40	.37	1.14
	50	.27	1.81
	60	.26	2.13
ICL	20	0.44	1.21
	40	.28	1.49
	60	.26	1.79
2CI	10	0.53	1.27
	20	.58	1.42
3B1	5	0.25	1.10
	10	.32	1.50
	20	.36	(c)
	25	.34	1.30
	30	.38	(c)
	40	.42	1.16
	50	.50	1.1
	60	.32	0.94
	70	.35	1.1
	80	.28	1.3

TABLE 88.—Water content and bulk density of cores from test holes drilled with CME-750 rig--Continued

Test-hole number	Depth (feet below land surface)	Water Content (by weight)	Bulk Density (grams/cm^3)
3C	5	0.36	0.8
	10	.55	.9
	15	.52	.9
	20	.46	1.16
	25	.41	1.20
	30	.45	1.29
	40	.43	(c)
	50	.42	1.36
3CN	10	0.70	1.64
	19	.29	(c)
	39	0.42	1.21
	49	.35	1.70
4	10	0.58	0.77
	15	.15	1.42
	20	.55	.93
	25	.42	.97
	30	.18	1.68
	40	.26	1.28
	60	.31	1.61
	70	.27	1.66
	80	.24	1.50
			0.73
5	5	0.50	1.20
	10	.41	1.04
	15	.51	1.30
	20	.37	1.36
	25	.37	1.70
	30	.26	1.37
	40	.30	1.55
	50	.22	(b)
	80	(b)	
5A	25	0.21	1.60
	30	.08	1.7
6	5	0.72	0.8
	10	.60	1.02
	15	.47	1.07
	20	.47	1.18
	25	.43	1.36
	30	.47	1.21

TABLE 88.--Water content and bulk density of cores from test holes drilled with CME-750 rig--Continued

Test-hole number	Depth (feet below land surface)	Water Content (by weight)	Bulk Density (grams/cm^3)
8	5	0.20	1.39
	15	.24	1.53
	20	.21	(c)
14	80	0.26	1.39
16	20	0.34	(c)
	40	.37	1.35
	60	.27	1.60
19A	10	0.45	1.3
	20	.43	1.2
	30	.38	1.27
	40	.46	1.2
	50	.37	1.1
20	5	0.49	(c)
	10	(b)	(b)
	15	.36	(c)
	20	.47	1.17
	25	.52	1.06
20A	30	0.35	1.48
	40	(b)	(b)
	50	.37	1.00
	60	.30	1.38
21	6	0.51	1.15
	8	.43	1.1
	10	.25	1.33
	12	.22	1.53
	14	.20	1.47
22A	60	0.21	1.4

[a] Sample was unconsolidated and had dried out.

[b] Six-inch unsegmented sample was saved for other hydraulic tests.

[c] Core contained irregularly shaped rocks protruding from core surface; this excess volume could not be estimated.

TABLE 89.--General mineralogy of selected cores from piezometers drilled with CME-750 rig

Test-hole number	Depth of core (feet below land surface)	Semiquantitative determinations			
		Major	Moderate	Minor	Trace
1B	5	Plagioclase Smectite	Alunite Goethite	--	Chlorite
	18	Quartz Smectite	Sanidine Goethite Alunite	Pyrite Chlorite [a]Halloysite	--
	40	Smectite Tridymite	Sanidine Goethite	Gypsum Pyrite	--
	60	Smectite	--	--	Chlorite
	80	Tridymite Kaolinite	Pyrite	--	[a]Quartz
1C	90	Tridymite	Kaolinite Stilpnomelane	Pyrite	--
10	120	Smectite	--	--	Plagioclase or Sanidine Goethite [a]Celestite
3A	[b]50-69	Plagioclase Calcite Smectite	--	Pyroxene	--
	[b]89-98	Plagioclase Calcite	Smectite	Pyroxene	--
3B1	15	Quartz	Pyroxene	Anatase Chlorite	--
	50	Opal-CT	Quartz Pyroxene	Anatase Kaolinite	-- --
	80	Quartz	--	Anhydrite Elemental sulfur Pyrite [a]Hermatite [a]Jarosite	--

TABLE 89.--General mineralogy of selected cores from piezometers drilled with CME-750 rig--Continued

Test-hole number	Depth of core (feet below land surface)	Semiquantitative determinations			
		Major	Moderate	Minor	Trace
3C	5	Tridymite Smectite	Kaolonite Chlorite Alunite	Natrojarosite Quartz	Pyrite
	10	Smectite	Goethite	Chlorite or Kaolinite Sanidine	--
	20	Smectite	--	Sanidine	--
	30	Smectite	--	Gypsum	Sanidine
	50	Smectite	--	Kaolinite Sanidine Geothite Pyrite	--
	70	Quartz	--	--	Pyrite Anhydrite Illite [a]Acmite-Augite [b]Amphibole
	73	Quartz	--	[a]Anatase	--
	80	Smectite	Plagioclase or Sanidine	Quartz Geothite	--
4	40	Plagioclase Calcite Smectite	--	Pyroxene	--
	90	Plagioclose Calcite	Smectite Quartz Pyroxene	--	--
5	103	Plagioclase Smectite Orthoclase	Calcite	Pyroxene Muscovite	--

TABLE 89.--General mineralogy of selected cores from piezometers drilled with CME-750 rig--Continued

Test-hole number	Depth of core (feet below land surface)	Semiquantitative determinations			
		Major	Moderate	Minor	Trace
20	20	Quartz Plagioclase	Smectite	Kaolmite [a]Pyrite	--
20A	40	Plagioclase Smectite	Pyroxene	[a]Pentlandite [a]Rhodochrosite	--
	90.5	Plagioclase	Smectite Quartz Pyroxene	Muscovite	--
21	10	Plagioclase Smectite	Pyroxene	Quartz Calcite	--
	23	Plagioclase Calcite	Smectite	--	--
	29	Plagioclase	Pyroxene Smectite	Calcite	--
	37	Cristobalite Plagioclase	Smectite	--	--
	43	Plagioclase Calcite	Smectite	Corellite	--

[a] Some uncertainty in mineral identification.

[b] Composite sample of return cuttings from auger flights.

TABLE 90.--Clay mineralogy of selected cores from piezometers drilled with CME-750 rig

Test-hole number	Depth of core (feet below land surface)	Percent of total clay content in size fraction smaller than 2 micrometers		
		Smectite	Kaolinite	Illite
3A	25	77	23	0
3A	30	[a]100	0	0
3B1	30	83	17	0
4	80	79	0	21
5	50	[b]100	0	0
5	100	[a]100	0	0
20	10	94	6	0
20	25	77	23	0
20A	60	100	0	0
20A	90.5	100	0	0
21	23	100	0	0
21	37	100	0	0
21	43	100	0	0

[a] Regularly stratified mixed-layer smectites.

[b] Sample was dominated by carbonate minerals.

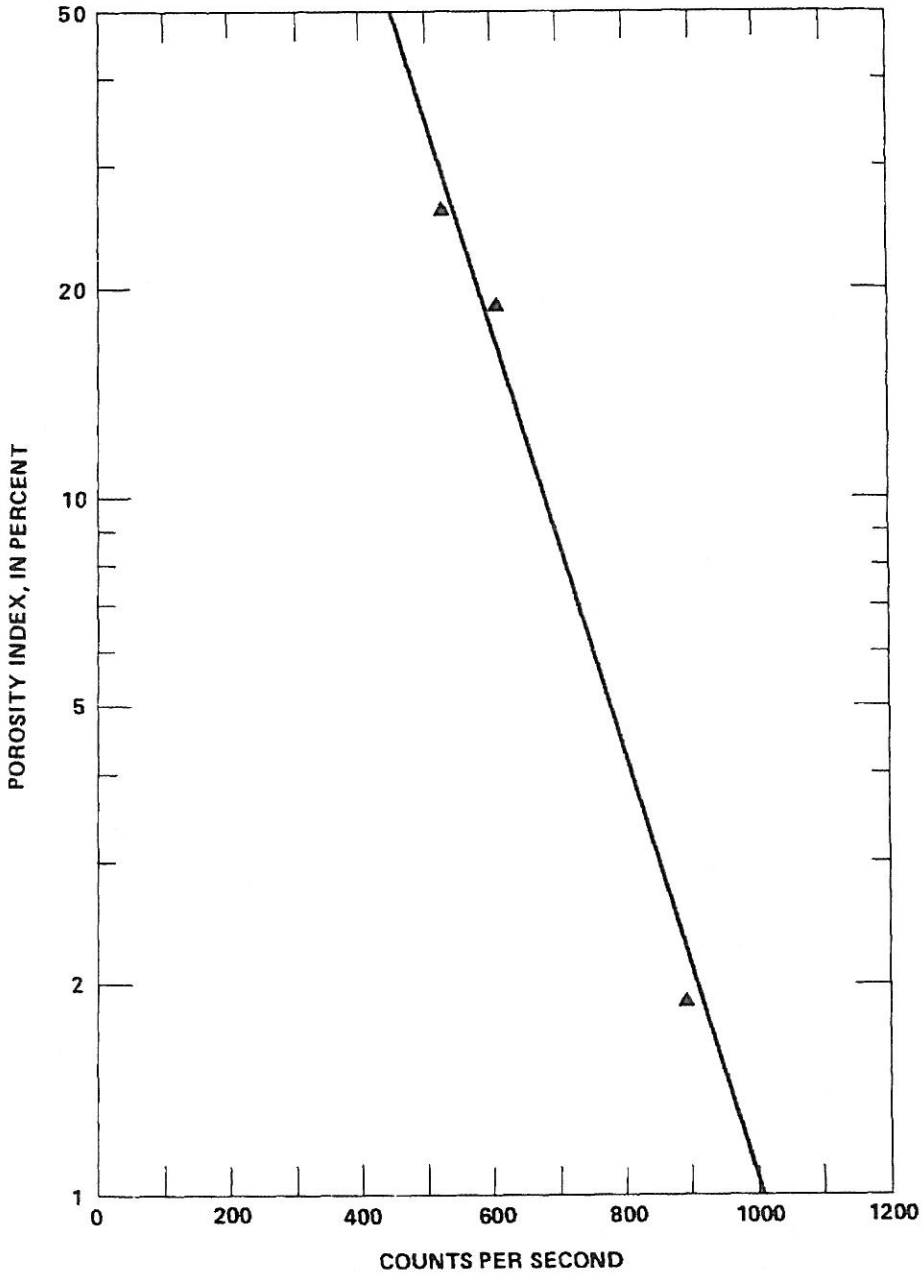


FIGURE 6.--Calibration curve for neutron-porosity logs.

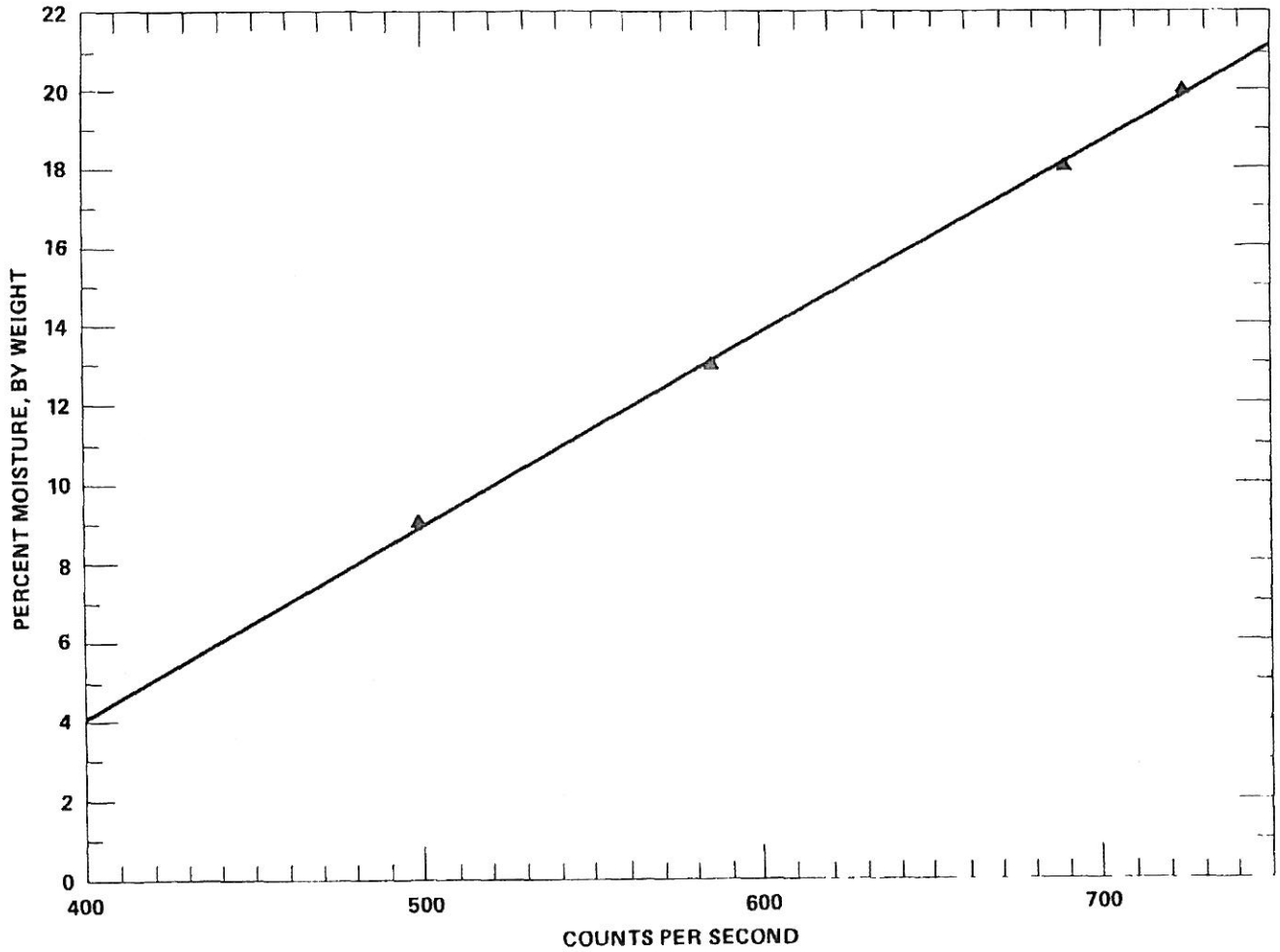


FIGURE 7.--Calibration curve for neutron-moisture logs.

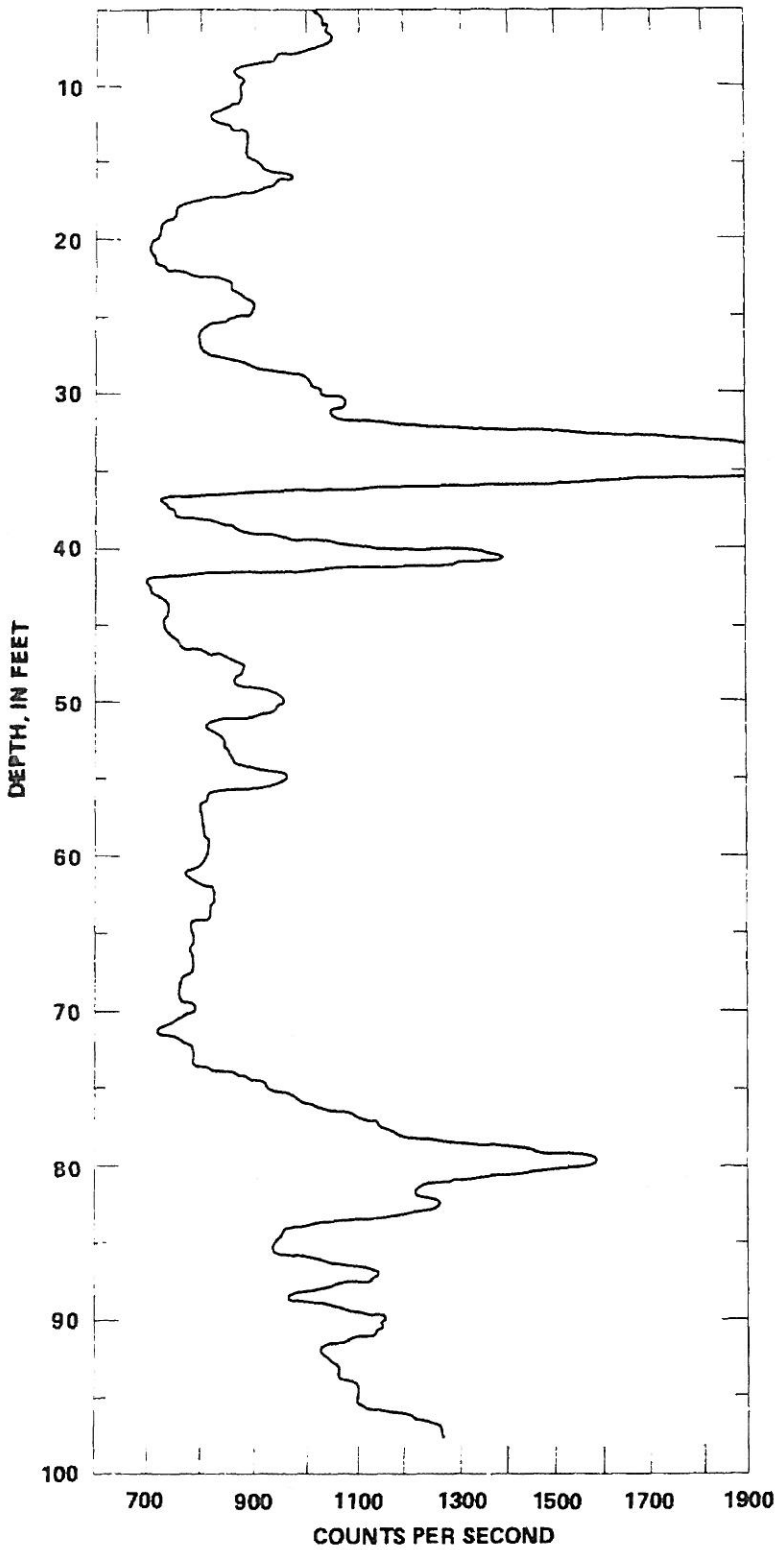


FIGURE 8.–Neutron-porosity log, test hole 1AN.

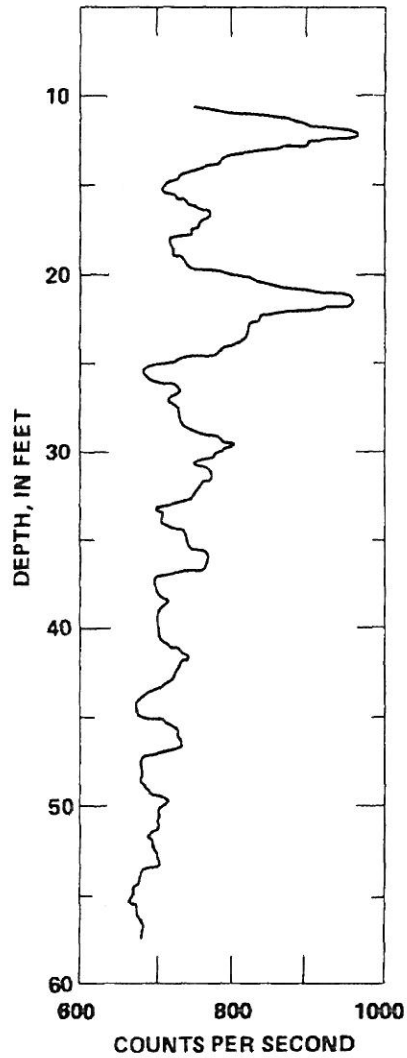


FIGURE 9.–Neutron-porosity log, test hole 1BN.

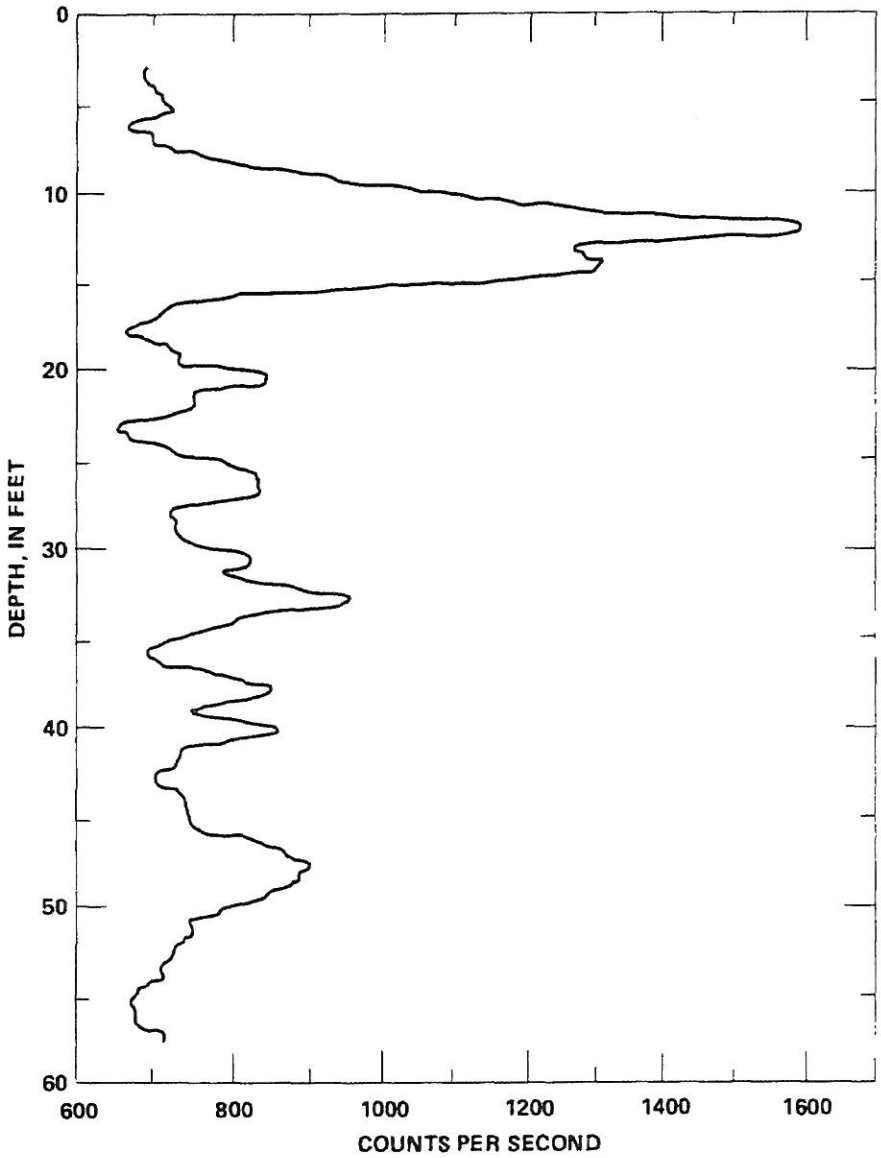


FIGURE 10.--Neutron-porosity log, test hole 1CN.

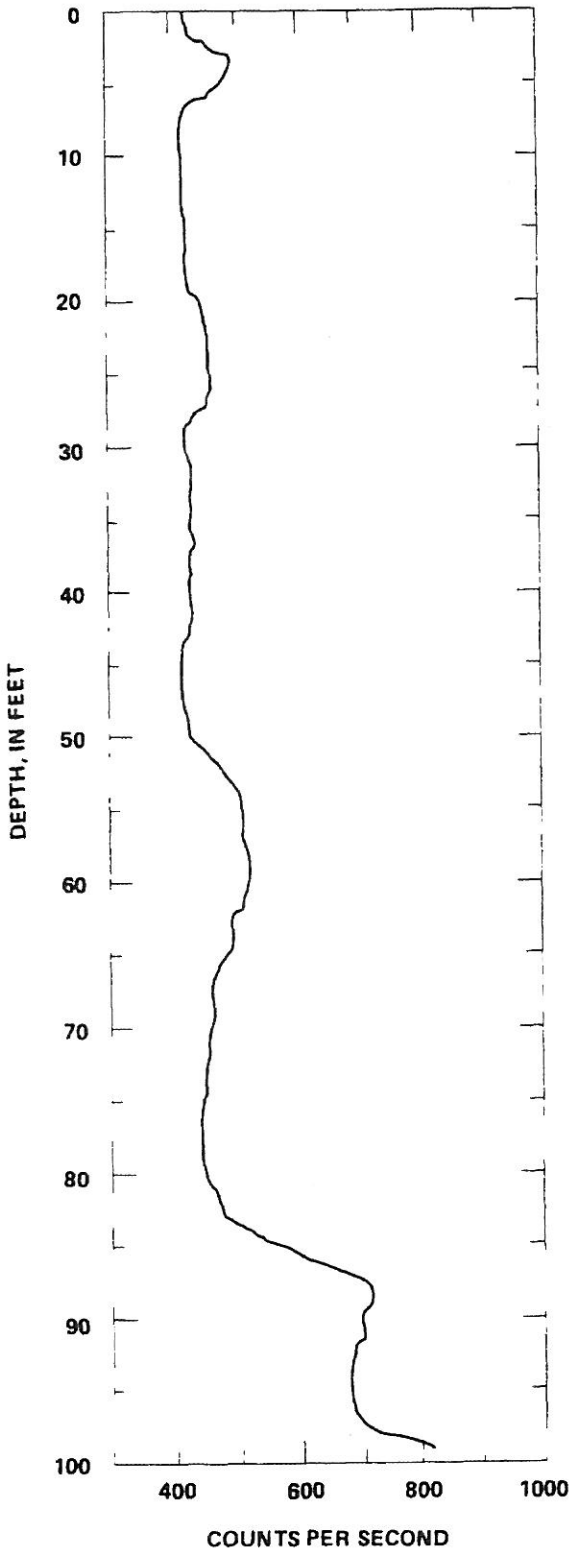


FIGURE 11.--Neutron-moisture log, test hole 1AN.

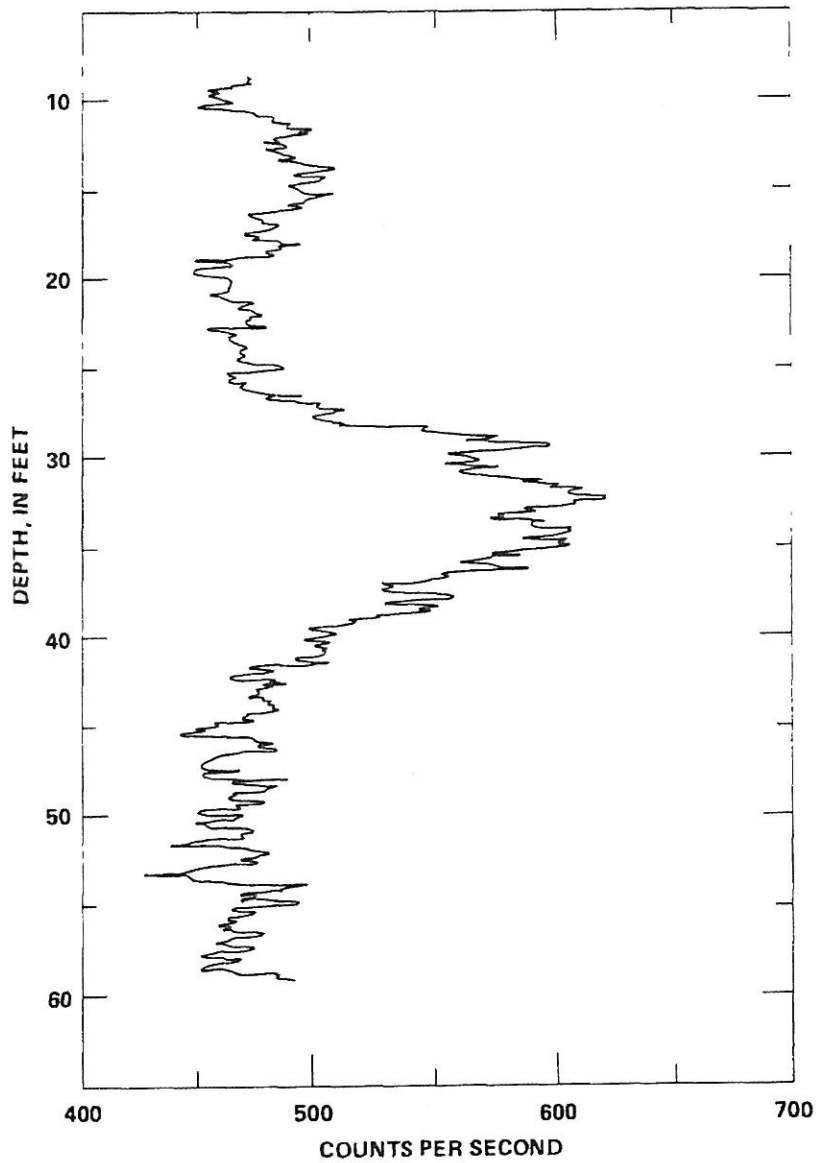


FIGURE 12.--Neutron-moisture log, test hole 1BN.

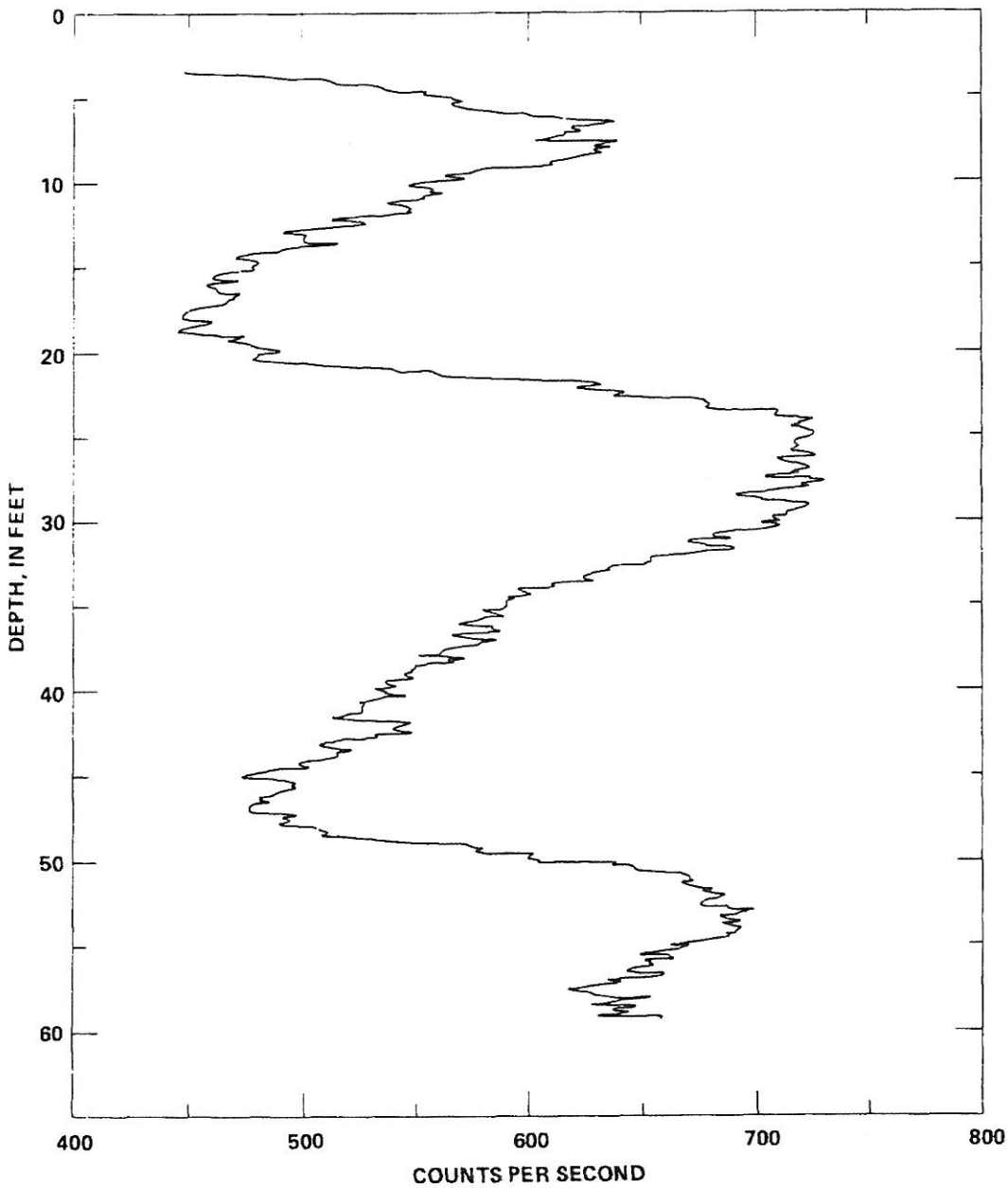


FIGURE 13.--Neutron-moisture log, test hole 1CN.

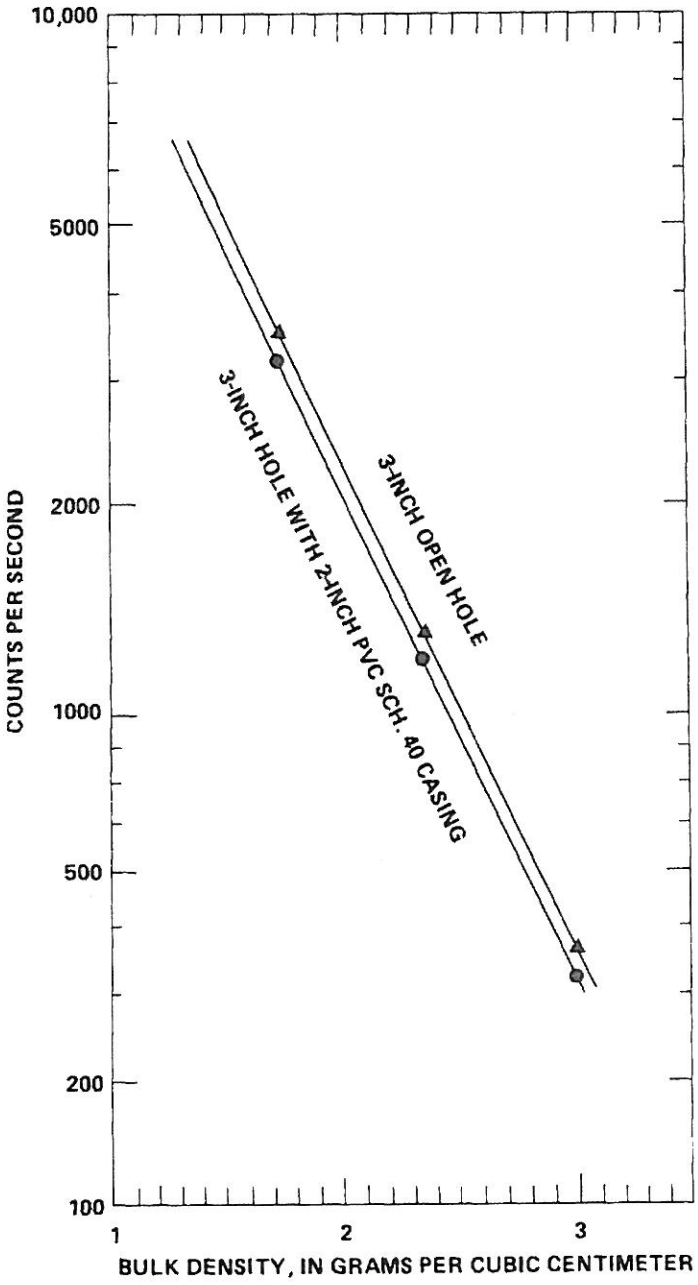


FIGURE 14.--Calibration curves for gamma-gamma log versus bulk density.

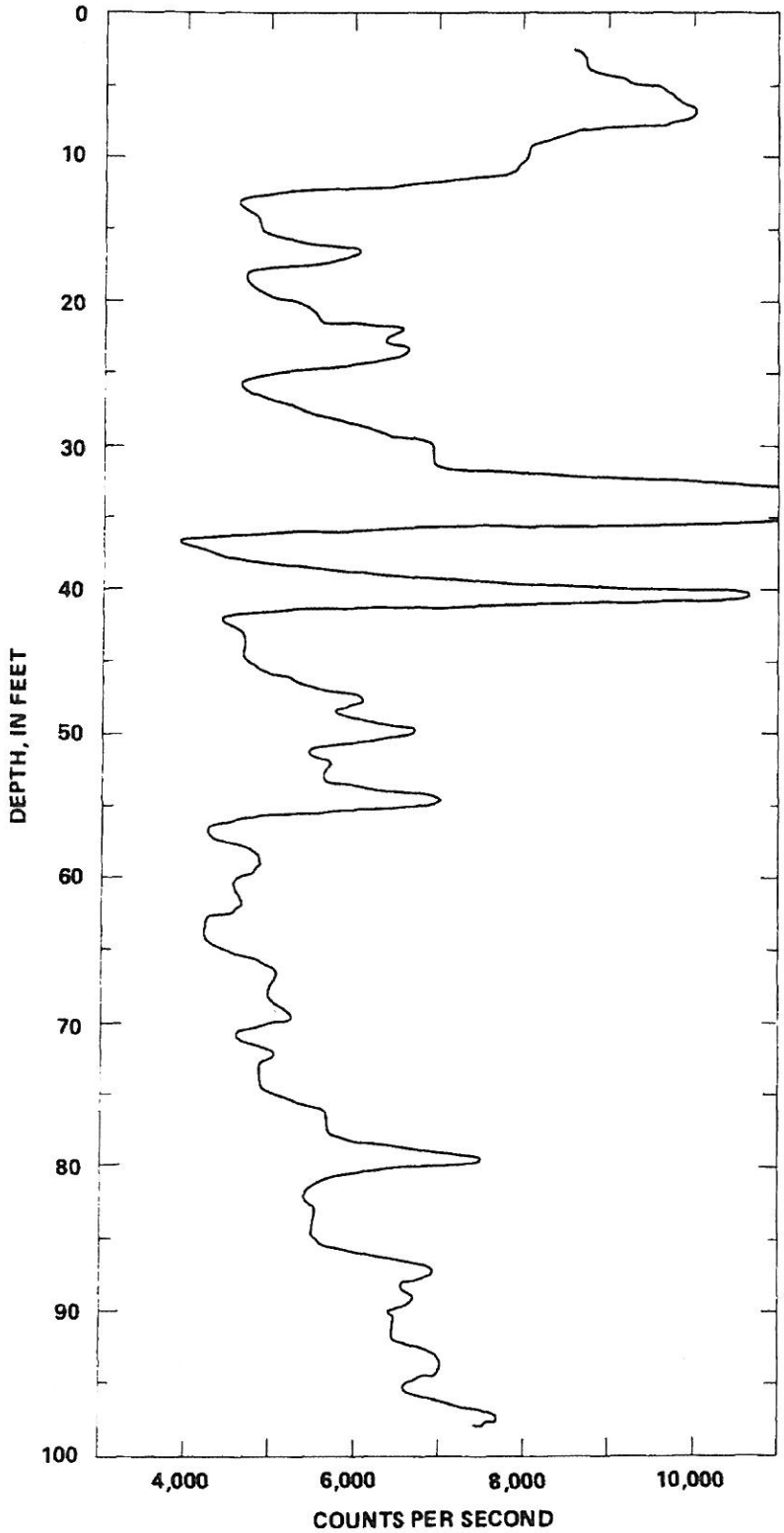


FIGURE 15.--Gamma-gamma density log, test hole 1AN.

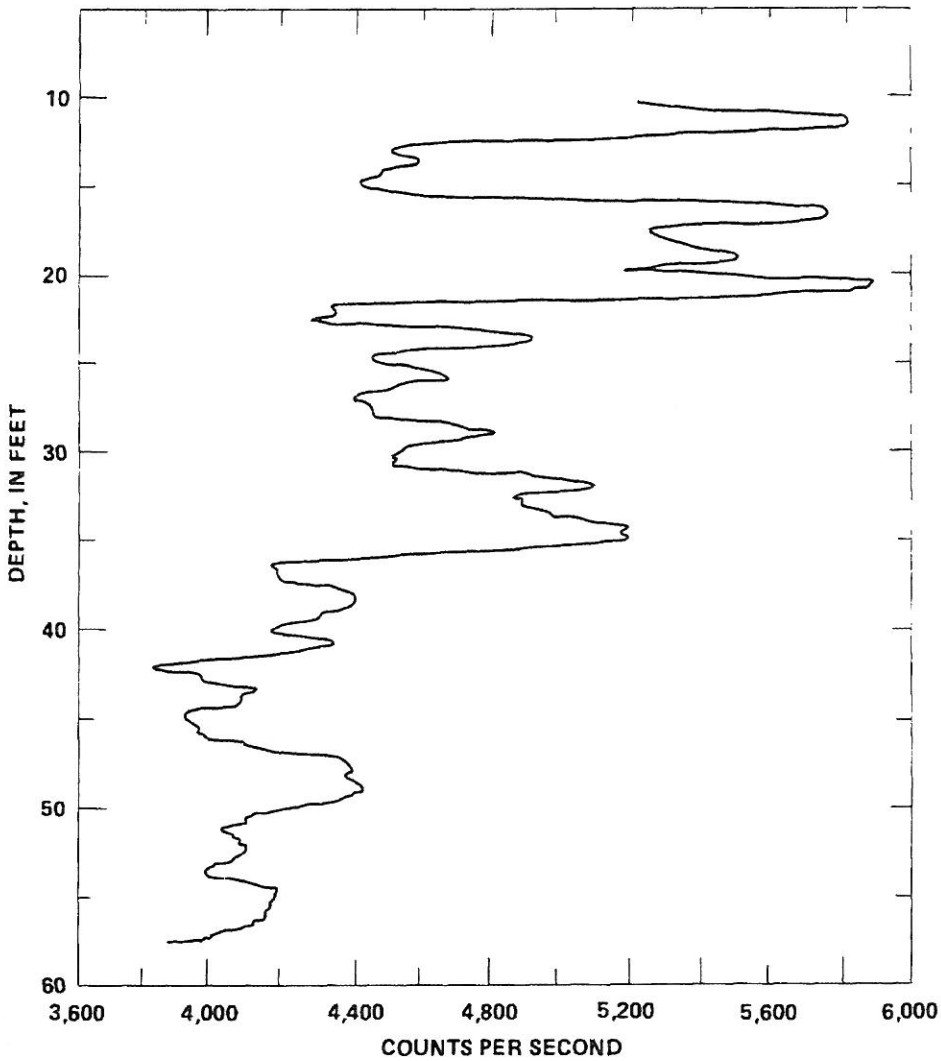


FIGURE 16.--Gamma-gamma density log, test hole 1BN.

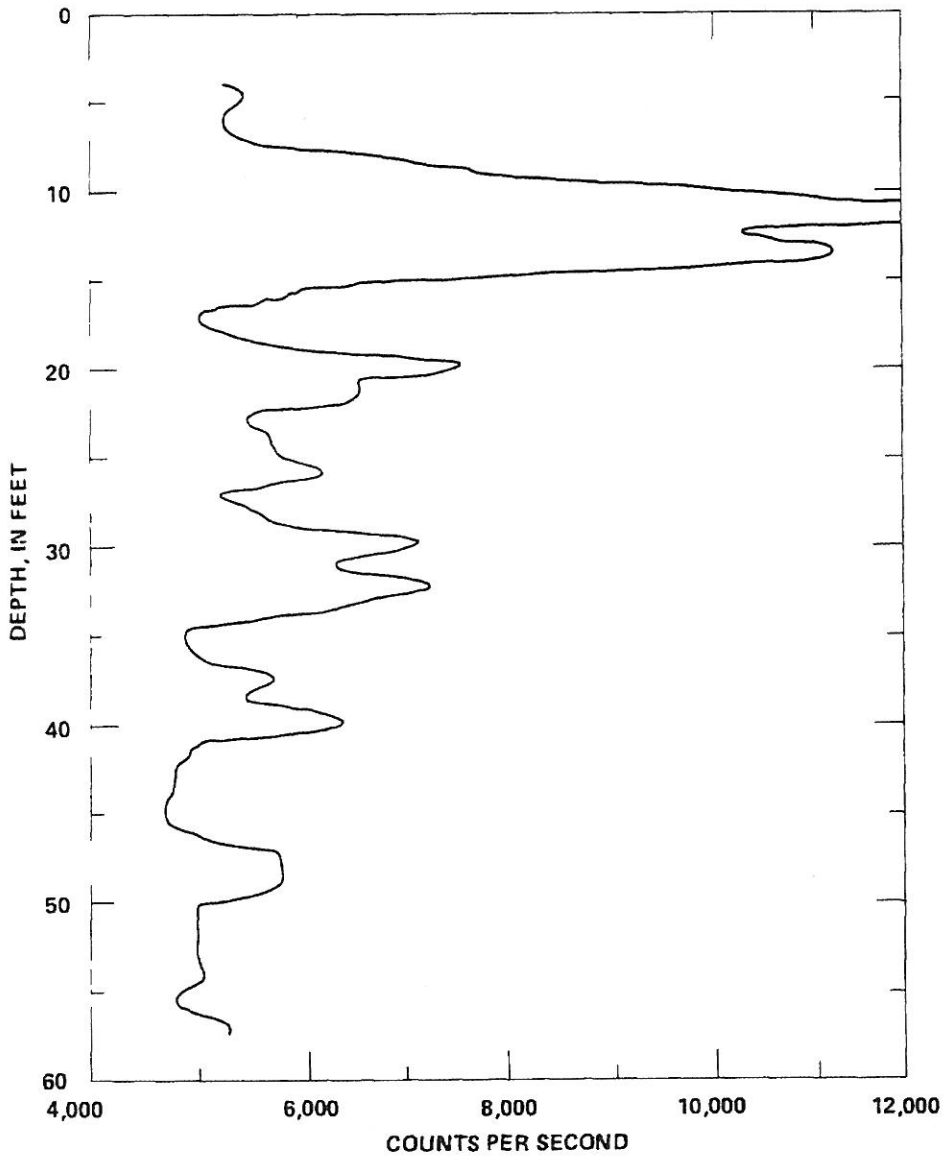


FIGURE 17.--Gamma-gamma density log, test hole 1CN.

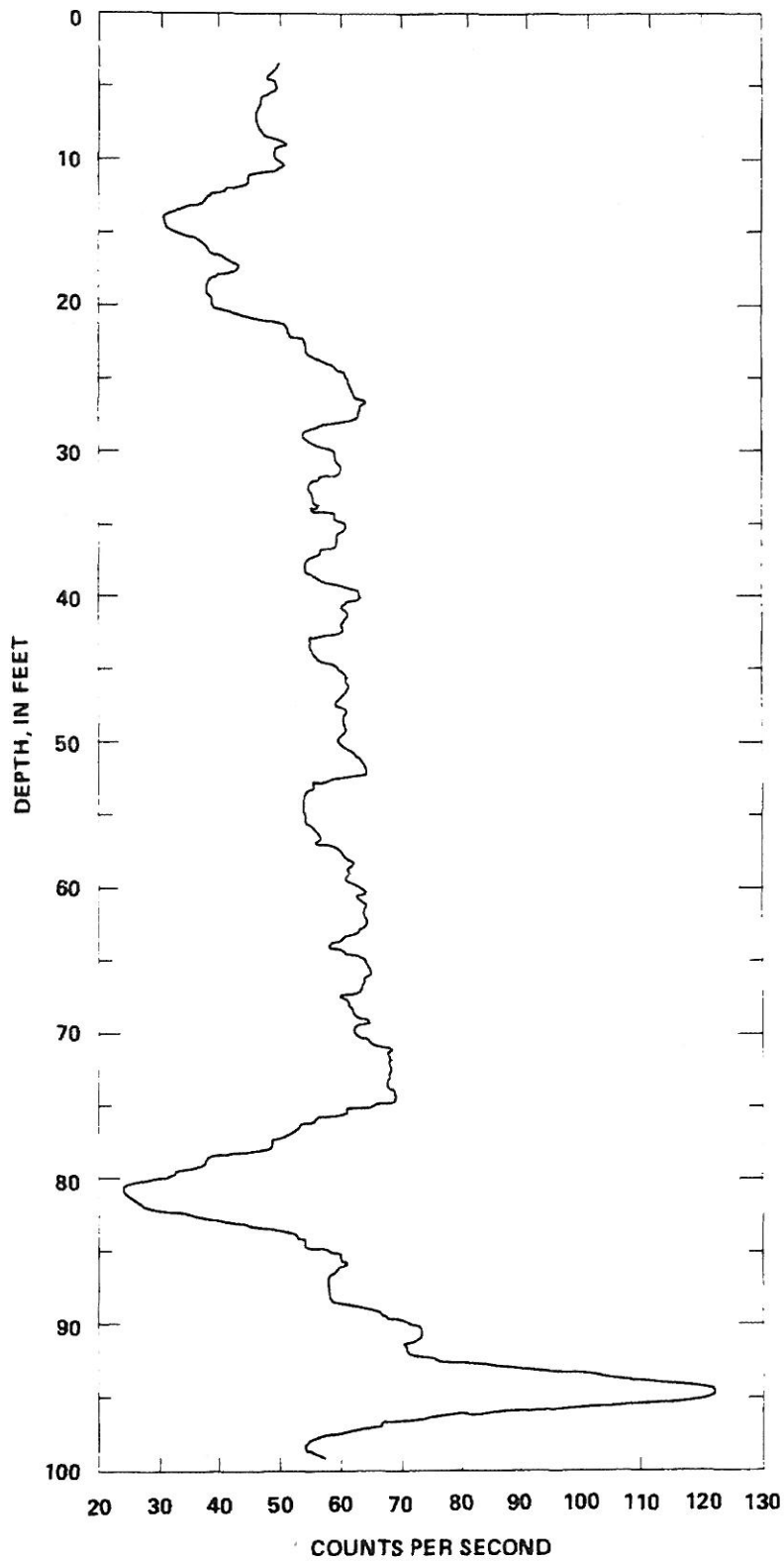
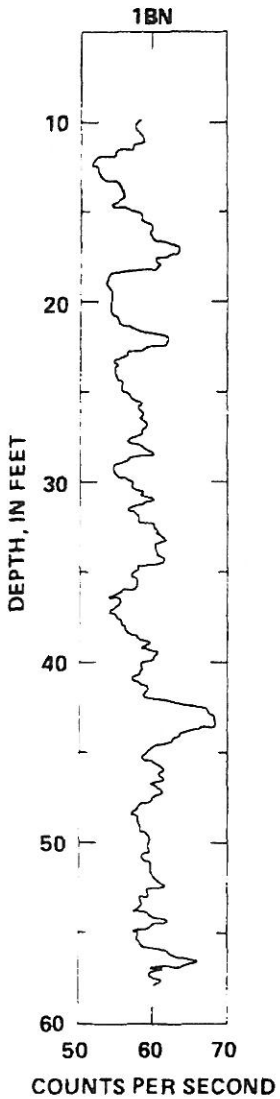
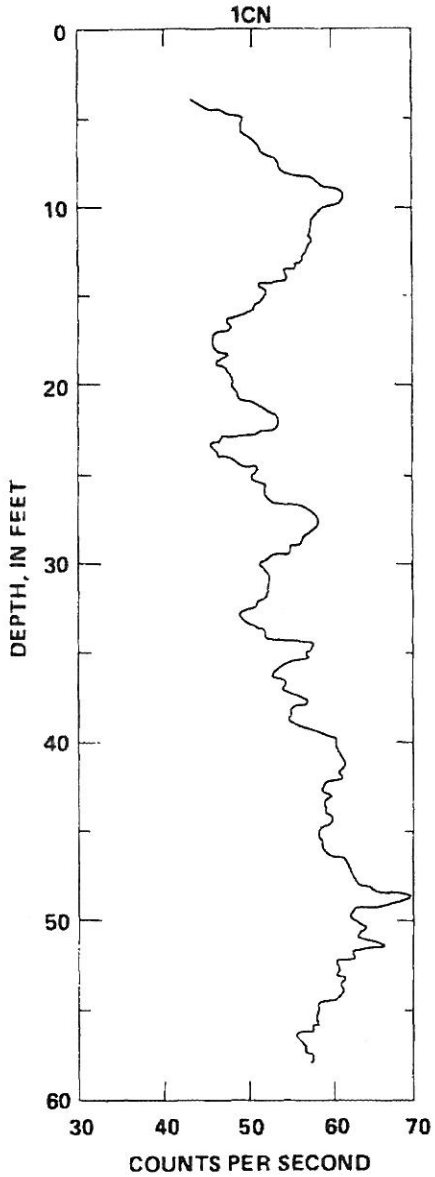


FIGURE 18.--Natural-gamma log, test hole 1AN.





FIGURES 19 and 20.--Natural-gamma logs for test holes 1BN and 1CN.

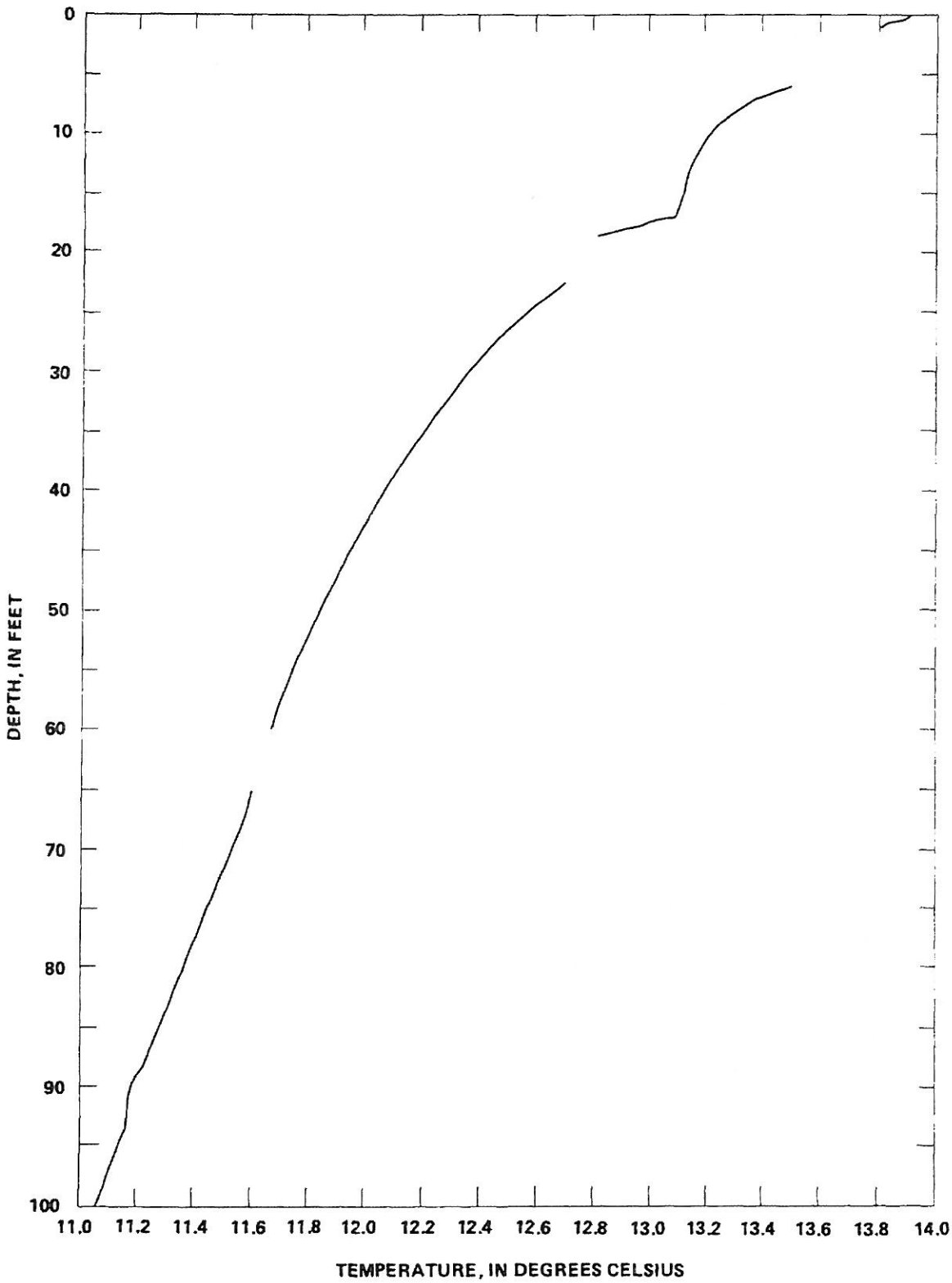
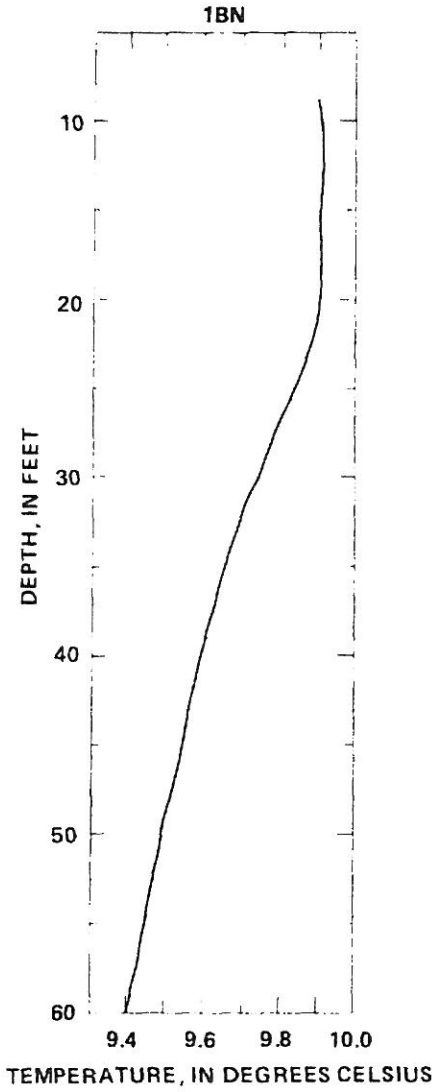
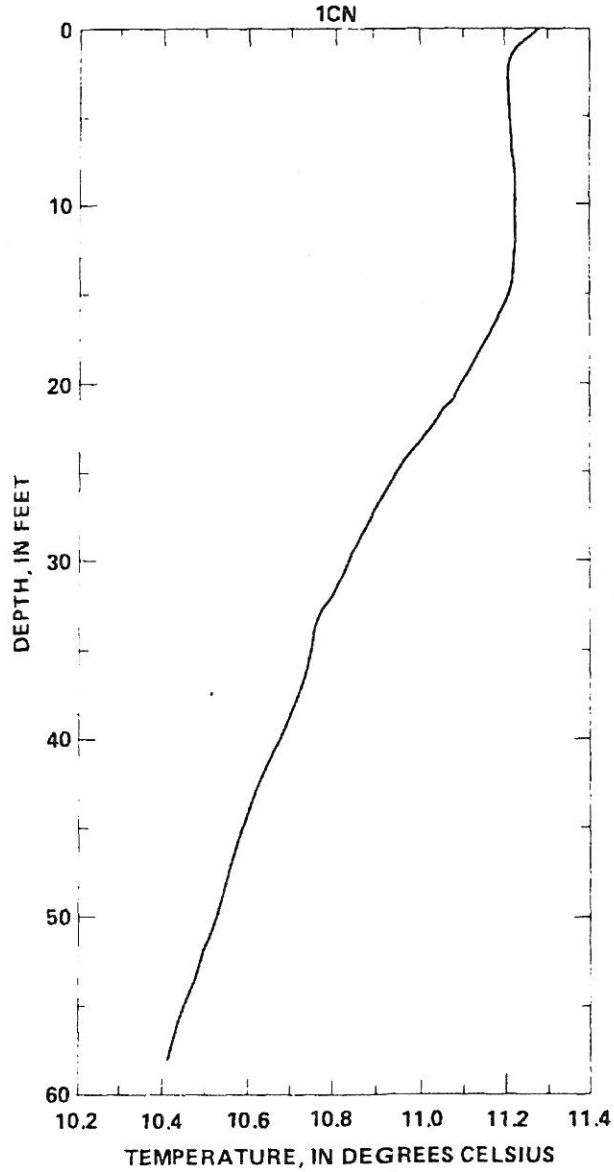


FIGURE 21.--Temperature log, test hole 1AN.





FIGURES 22 and 23.--Temperature logs for test holes 1BN and 1CN.

FINAL REVISED ANALYSES OF MAJOR AND TRACE ELEMENTS FROM ACID MINE WATERS IN THE LEVIATHAN MINE DRAINAGE BASIN, CALIFORNIA AND NEVADA, OCTOBER 1981 TO OCT 1982

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U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 89-4138

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ALPECS

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By James W. Ball and D. Kirk Nordstrom

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Dallas L. Peck, Director

For additional information write to:

Regional Hydrologist
U.S. Geological Survey
345 Middlefield Road
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CONVERSION FACTORS AND ABBREVIATIONS

For the use of readers who prefer to use inch-pound units, rather than the metric (International System) units used in this report, the following conversion factors may be used:

Multiply metric unit	By	To obtain inch-pound unit
m^3/s (cubic meters per second)	35.31	ft^3/s (cubic feet per second)
L (liter)	0.2642	gal (gallon)
μg (microgram)	3.520×10^{-8}	oz (ounce)
mg (milligram)	3.520×10^{-5}	oz (ounce)
g (gram)	0.03520	oz (ounce)

Temperature in degrees Fahrenheit (°F) as follows:

degree Fahrenheit (°F) = 1.8 x degree Celsius (°C) + 32

Explanation of abbreviations:

M (Molar, moles per liter)
N (Normal, equivalents per liter)
mg/L (milligrams per liter)
nm (nanometers)
$\mu g/L$ (micrograms per liter)

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By James W. Ball and D. Kirk Nordstrom

ABSTRACT

The U.S. Geological Survey collected hydrologic and water-quality data from the Leviathan/Bryant Creek drainage basin, California and Nevada, during 1981-82. Sixty-seven water samples collected from 45 sites in the basin at three different times were initially analyzed for 37 major and trace constituents using direct-current-argon-plasma emission spectrometry, flame, hydride generation and graphite furnace atomic absorption spectrometry, UV-Visible colorimetry, and ion chromatography. The previously published set of analytical data (Ball, J. W., and Nordstrom, D. K., 1985, Major and trace-element analyses of acid mine waters in the Leviathan Mine drainage basin, California/Nevada--October, 1981 to October, 1982: U.S. Geological Survey Water-Resources Investigations Report 85-4169, 46 p.) provided immediate information needed to initiate water-quality improvement of the Leviathan/Bryant Creek drainage system. An additional scientific motivation was to model the attenuation of major and trace elements during downstream transport with the best available techniques of surface-water-flow measurement and analytical and physical chemistry. Overall accuracy and precision of the chemical analyses were significantly improved by additional determinations using the more stable inductively-coupled-plasma and the more sensitive Zeeman graphite furnace atomic absorption spectrometric techniques. These additional determinations are considered essential for reliable calculations with geochemical equilibrium modeling programs and for evaluating the discharge measurements.

This additional analysis and evaluation has resulted in (1) revision of concentrations for Al, As, Ba, Cd, Ca, Cr, Co, Cu, Pb, Mg, Mn, Ni, K, SiO_2, Na, Sr, SO_4, V and Zn; (2) generation of concentration values to replace trace-metal values previously below the detection limit; (3) many duplicate analyses for the major constituents; and (4) revision of selected sulfate determinations based on more accurate metal concentration estimates and constraints of charge balance and stream flows determined by a concurrent tracer injection study. Inductively-coupled-plasma spectrometry was used to determine concentration values for Al, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, SiO_2, Na, Sr, V and Zn for comparison with their direct-current-plasma counterparts. Elements determined by Zeeman graphite furnace atomic absorption spectrometry to extend the detection limits to levels below those obtainable by inductively-coupled-plasma or direct-current-plasma spectrometry were Al, As, Cd, Cr, Co, Cu, Pb, Mn, Ni, V and Zn. Some of the samples were analyzed for Na and K by flame atomic absorption spectrometry and the results compared with inductively-coupled-plasma and the previous direct-current-plasma data. We have extensively compared our earlier direct-current-plasma results with our inductively-coupled-plasma, graphite furnace atomic absorption spectrometry and flame atomic absorption spectrometry results. The revisions resulting from these comparisons have yielded a more complete, accurate, and precise data set.

INTRODUCTION

The inactive Leviathan open-pit sulfur mine is located near Markleeville in Alpine County, California (fig. 1). In the early 1980s, this mine and its drainage basin became subject to a pollution abatement project undertaken by the California Regional Water Quality Control Board. As a part of this project, the U.S. Geological Survey collected basic hydrologic and water-quality data for the drainage basin (Hammermeister and Walmsley, 1985). One aspect of the program involved the collection of 63 samples of the water to provide detailed data on trace-element contaminants in the basin and to study downdrainage attenuation of the contaminants under different flow conditions (Ball and Nordstrom, 1985).

Meaningful interpretation of geochemical modeling calculations mandates the highest accuracy in analytical data. This necessitated careful evaluation and revision of the original data of Ball and Nordstrom (1985). Since publication of the initial set of data, all samples collected in June 1982 and October 1982 have been analyzed by multi-element ICP (inductively-coupled-plasma) spectrometry. In addition, analysis by Zeeman GFAAS (graphite furnace atomic absorption spectrometry) of samples having trace-metal concentrations below the detection limits obtainable by ICP or DCP (direct-current-plasma) spectrometry has been completed. Detection limits using plasma techniques are typically two to 400 times those obtainable using the Zeeman GFAAS technique.

Sulfate usually comprises more than 95 percent of the anions in solution in this watershed. Several evaluation techniques were used to revise the SO_4 data presented in this report. Element ratios at confluence points in the watershed sampled were compared. If the values could be adjusted to concomitantly improve: 1) the SO_4 to conductance relation; 2) the metal/SO_4 ratios; 3) the adherence to a mixing line calculated between selected representative end members; and 4) charge balance, the new values were adopted. It is important that all four of the independently calculated relations had to be improved by the change before a new value was adopted.

PURPOSE AND SCOPE

The purpose of this report is to document the final revised values from this analytical comparison and evaluation so that chemical equilibrium modeling can proceed. The full report justifying the choice of final values and determinations and comparing the capabilities of the different techniques is in preparation (Ball and Nordstrom, written commun., September 1989).

This report presents the results of these additional analyses, together with brief statements of the reasons for selecting values. For a description of the sampling area and discussions of the sample collection and preservation methods and the analytical methods used to obtain the original set of analytical data, the reader is referred to Ball and Nordstrom (1985). All data values are tabulated in this report, but the discussion will focus only on the evaluated and revised data.

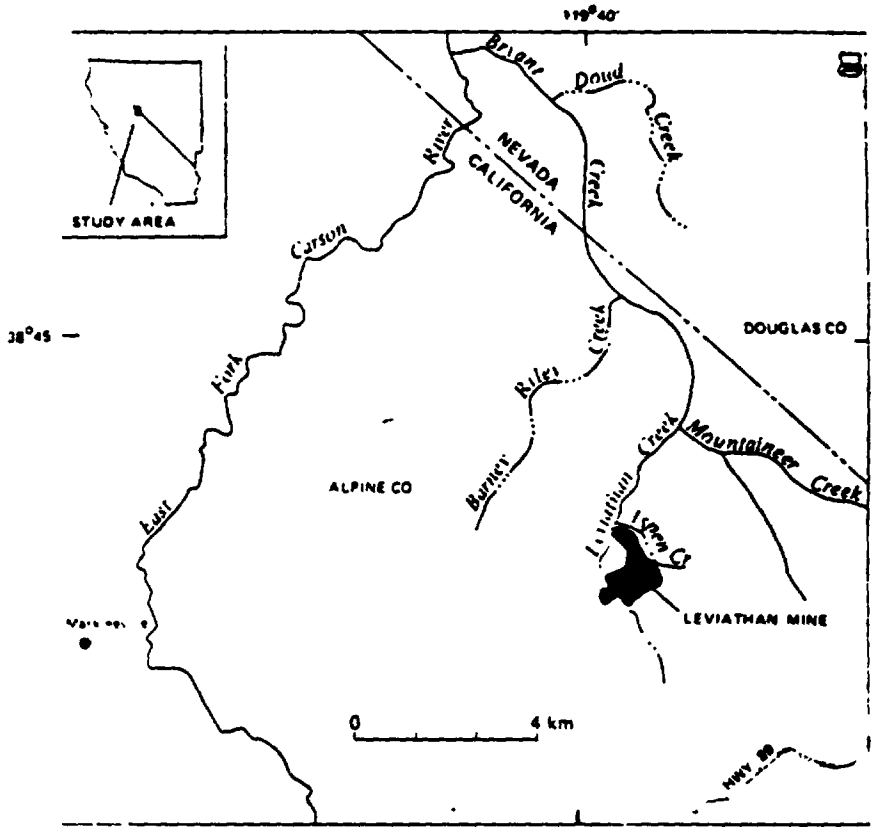

FIGURE 1.--Location of Leviathan Mine.
(from Hammermeister and Walmsley, 1985)

APPROACH

The previous set of analytical data reported by Ball and Nordstrom (1985) provided immediate information that was needed to implement water quality improvement of the Leviathan/Bryant Creek drainage system, in cooperation with the California Regicnal Water Quality Control Board. The scientific motivation for this investigation was to model the attenuation of major and trace elements during downstream transport with the best available techniques of surface water flow measurement, analytical chemistry and physical chemistry. Surface water flow was determined by a tracer injection experiment (Flint and others, 1985). These data provide quantitative estimates of convection and dispersion for solutes in most of the stream reach sampled in the drainage basin. Statistically, the accuracy and precision of the chemical analyses should be greatly improved by additional determinations for metals using more than one analytical technique. Many determinations were below detection by either DCP or ICP techniques and these low concentration values were needed for chemical modeling purposes. Hence, GFAAS determinations were done in these instances. These additional determinations were considered essential for reliable calculations of chemical equilibrium with such programs as WATEQ4F (Ball and others, 1987) and for evaluating the discharge measurements. In addition, it was clear that much new knowledge could be gained about the relative merits of DCP as compared with ICP by analyzing these samples by both techniques and comparing the results. Because these acid mine waters contain a very large range of concentration (orders of magnitude) they are ideally suited to this type of analytical comparison and evaluation.

ANALYTICAL METHODS

Three techniques were employed in the additional analysis of the samples. They are: (1) ICP multi-element atomic emission spectrometry, for the determination of Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Se, SiO_2, Sr, V and Zn; (2) Zeeman GFAAS, for the determination of low levels of Al, As, Cd, Co, Cr, Cu, Mn, Ni, Pb, V and Zn, and (3) Flame atomic absorption spectrometry (flame AAS) for the determination of Na and K in a selected subset of samples. These techniques are discussed in more detail in the following sections.

Inductively-Coupled-Plasma Spectrometry

Samples were analyzed using a Leeman Labs Plasma-Spec III[1] simultaneous direct-reading inductively-coupled-plasma spectrometer (Leeman Labs, Lowell, Mass.). A set of working standards was prepared by making 1 N HNO_3 dilutions of the primary multi-element standard containing the 22 elements in 1 N HNO_3. A solution of 0.1 N HNO_3 was used as a blank and was prepared by diluting ultrapure HNO_3 with double distilled, deionized water. The multi-element solution was composed of alkali and alkaline earth salts of purity 99.99 percent or better and other metal salts, acids, and commercially prepared solutions of purity 99.999 percent or better. The individual photomultiplier tube voltages were optimized by the manufacturer to achieve the best combination of sensitivity and stability. The position of the torch image on the

[1]The use of trade, brand, or product names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

spectrometer input slit was optimized for maximum sensitivity for the detection of Mn. Manganese was chosen because it has a midrange excitation potential and because high Mn concentrations are quickly flushed out of the ICP torch. Several other metals, including Cu and Ni, are equally suitable.

Analytical settings and wavelengths for the ICP spectrometer are shown in table 1. Four standard solutions and the 0.1 N HNO_3 blank, analyzed as unknowns, were interspersed among samples during analysis, and a calibration curve for each element was constructed using the resulting emission data. The 22 elements determined using the simultaneous multi-element mode of operation were: Al, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Si, Na, Sr, V and Zn. Elements available in the simultaneous mode of operation but found by prior experiment to be below detection using ICP are: Li, P, Rb, Se, Ti, Tl, W and U.

Samples were diluted as required for compatibility with the 0.1 percent w/v dissolved solids concentration limit of the sample introduction tube of the torch. Otherwise, no dilution was required, as the linear dynamic range of the instrument was not exceeded, even by several decades of concentration difference between samples. Memory effects can be severe for some elements, depending on differences in concentration among samples. Therefore, samples of similar concentration were grouped together, and nebulized in increasing concentration order. The emission data generated by the instrument were collected on the flexible diskette storage device of an IBM or IBM-compatible personal computer.

The factory-installed dynamic background correction feature was used for each channel, wherein the emission at a wavelength near each primary emission line is measured immediately after measurement of the emission at the primary wavelength and subtracted from the primary emission. When data for all elements were available, sample concentrations were corrected for inter-element spectral effects which result from the presence of concomitant major elements and are observed when measuring concentrations of minor elements. This correction required collection of background-corrected apparent concentration data for a representative concentration range of the suspected interferent in the absence of analyte at the appropriate wavelengths. The resulting apparent analyte concentration values were fitted to various types of linear and exponential simple regression equations, and the selected fit parameters were determined. The concentration of the concomitant element in an unknown sample was combined with the fit parameters to yield a numerical value for its interference which was then subtracted from the apparent concentration of the analyte. The resulting data were stored in a master data set, to which additional data from other sources could be added later.

The above inter-element interference correction technique was used to correct for the effects of Ca, Mg, Si, Fe and Al on the apparent concentrations of Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, Na, Sr, V and Zn. No effects of Ca, Mg, Si, Fe or Al at their upper concentration limits (490, 110, 110, 2,510 and 620 mg/L, respectively) were observed on the apparent concentrations of Ba, Be, B, Co, Mo, K or Si. The effect of Ca (Johnson and others, 1979) is the most serious, followed by the effect of Fe (Ball and Nordstrom, 1985), for the analysis of acid mine effluent by ICP spectrometry.

Table 1.--Instrument settings and individual element data for the ICP spectrometer
[RF, radio frequency; mg/L, milligrams per liter]

Torch settings:

RF current	-	0.55 amperes
Nebulizer pressure	-	38 pounds per square inch
Coolant flow	-	12.5 (arbitrary units)
Auxiliary flow	-	0

Wavelengths and analytical ranges for the individual elements:

Element	Wavelength, nanometers	Maximum standard concentration, mg/L	[1]Detection limit, mg/L
Al	308.22	2.0	0.5
As	197.20	20.0	0.3
Ba	455.40	0.5	0.005
Be	313.04	0.1	0.001
B	249.68	5.0	0.2
Cd	214.44	0.1	0.005
Ca	315.89	5.0	0.05
Cr	205.55	0.5	0.01
Co	228.62	0.5	0.002
Cu	327.40	1.0	0.05
Fe	238.20	2.0	0.1
Pb	220.35	1.0	0.2
Mg	279.08	20.0	0.5
Mn	257.61	2.0	0.02
Mo	202.03	1.0	none[2]
Ni	231.60	0.5	0.003
K	766.49	20.0	0.3
Si	288.16	10.0	0.5
Na	589.59	20.0	0.2
Sr	407.77	0.5	0.002
V	310.23	1.0	0.075
Zn	206.20	1.0	0.01

[1]Determined in this study, for these waters.
[2]Analysis was so poor in the simultaneous mode that no standard curve could be calculated.

Zeeman Graphite Furnace Atomic Absorption Spectrometry

Samples were analyzed using a Perkin-Elmer Zeeman/5000 atomic absorption spectrometer equipped with a HGA-500 controller, AS-40 autosampler and Perkin-Elmer Model 7300 computer, driven by the Perkin-Elmer HGA Graphics II software. Instrument settings for the determinations using Zeeman GFAAS are in table 2. The graphite tube used was of the platform configuration, except for the analysis of Al and V, for which wall atomization was used.

Table 2.--Instrument settings and individual element data for the Zeeman graphite furnace atomic absorption analyses
[°C, degree Celsius; μL, microliter; mg/L, milligrams per liter]

General GFAAS settings:

Typical furnace settings:	
Dry	- 140 °C, 60 seconds
Pretreat	- 45 seconds
Atomize	- 6 seconds, interrupted gas flow
Clean	- 2,700 °C, 8 seconds
Autosampler settings:	
Sample volume	- 20 μL
Alt volume	- 5 μL
Spectrometer settings:	
Integration time	- 7 seconds
Number of replicates	- 3

Specific element data:

Element	Wavelength, nanometers	Atomization temperature, °C	Matrix modifier	Detection limit, mg/L
Al	309.3	2,500	none	0.005
As	193.7	2,500	$Ni(NO_3)_2$	0.001
Cd	228.8	1,600	$Mg(NO_3)_2$ +$NH_4H_2PO_4$	0.00005
Co	240.7	2,500	$Mg(NO_3)_2$	0.001
Cr	357.8	2,500	$Mg(NO_3)_2$	0.0001
Cu	324.7	2,500	$Mg(NO_3)_2$	0.0005
Pb	283.3	1,800	$Mg(NO_3)_2$ +$NH_4H_2PO_4$	0.0005
Mn	279.5	2,200	$Mg(NO_3)_2$	0.0001
Ni	232.0	2,500	$Mg(NO_3)_2$	0.00015
V	318.4	2,650	$Mg(NO_3)_2$	0.001
Zn	213.9	1,800	$Mg(NO_3)_2$	0.0001

Flame Atomic Absorption Determinations for Na and K

The compromise torch power and entrance slit alignment settings used for the ICP and DCP determinations were significantly suboptimal for the alkali metals. Hence, we have concluded that the flame AAS Na and K data were the most accurate of the data collected for these two elements. Accordingly, all available flame AAS Na and K data have been substituted into the master data table of this report. The estimated maximum error in the Na and K values presented here is about 5 percent of the reported concentration for the flame AAS determinations and 20 percent of the reported concentration for the DCP determinations.

ANALYTICAL RESULTS

Accuracy of Plasma Analyses

Accuracy of analysis is variable between elements, and is generally dependent on analyte concentration compared with instrument sensitivity, presence of background or inter-element spectral interferences, and precision with which the spectrometer can measure the emitted energy from the ICP source at the wavelength of interest. Instrument sensitivity depends on which wavelength is selected for inclusion in the multi-element array. This is sometimes a function of space constraints within the detector module. Sensitivity also depends on torch and nebulizer operating conditions and positioning of the torch image on the spectrometer entrance slit. The severity of background and inter-element effects depends on the proximity of analyte wavelengths to interferent wavelengths, and on the interferent-to-analyte concentration ratio. The closer the wavelengths are to each other, and the larger the magnitude of the interferent-to-analyte ratio, the more severe the interference will be, and the less precise will be its correction.

Instrument precision depends on the excitation energy and concentration of the element of interest. If either the excitation energy or analyte concentration or both are exceedingly low or high, the measurement will be less precise. Thus, Ni at 0.25 mg/L, an element with a midrange excitation energy present at a midrange concentration, can be measured with far greater precision than can Na at 1,000 mg/L, an element with a very low excitation energy present at very high concentration. Similarly, B at 0.05 mg/L, an element with a very high excitation energy present at very low concentration, also may be determined with only limited precision.

Accuracy of Zeeman GFAAS Analyses

The accuracy with which elements can be determined using Zeeman GFAAS is, like that of the plasma determinations, variable among elements. It depends on analyte concentration compared to instrument sensitivity, and on the presence of interferences due to a specific solution species (chemical interferences) or those due to bulk, or ionic strength and viscosity effects (matrix or background interferences). These types of interference effects are largely mitigated by using the Zeeman feature of the instrument and the matrix modifiers referred to in table 2. Also, the highest concentrations of the analyte of interest usually occur in the most concentrated solutions. Thus, it was nearly always possible to dilute them as necessary to

eliminate such interferences. The largest source of inaccuracy is probably degradation of the graphite tube over the course of an analytical run, such that accurate, precise standardization over several hours is a serious problem. This effect is particularly noticeable for the more refractory elements such as Al and V, which require higher atomization temperatures.

Physical Measurements and Chemical Analyses

Physical measurements and concentration values for chemical constituents are shown in table 3, which is formatted identically to the table 3 of Ball and Nordstrom (1985). The data are arranged in order of site number,with earlier samples preceding later ones at a given site. Figures 2a and 2b show locations of all sites from which water samples were collected. Values identical to those of Ball and Nordstrom (1985) are: discharge, temperature, specific conductance (field and lab), pH (field and lab), Eh, alkalinity, Sb, Be, Bi, B, Cl, F, Fe^{2+}, Fe^{total}, Li, Mo, Se, and Tl. All other major and trace constituents have been revised based on new information obtained by ICP spectrometry or Zeeman GFAAS, and are discussed in the following sections.

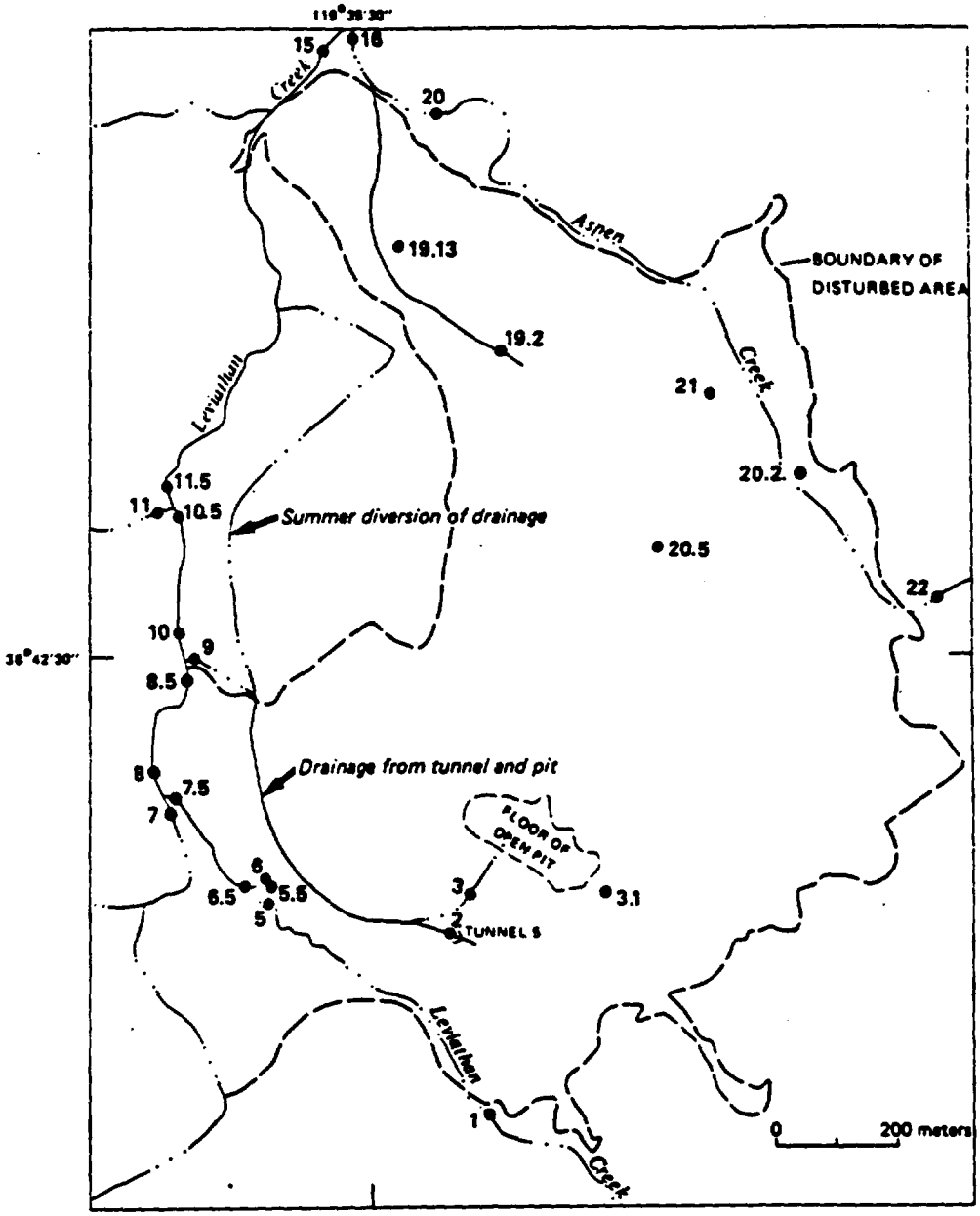

FIGURE 2A.--Surface-water sampling sites in the mine area. Site numbers correspond with those in table 3. (from Hammermeister and Walmsley, 1985)

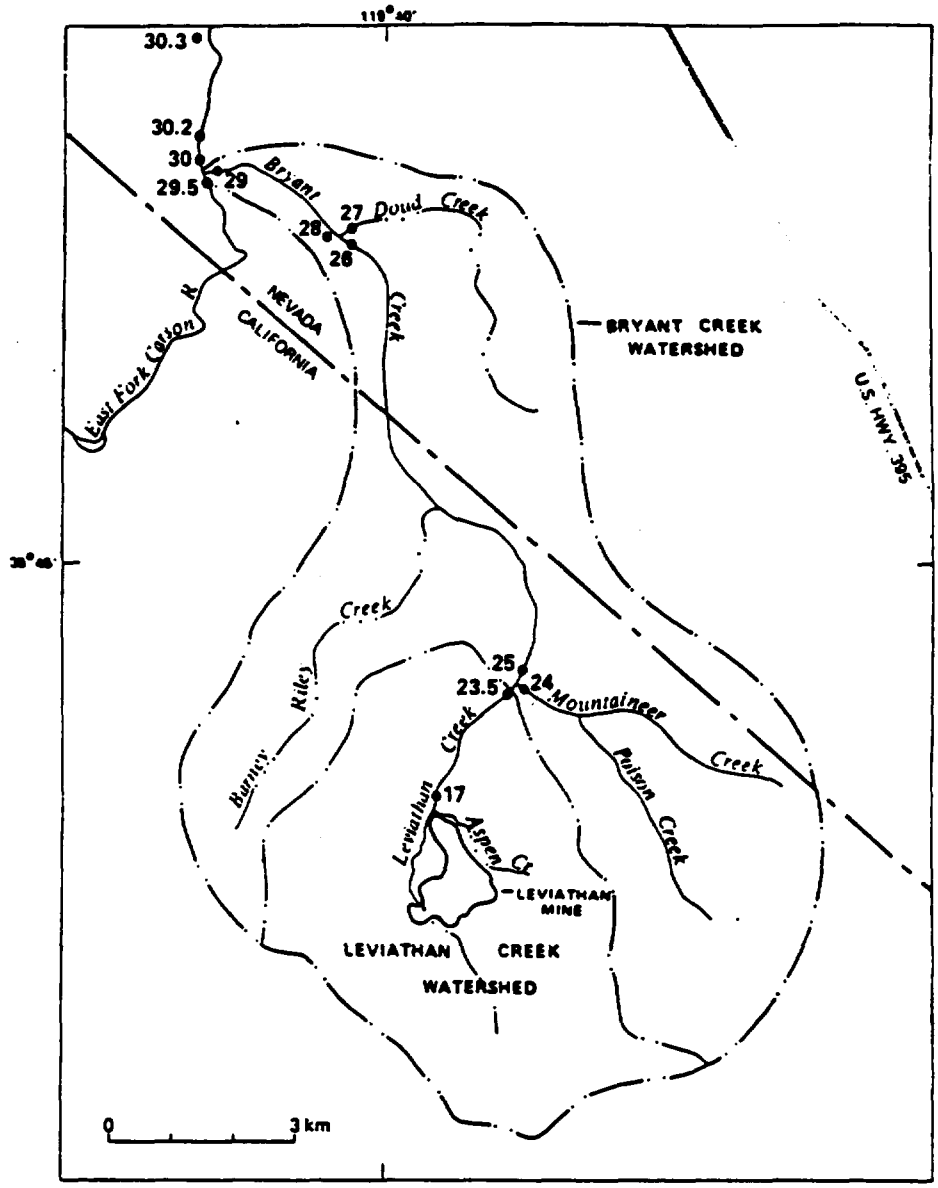

FIGURE 2B.--Surface-water sampling sites downstream from the mine area. Site numbers correspond with those in table 3. (from Hammermeister and Walmsley, 1985)

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin

[m^3/s, cubic meter per second; °C, degree Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; %, percent]

	Site#1			Site#2
	Sample Code Number			
	82WA117	82WA170	81WA132C	82WA118
	Date Collected			
	6/16/82	10/6/82	10/9/81	6/16/82
Determination				
Discharge, m^3/s	0.025	0.0031	0.001	0.001
Temperature, °C	12.5	6.0	12.5	12.0
Specific Conductance,				
field, µS/cm	105	150	6,250	9,300
lab, µS/cm	113	138	4,150	8,040
pH, field	8.10	7.50	2.45	1.80
lab	8.27	8.34	2.60	2.00
Eh, volts	0.380	0.279	0.463	0.465
Alkalinity,				
mg/L as HCO_3	60.4	82.4	------	------
Aluminum	0.018	0.029	440	438
Antimony	<0.0005	------	0.002	0.002
Arsenic	0.004	0.0007	27.1	35
Barium	0.065	0.060	0.007	0.0075
Beryllium	<0.002	<0.002	0.01	0.013
Bismuth	<0.0005	------	0.003	0.067
Boron	<0.02	<0.02	<0.02	0.1
Cadmium	0.00010	0.00045	0.15	0.282
Calcium	10.4	13.0	110	131
Chloride	1	1.1	------	8.4
Chromium	0.0003	0.0002	1.8	2.58
Cobalt	<0.001	<0.001	3.3	5.11
Copper	0.0015	<0.0005	1.2	5.32
Fluoride	0.054	0.063	------	3.4
Iron(Fe^{2+})	0.0076	0.0005	1,100	1,440
Iron(total)	0.0088	0.0041	1,160	1,570
Lead	0.0010	0.0005	<0.02	0.0745
Lithium	0.0021	0.0018	0.0815	0.0935
Magnesium	3.21	4.61	42	53.8
Manganese	0.0187	0.0085	7.6	10.5
Molybdenum	0.0111	0.0151	<0.003	0.0244
Nickel	0.00075	<0.00015	8.0	11.9
Potassium	2.08	3.37	13	13.8
Selenium	<0.002	------	0.01	<0.002
Silica	42.6	40.8	100	109
Sodium	6.39	8.36	26	19.4
Strontium	0.209	0.237	2.4	2.84
Sulfate	5.30	7.21	5,400	7,540
Thallium	0.001	0.002	0.81	2.0
Vanadium	0.003	<0.001	0.76	1.23
Zinc	0.0001	0.0046	1.4	1.39
Charge Balance, %	-0.481	-1.66	-2.19	-0.515

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site #2	Site #3	Site #3.1	Site #5
	Sample Code Number			
	82WA169	82WA119	82WA120	82WA166
	Date Collected			
	10/6/82	6/16/82	6/16/82	10/6/82
Determination				
Discharge, m^3/s	0.001	0.0009	<0.0003	0.003
Temperature, °C	12.0	14.0	10.5	8.2
Specific Conductance,				
field, µS/cm	5,900	12,900	2,200	315
lab, µS/cm	5,690	7,530	2,070	376
pH, field	2.28	1.85	2.50	5.08
lab	2.14	2.10	2.38	3.64
Eh, volts	0.494	0.543	0.756	0.437
Alkalinity,				
mg/L as HCO_3	------	------	------	------
Aluminum	399	623	24.4	2.13
Antimony	------	0.002	<0.0005	------
Arsenic	33	41	0.002	0.001
Barium	0.009	0.013	<0.005	0.063
Beryllium	0.013	0.012	0.004	<0.002
Bismuth	------	0.041	<0.0005	------
Boron	0.09	0.35	0.1	<0.02
Cadmium	0.194	0.338	0.00285	0.00170
Calcium	114	266	64.9	24.3
Chloride	6.9	9.2	0.9	1.3
Chromium	2.31	3.69	0.0760	0.0039
Cobalt	4.08	5.07	0.099	0.069
Copper	1.48	9.64	0.424	0.0260
Fluoride	3.6	5.1	1.5	0.27
Iron(Fe^{2+})	1,240	2,150	4.46	11.1
Iron(total)	1,270	2,510	60.6	11.4
Lead	0.0320	0.0375	<0.0005	<0.0005
Lithium	0.101	0.163	0.0368	0.0055
Magnesium	42.2	97.0	14.8	7.41
Manganese	7.98	9.32	2.74	0.775
Molybdenum	0.0729	0.0657	0.0350	0.0171
Nickel	9.73	13.0	0.153	0.139
Potassium	14.1	23.2	1.62	3.91
Selenium	------	<0.002	<0.002	------
Silica	98.6	109	9.8	43.4
Sodium	20.7	24.3	3.26	9.27
Strontium	2.47	3.61	0.112	0.282
Sulfate	5,690	11,200	680	143
Thallium	1.1	0.82	0.007	0.002
Vanadium	1.10	1.91	0.002	<0.001
Zinc	1.05	2.62	0.289	0.0346
Charge Balance, %	-4.70	-2.50	2.53	-1.03

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#5.5	Site#6	Site#6.5	Site#7
	Sample Code Number			
	82WA167	82WA168	82WA165	82WA121
	Date Collected			
	10/6/82	10/6/82	10/6/82	6/17/82
Determination				
Discharge, m^3/s	0.003	0.002	0.0031	0.0037
Temperature, °C	7.9	7.9	7.8	18.0
Specific Conductance,				
field, µS/cm	4,050	3,500	1,800	750
lab, µS/cm	5,270	5,060	2,460	690
pH, field	2.97	3.28	3.78	6.85
lab	2.10	2.05	2.75	8.18
Eh, volts	0.563	0.528	0.547	0.238
Alkalinity,				
mg/L as HCO_3	------	------	------	146
Aluminum	108	103	51.0	0.038
Antimony	------	------	------	<0.0005
Arsenic	0.52	0.43	0.023	0.002
Barium	0.016	0.008	0.044	0.069
Beryllium	0.012	0.012	0.007	<0.002
Bismuth	------	------	------	<0.0005
Boron	0.2	0.2	0.08	0.03
Cadmium	0.0154	0.0182	0.00970	0.00030
Calcium	307	310	158	99.9
Chloride	4.6	4.4	1.6	0.9
Chromium	0.197	0.179	0.0826	0.0002
Cobalt	2.14	2.04	0.963	0.035
Copper	0.0630	0.398	0.192	0.0005
Fluoride	5.1	4.9	2.4	0.22
Iron(Fe^{2+})	626	606	278	6.03
Iron(total)	631	621	280	6.38
Lead	0.0040	<0.0005	<0.0005	<0.0005
Lithium	0.0735	0.0741	0.0365	0.0060
Magnesium	88.0	89.4	43.2	25.1
Manganese	22.6	22.6	11.1	2.13
Molybdenum	0.108	0.107	0.0881	0.0481
Nickel	4.08	4.09	1.93	0.0778
Potassium	20.1	20.4	10.2	2.74
Selenium	------	------	------	<0.002
Silica	54.3	50.8	46.2	31.7
Sodium	25.0	24.3	14.4	14.0
Strontium	1.61	1.52	0.890	1.02
Sulfate	2,880	2,810	1,450	276
Thallium	0.037	0.099	0.067	0.002
Vanadium	0.234	0.230	0.025	0.002
Zinc	0.675	0.712	0.332	0.0182
Charge Balance, %	1.88	5.35	-3.86	-0.865

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#7	Site#7.5		Site#8
	Sample Code Number			
	82WA162	82WA129	82WA164	82WA122
	Date Collected			
	10/5/82	6/17/82	10/5/82	6/17/82
Determination				
Discharge, m^3/s	0.0003	0.021	0.0057	0.032
Temperature, °C	14.3	18.0	11.5	18.0
Specific Conductance,				
field, µS/cm	1,870	875	2,240	920
lab, µS/cm	1,870	1,610	3,550	1,520
pH, field	6.00	4.18	3.43	4.50
lab	7.29	2.68	2.23	2.68
Eh, volts	0.263	0.488	0.574	0.471
Alkalinity,				
mg/L as HCO_3	37.6	------	------	------
Aluminum	0.45	21.7	55.6	16.0
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.006	0.008	0.032	0.005
Barium	0.035	0.049	0.039	0.057
Beryllium	<0.002	<0.002	0.007	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.05	0.04	0.09	0.03
Cadmium	0.00070	0.00515	0.0100	0.00455
Calcium	334	64.0	176	75.0
Chloride	1.4	1.3	2.3	1.0
Chromium	0.0003	0.0290	0.118	0.0130
Cobalt	0.180	0.363	1.02	0.326
Copper	<0.0005	0.180	0.209	0.165
Fluoride	0.72	0.69	2.8	0.55
Iron(Fe^{2+})	37.6	90.0	299	77.8
Iron(total)	38.1	91.1	308	80.0
Lead	<0.0005	0.0005	0.0035	0.0015
Lithium	0.0162	0.0154	0.0426	0.0142
Magnesium	71.1	18.8	48.5	21.1
Manganese	11.4	3.87	12.0	3.85
Molybdenum	0.104	0.0475	0.07748	0.0318
Nickel	0.415	0.734	2.03	0.672
Potassium	3.89	4.68	11.6	4.92
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	25.0	44.7	47.7	43.7
Sodium	19.6	8.70	16.4	11.0
Strontium	2.34	0.425	0.912	0.570
Sulfate	1,200	517	1,570	504
Thallium	0.004	0.029	0.070	0.024
Vanadium	<0.001	0.001	0.100	0.001
Zinc	0.0510	0.137	0.383	0.155
Charge Balance, %	-0.890	1.87	-1.56	1.98

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

Determination	Site #8	Site #8.5	Site #9	Site #10
	Sample Code Number			
	82WA163	82WA130	82WA132	82WA131
	Date Collected			
	10/5/82	6/17/82	6/17/82	6/17/82
Discharge, m^3/s	0.0082	0.032	0.003	0.031
Temperature, °C	12.0	18.0	18.0	18.0
Specific Conductance,				
field, µS/cm	2,160	900	7,280	1,340
lab, µS/cm	3,450	1,550	5,180	2,390
pH, field	3.78	4.58	2.10	3.40
lab	2.24	2.72	2.27	2.41
Eh, volts	0.555	0.461	0.601	0.591
Alkalinity,				
mg/L as HCO_3	------	------	------	------
Aluminum	46.9	15.0	355	39.9
Antimony	<0.0005	<0.0005	0.002	<0.0005
Arsenic	0.019	0.007	27	1.5
Barium	0.034	0.051	0.012	0.047
Beryllium	0.007	<0.002	0.012	0.002
Bismuth	<0.0005	<0.0005	0.015	<0.0005
Boron	0.09	0.04	0.2	0.05
Cadmium	0.00815	0.00485	0.188	0.0144
Calcium	205	82.0	234	95.5
Chloride	2.3	1.4	7.7	1.2
Chromium	0.0941	0.0135	2.09	0.168
Cobalt	0.894	0.323	3.97	0.566
Copper	0.196	0.153	5.43	0.447
Fluoride	2.9	0.60	3.9	1.3
Iron(Fe^{2+})	264	79.4	1,070	142
Iron(total)	266	81.3	1,210	150
Lead	<0.0005	<0.0005	0.0350	0.0025
Lithium	0.0386	0.0148	0.0924	0.0193
Magnesium	51.8	23.2	86.1	27.0
Manganese	12.6	4.31	15.4	5.05
Molybdenum	0.0919	0.0436	0.0887	0.0546
Nickel	1.83	0.665	9.24	1.27
Potassium	9.99	5.10	12.9	5.18
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	45.6	44.7	92.0	48.7
Sodium	15.9	11.1	21.9	11.3
Strontium	1.17	0.625	2.87	0.749
Sulfate	1,520	530	5,730	833
Thallium	0.057	0.023	1.1	0.093
Vanadium	0.033	0.002	0.967	0.068
Zinc	0.320	0.146	1.29	0.205
Charge Balance, %	-1.94	-5.10	3.53	3.29

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#10.5		Site#11	
	Sample Code Number			
	82WA116	82WA161	82WA114	82WA159
	Date Collected			
	6/16/82	10/5/82	6/16/82	10/5/82
Determination				
Discharge, m^3/s	0.041	0.0079	0.0045	0.002
Temperature, °C	18.5	9.1	13.5	4.0
Specific Conductance,				
field, µS/cm	1,300	2,620	240	415
lab, µS/cm	2,390	3,840	231	394
pH, field	3.32	3.10	8.00	7.15
lab	2.36	2.24	8.20	8.03
Eh, volts	0.622	0.612	0.384	0.463
Alkalinity,				
mg/L as HCO_3	------	------	73.4	75.7
Aluminum	37.5	58.1	0.195	0.016
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	1.2	0.032	0.005	0.001
Barium	0.045	0.029	0.079	0.089
Beryllium	0.002	0.008	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.05	0.07	<0.02	<0.02
Cadmium	0.0168	0.0103	0.00005	<0.00005
Calcium	96.0	254	25.0	42.5
Chloride	1.8	2.4	1.1	1.0
Chromium	0.154	0.162	0.0014	0.0006
Cobalt	0.541	0.970	<0.001	<0.001
Copper	0.348	0.224	0.0020	0.0005
Fluoride	1.3	2.8	0.15	0.23
Iron(Fe^{2+})	123	254	0.0081	0.0053
Iron(total)	141	277	0.0091	0.0127
Lead	0.0025	0.0010	0.0110	<0.0005
Lithium	0.0207	0.0483	0.0041	0.0072
Magnesium	28.5	70.9	7.24	11.9
Manganese	5.25	15.2	0.0247	0.0109
Molybdenum	0.0524	0.0890	0.0153	0.0337
Nickel	1.21	2.06	0.00240	0.00125
Potassium	4.72	8.59	2.67	3.43
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	48.7	50.6	43.2	39.0
Sodium	11.5	17.0	9.60	14.1
Strontium	0.780	1.44	0.401	0.634
Sulfate	790	1,870	57.2	130
Thallium	0.093	0.047	0.001	<0.001
Vanadium	0.030	0.051	0.002	<0.001
Zinc	0.192	0.385	0.0013	0.0003
Charge Balance, %	5.95	-1.89	-2.05	-2.35

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#11.5		Site#15	
	Sample Code Number			
	82WA115	82WA160	82WA113	82WA152
	Date Collected			
	6/16/82	10/5/82	6/16/82	10/4/82
Determination				
Discharge, m^3/s	0.031	0.011	0.040	0.010
Temperature, °C	18.0	6.0	14.5	7.0
Specific Conductance,				
field, µS/cm	1,200	2,260	1,050	2,230
lab, µS/cm	2,090	3,450	1,880	3,200
pH, field	3.58	3.52	3.31	3.11
lab	2.55	2.29	2.63	2.35
Eh, volts	0.612	0.607	0.644	0.658
Alkalinity,				
mg/L as HCO_3	------	------	------	------
Aluminum	32.2	47.8	28.8	45.0
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	1.0	0.032	0.45	0.019
Barium	0.054	0.035	0.055	0.036
Beryllium	<0.002	0.007	<0.002	0.006
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.03	0.07	0.03	0.06
Cadmium	0.0134	0.00880	0.0119	0.00795
Calcium	87.9	221	81.6	219
Chloride	1.6	1.8	1.4	1.7
Chromium	0.124	0.132	0.105	0.114
Cobalt	0.466	0.802	0.400	0.753
Copper	0.261	0.213	0.260	0.202
Fluoride	0.89	2.5	0.81	2.2
Iron(Fe^{2+})	103	215	66.6	112
Iron(total)	117	233	83.3	174
Lead	0.0020	<0.0005	<0.0005	<0.0005
Lithium	0.0179	0.0432	0.0165	0.0408
Magnesium	25.2	61.3	24.2	61.5
Manganese	4.31	12.7	3.84	11.8
Molybdenum	0.0452	0.0863	0.0441	0.0868
Nickel	1.05	1.67	0.875	1.57
Potassium	5.60	8.71	5.15	8.38
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	49.5	48.4	50.0	47.2
Sodium	12.8	20.3	12.7	18.9
Strontium	0.734	1.34	0.771	1.36
Sulfate	686	1,550	631	1,480
Thallium	0.092	0.044	0.070	0.043
Vanadium	0.013	0.060	0.002	0.012
Zinc	0.147	0.332	0.136	0.307
Charge Balance, %	4.96	-1.12	3.34	-0.441

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#16		Site#17	
	Sample Code Number			
	82WA111	82WA150	81WA131C	82WA112
	Date Collected			
	6/16/82	10/4/82	10/9/81	6/16/82
Determination				
Discharge, m^3/s	0.018	0.014	------	0.070
Temperature, °C	13.0	11.9	12.5	14.0
Specific Conductance,				
field, µS/cm	610	610	1,170	880
lab, µS/cm	640	597	1,440	1,450
pH, field	7.98	7.62	3.62	3.68
lab	7.98	8.04	3.04	2.74
Eh, volts	0.304	0.235	0.641	0.628
Alkalinity,				
mg/L as HCO_3	50.8	59.6	------	------
Aluminum	0.109	0.088	13	20.5
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.003	0.005	0.008	0.35
Barium	0.027	0.029	0.04	0.044
Beryllium	<0.002	<0.002	<0.002	0.003
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.03	<0.02	0.04	0.03
Cadmium	0.00040	0.00015	<0.01	0.00820
Calcium	78.7	77.4	150	83.8
Chloride	1.2	1.3	2.8	1.4
Chromium	0.0001	0.0048	0.009	0.0632
Cobalt	0.016	0.010	0.29	0.283
Copper	0.0120	0.0015	0.10	0.231
Fluoride	0.38	0.35	------	0.58
Iron(Fe^{2+})	0.0177	0.0045	30.0	47.9
Iron(total)	0.0207	0.0123	39.0	55.7
Lead	<0.0005	<0.0005	<0.02	0.0010
Lithium	0.0114	0.0075	0.118	0.0145
Magnesium	21.45	20.4	42	23.8
Manganese	1.26	0.950	6.2	3.06
Molybdenum	<0.003	0.0572	<0.003	0.0363
Nickel	0.0418	0.0204	0.61	0.634
Potassium	3.89	4.24	4.9	4.31
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	25.6	23.2	31	36.4
Sodium	10.7	13.2	15	10.9
Strontium	0.608	0.611	1.1	0.696
Sulfate	283	245	760	564
Thallium	0.002	<0.001	0.012	0.053
Vanadium	<0.001	<0.001	<0.005	0.001
Zinc	<0.0001	0.0015	0.11	0.109
Charge Balance, %	-4.09	1.31	-3.37	-2.37

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#17	Site#19.13		Site#19.2
	Sample Code Number			
	82WA151	82WA128	82WA158	82WA127
	Date Collected			
	10/4/82	6/17/82	10/5/82	6/17/82
Determination				
Discharge, m^3/s	0.024	<0.0003	0.0003	<0.0003
Temperature, °C	7.8	17.0	14.0	15.0
Specific Conductance,				
field, µS/cm	1,290	2,200	2,780	2,100
lab, µS/cm	1,560	2,490	2,440	2,420
pH, field	3.55	7.44	7.75	3.65
lab	2.84	7.81	6.80	3.75
Eh, volts	------	0.521	0.463	0.667
Alkalinity,				
mg/L as HCO_3	------	34.9	106	------
Aluminum	18.8	0.222	0.100	52.7
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.012	0.004	0.001	0.008
Barium	0.033	0.019	0.018	0.008
Beryllium	0.003	<0.002	<0.002	0.007
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.04	0.1	0.1	0.1
Cadmium	0.00305	0.00125	0.00035	0.00730
Calcium	145	465	465	352
Chloride	1.6	1.7	1.6	1.9
Chromium	0.0413	0.0007	0.0003	0.0065
Cobalt	0.320	0.069	0.012	0.375
Copper	0.101	0.0095	0.0070	0.761
Fluoride	1.1	1.1	1.5	4.4
Iron(Fe^{2+})	45.6	0.0055	0.0058	1.08
Iron(total)	56.2	0.0056	0.0124	1.90
Lead	<0.0005	0.0005	<0.0005	0.0010
Lithium	0.0223	0.0297	0.0262	0.0580
Magnesium	37.9	108	104	95.7
Manganese	5.53	5.18	1.97	17.3
Molybdenum	0.0646	0.114	0.106	0.114
Nickel	0.682	0.151	0.0420	0.527
Potassium	5.18	7.52	8.34	8.37
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	34.8	24.4	17.4	54.7
Sodium	13.9	26.1	25.3	24.1
Strontium	0.962	1.82	2.14	0.986
Sulfate	764	1,650	1,580	1,600
Thallium	0.016	0.004	0.003	0.018
Vanadium	0.002	<0.001	<0.001	<0.001
Zinc	0.125	0.0385	0.0094	0.521
Charge Balance, %	-0.775	-2.94	-3.31	0.249

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site #19.2	Site #20	Site #20.2	Site #20.5
	Sample Code Number			
	82WA157	82WA126	82WA155	82WA124
	Date Collected			
	10/5/82	6/17/82	10/5/82	6/17/82
Determination				
Discharge, m^3/s	<0.0003	0.012	0.0009	0.003
Temperature, °C	12.8	13.5	8.6	15.5
Specific Conductance,				
field, µS/cm	2,670	418	758	1,680
lab, µS/cm	2,490	447	736	1,550
pH, field	3.78	7.73	4.19	3.65
lab	3.66	7.66	3.99	3.83
Eh, volts	0.669	0.385	0.497	0.602
Alkalinity,				
mg/L as HCO_3	------	39.2	------	------
Aluminum	54.7	0.134	7.18	29.8
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.017	0.005	0.030	0.002
Barium	0.009	0.038	<0.005	0.011
Beryllium	0.009	<0.002	<0.002	0.007
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.10	0.02	0.04	0.10
Cadmium	0.00675	0.00080	0.00195	0.00465
Calcium	399	52.0	91.9	209
Chloride	2.0	1	1.4	2.1
Chromium	0.0076	0.0002	0.0007	0.0053
Cobalt	0.409	0.015	0.027	0.182
Copper	0.891	0.0065	0.307	0.470
Fluoride	4.4	0.39	0.61	1.7
Iron(Fe^{2+})	0.500	0.0147	0.0089	1.86
Iron(total)	1.29	0.0154	0.0336	2.27
Lead	0.0005	<0.0005	0.0005	<0.0005
Lithium	0.0650	0.0102	0.0161	0.0413
Magnesium	102	13.9	22.5	53.1
Manganese	19.5	1.18	3.24	8.75
Molybdenum	0.104	0.0174	0.0565	0.0713
Nickel	0.588	0.0378	0.110	0.323
Potassium	8.50	3.58	6.83	12.1
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	49.3	28.46	37.48	45.9
Sodium	19.8	9.69	10.1	13.5
Strontium	0.951	0.361	0.401	0.840
Sulfate	1,670	190	364	912
Thallium	0.016	0.002	0.003	0.008
Vanadium	<0.001	0.001	<0.001	0.001
Zinc	0.686	0.0064	0.102	0.418
Charge Balance, %	3.19	-4.31	3.27	2.36

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#20.5	Site#21		Site#22
	Sample Code Number			
	82WA154	82WA125	82WA156	82WA123
	Date Collected			
	10/5/82	6/17/82	10/5/82	6/17/82
Determination				
Discharge, m^3/s	0.0005	0.003	0.003	0.003
Temperature, °C	11.2	15.5	14.0	19.0
Specific Conductance,				
field, μS/cm	183	2,900	3,000	200
lab, μS/cm	122	4,160	3,360	198
pH, field	7.60	3.19	3.35	8.10
lab	7.66	2.38	2.27	8.29
Eh, volts	0.396	0.622	0.618	0.328
Alkalinity,				
mg/L as HCO_3	107	------	------	131
Aluminum	0.002	74.6	58.8	0.007
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.001	0.001	0.001	0.003
Barium	<0.005	0.006	<0.005	0.028
Beryllium	<0.002	0.013	0.012	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	<0.02	0.30	0.27	<0.02
Cadmium	<0.00005	0.00840	0.00510	0.00240
Calcium	20.6	392	373	23.1
Chloride	0.8	2.0	2.0	0.8
Chromium	0.0007	0.0130	0.0116	0.0008
Cobalt	<0.001	0.485	0.446	0.001
Copper	0.0010	1.91	1.56	0.0010
Fluoride	0.02	5.9	5.2	0.03
Iron(Fe^{2+})	0.0010	173	167	0.0461
Iron(total)	0.0040	196	190	0.0569
Lead	<0.0005	<0.0005	<0.0005	<0.0005
Lithium	0.0018	0.0704	0.0714	<0.0010
Magnesium	4.88	106	96.9	6.18
Manganese	0.0001	23.0	21.2	0.0055
Molybdenum	0.0209	0.115	0.112	0.0074
Nickel	<0.00015	0.693	0.636	<0.00015
Potassium	0.665	22.6	23.8	2.32
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	23.4	45.7	35.7	30.8
Sodium	9.29	18.7	18.6	10.5
Strontium	0.292	0.570	0.560	0.351
Sulfate	1.27	2,340	2,030	1.14
Thallium	<0.001	0.013	0.012	0.002
Vanadium	0.002	0.027	0.026	0.003
Zinc	0.0003	0.786	0.816	0.0001
Charge Balance, %	1.52	-2.66	1.12	-0.189

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#22	Site#23.5		Site#24
	Sample Code Number			
	82WA153	82WA110	82WA149	82WA108
	Date Collected			
	10/5/82	6/15/82	10/4/82	6/15/82
Determination				
Discharge, m^3/s	0.0037	0.071	0.040	0.091
Temperature, °C	7.3	19.5	8.3	12.5
Specific Conductance,				
field, µS/cm	209	1,100	1,350	150
lab, µS/cm	179	1,260	1,600	143
pH, field	8.25	3.25	------	8.85
lab	8.20	2.90	2.84	8.24
Eh, volts	0.399	0.689	0.662	0.379
Alkalinity,				
mg/L as HCO_3	125	------	------	94.3
Aluminum	<0.005	19.8	19.9	(0.045)
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.002	0.018	0.011	0.002
Barium	0.009	0.048	0.034	0.039
Beryllium	<0.002	<0.002	0.003	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	<0.02	0.02	0.03	<0.02
Cadmium	<0.00005	0.00790	0.00390	0.00020
Calcium	22.8	82.2	143	13.7
Chloride	0.9	1.1	1.4	1
Chromium	0.0002	0.0447	0.0296	(0.0090)
Cobalt	<0.001	0.276	0.322	(0.023)
Copper	0.0020	0.231	0.108	0.0010
Fluoride	0.02	0.52	1.2	0.04
Iron(Fe^{2+})	0.0035	9.01	23.6	0.0086
Iron(total)	0.0058	18.4	35.5	0.0099
Lead	<0.0005	<0.0005	0.0010	<0.0005
Lithium	0.0016	0.0145	0.0208	0.0024
Magnesium	5.86	23.6	38.3	5.78
Manganese	0.0018	3.04	5.48	(0.0221)
Molybdenum	0.0265	0.0442	0.0710	0.0102
Nickel	<0.00015	0.608	0.684	(0.0146)
Potassium	0.83	4.57	5.00	2.29
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	26.0	46.4	36.9	42.6
Sodium	9.89	11.8	13.7	6.83
Strontium	0.334	0.708	1.00	0.237
Sulfate	1.25	483	723	1.89
Thallium	<0.001	0.033	0.017	<0.001
Vanadium	0.003	<0.001	<0.001	0.004
Zinc	0.0008	0.147	0.129	(0.510)
Charge Balance, %	-0.505	2.46	3.14	-2.72

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#24		Site#25	
	Sample Code Number			
	82WA147	81WA130C	82WA109	82WA148
	Date Collected			
	10/4/82	10/9/81	6/15/82	10/4/82
Determination				
Discharge, m^3/s	0.057	------	0.16	0.091
Temperature, °C	7.0	5.0	16.0	7.0
Specific Conductance,				
field, µS/cm	162	455	435	500
lab, µS/cm	151	407	477	467
pH, field	8.20	6.70	4.90	5.53
lab	8.14	6.84	3.87	4.34
Eh, volts	0.344	0.303	0.692	0.370
Alkalinity,				
mg/L as HCO_3	95.5	------	------	------
Aluminum	0.010	0.11	5.06	0.62
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.003	<0.0005	0.010	0.004
Barium	0.030	0.03	0.042	0.034
Beryllium	<0.002	<0.002	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	<0.02	<0.02	<0.02	<0.02
Cadmium	0.00010	<0.01	0.00400	0.00165
Calcium	15.4	52	44.7	51.2
Chloride	1.1	------	1	1.1
Chromium	0.0003	<0.003	0.0027	0.0008
Cobalt	<0.001	0.067	0.112	0.098
Copper	0.0020	0.005	0.0930	0.0175
Fluoride	0.04	------	0.30	0.21
Iron(Fe^{2+})	0.0059	3.60	4.44	6.94
Iron(total)	0.0110	3.70	4.72	7.00
Lead	<0.0005	<0.02	<0.0005	<0.0005
Lithium	0.0021	<0.0010	0.0073	0.0084
Magnesium	6.19	15	13.5	15.8
Manganese	0.0052	1.5	1.26	1.57
Molybdenum	0.0230	<0.003	0.0073	0.0297
Nickel	0.00030	0.14	0.247	0.184
Potassium	2.21	3.1	3.21	3.848
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	34.4	29	42.6	36.4
Sodium	6.81	9.6	8.60	9.93
Strontium	0.242	0.44	0.438	0.478
Sulfate	1.26	195	206	219
Thallium	<0.001	0.002	0.017	0.005
Vanadium	0.003	<0.005	<0.001	<0.001
Zinc	0.0001	<0.006	0.0429	0.0388
Charge Balance, %	0.368	0.250	2.75	1.97

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#26		Site#27	
	Sample Code Number			
	82WA107	82WA146	82WA105	82WA144
	Date Collected			
	6/15/82	10/4/82	6/15/82	10/4/82
Determination				
Discharge, m^3/s	0.22	0.11	0.0085	0.0057
Temperature, °C	21.0	12.7	17.5	12.2
Specific Conductance,				
field, µS/cm	390	412	350	369
lab, µS/cm	445	396	345	355
pH, field	.5.30	7.69	8.41	8.20
lab	3.76	7.53	8.36	8.40
Eh, volts	0.398	0.404	0.340	0.439
Alkalinity,				
mg/L as HCO_3	------	33.8	168	173
Aluminum	0.73	0.036	0.007	0.009
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.003	0.002	0.003	0.003
Barium	0.042	0.030	0.044	0.037
Beryllium	<0.002	<0.002	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	<0.02	<0.02	<0.02	<0.02
Cadmium	0.00225	0.00020	0.00015	0.00005
Calcium	41.0	42.0	29.7	32.2
Chloride	1.2	1.2	4.0	4.1
Chromium	0.0003	0.0006	0.0002	0.0004
Cobalt	0.088	0.058	<0.001	<0.001
Copper	0.0555	0.0020	0.0020	0.0015
Fluoride	<0.002	0.22	0.069	0.008
Iron(Fe^{2+})	5.12	0.0018	0.0236	0.0155
Iron(total)	5.52	0.0091	0.0242	0.0389
Lead	<0.0005	<0.0005	<0.0005	<0.0005
Lithium	0.0067	0.0078	0.0044	0.0047
Magnesium	13.4	14.8	15.45	16.2
Manganese	1.04	1.04	0.0115	0.0075
Molybdenum	0.0095	0.0349	0.0124	0.0270
Nickel	0.190	0.131	0.00045	0.00015
Potassium	3.99	3.81	5.17	5.03
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	45.6	35.7	55.6	53.6
Sodium	9.54	9.81	16.3	16.7
Strontium	0.410	0.410	0.3245	0.341
Sulfate	188	152	38.9	44.7
Thallium	0.013	0.003	0.001	<0.001
Vanadium	<0.001	<0.001	0.007	0.007
Zinc	0.0327	0.0019	0.0002	0.0006
Charge Balance, %	0.330	1.85	-1.08	-1.05

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#28		Site#29	
	Sample Code Number			
	82WA106	82WA145	82WA104	82WA143
	Date Collected			
	6/15/82	10/4/82	6/14/82	10/4/82
Determination				
Discharge, m^3/s	0.24	0.11	0.071	0.11
Temperature, °C	20.0	13.5	23.0	14.0
Specific Conductance,				
field, µS/cm	350	406	430	442
lab, µS/cm	431	396	452	416
pH, field	5.88	7.78	5.50	7.80
lab	3.86	7.45	3.83	7.80
Eh, volts	0.338	0.394	0.392	0.423
Alkalinity,				
mg/L as HCO_3	2.65	39.7	------	39.2
Aluminum	0.202	0.107	0.048	0.14
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.003	0.003	0.002	0.003
Barium	0.042	0.026	0.040	0.029
Beryllium	<0.002	<0.002	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	<0.02	<0.02	0.02	<0.02
Cadmium	0.00215	0.00025	0.00200	0.00030
Calcium	38.6	41.9	40.6	41.5
Chloride	1.3	0.9	1.3	1.6
Chromium	0.0002	0.0001	0.0001	0.0006
Cobalt	0.078	0.044	0.074	0.041
Copper	0.0385	0.0340	0.0445	0.0015
Fluoride	0.11	<0.002	0.20	0.22
Iron(Fe^{2+})	4.84	0.0013	4.29	0.0019
Iron(total)	5.17	0.0033	4.59	0.0066
Lead	<0.0005	<0.0005	<0.0005	0.0025
Lithium	0.0079	0.0075	0.0070	0.0081
Magnesium	12.6	15.1	13.4	15.45
Manganese	0.961	0.928	0.957	0.923
Molybdenum	0.0127	0.0321	0.0095	0.0370
Nickel	0.187	0.118	0.164	0.0964
Potassium	4.07	4.55	3.81	4.20
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	45.4	37.9	46.6	36.2
Sodium	9.92	10.3	10.7	11.7
Strontium	0.438	0.441	0.466	0.408
Sulfate	180	158	189	156
Thallium	0.013	0.003	0.014	0.003
Vanadium	<0.001	<0.001	<0.001	0.002
Zinc	0.0335	0.0017	0.0331	0.0032
Charge Balance, %	-1.30	-0.263	-0.965	0.835

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

	Site#29.5		Site#30	
	Sample Code Number			
	82WA101	82WA142	81WA129N	82WA103
	Date Collected			
	6/14/82	10/4/82	10/8/81	6/14/82
Determination				
Discharge, m^3/s	40	5.6	------	40
Temperature, °C	10.0	11.5	13.0	12.8
Specific Conductance,				
field, µS/cm	65.0	126	233	80.0
lab, µS/cm	53.0	113	195	60.0
pH, field	7.65	8.18	8.72	7.60
lab	7.79	6.92	8.05	7.72
Eh, volts	0.347	0.379	0.302	0.239
Alkalinity,				
mg/L as HCO_3	27.6	52.6	------	29.2
Aluminum	0.042	0.059	<0.01	0.068
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.002	0.006	0.008	0.003
Barium	0.017	0.019	0.03	0.019
Beryllium	<0.002	<0.002	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.02	0.09	0.22	0.02
Cadmium	0.00120	0.00010	<0.01	0.00060
Calcium	5.23	10.3	18	6.22
Chloride	0.6	2.8	8.3	0.7
Chromium	0.0003	0.0002	<0.003	0.0001
Cobalt	<0.001	<0.001	<0.005	0.002
Copper	<0.0005	0.0010	0.003	0.0020
Fluoride	0.05	0.074	------	0.05
Iron(Fe^{2+})	0.0162	0.0152	0.0130	0.0076
Iron(total)	0.0239	0.0426	0.0260	0.0087
Lead	<0.0005	0.0005	<0.02	<0.0005
Lithium	0.0047	0.0158	<0.0010	0.0041
Magnesium	1.46	3.02	4.9	1.87
Manganese	0.0044	0.0060	0.01	0.0305
Molybdenum	0.0136	0.0199	<0.003	0.0177
Nickel	<0.00015	0.00030	<0.004	0.00375
Potassium	0.80	1.73	2	0.893
Selenium	<0.002	<0.002	<0.002	<0.002
Silica	13.1	21.0	21	14.4
Sodium	2.65	8.96	16	3.32
Strontium	0.0833	0.165	0.26	0.0956
Sulfate	2.86	10.2	27.0	8.17
Thallium	<0.001	<0.001	<0.001	<0.001
Vanadium	0.001	<0.001	<0.005	<0.001
Zinc	0.0007	0.0014	<0.006	0.0008
Charge Balance, %	-1.05	1.91	-1.37	-2.57

Table 3.--Physical measurements and revised chemical analyses of water collected from the Leviathan/Bryant Creek drainage basin--Continued

Determination	Site #30	Site #30.2	Site #30.3
	Sample Code Number		
	82WA141	82WA102	82WA100
	Date Collected		
	10/4/82	6/14/82	6/14/82
Discharge, m^3/s	5.6	40	40
Temperature, °C	9.2	10.4	8.0
Specific Conductance,			
field, µS/cm	144	69.1	56.0
lab, µS/cm	137	55.0	51.0
pH, field	8.05	7.60	8.20
lab	8.11	7.73	7.59
Eh, volts	0.421	0.300	0.352
Alkalinity,			
mg/L as HCO_3	49.1	28.6	32.3
Aluminum	0.043	0.047	0.039
Antimony	<0.0005	<0.0005	<0.0005
Arsenic	0.008	0.002	0.003
Barium	0.019	0.017	0.014
Beryllium	<0.002	<0.002	<0.002
Bismuth	<0.0005	<0.0005	<0.0005
Boron	0.08	0.03	0.03
Cadmium	0.00010	0.00030	0.00005
Calcium	12.5	5.70	5.35
Chloride	3.0	0.6	0.6
Chromium	0.0003	0.0003	0.0003
Cobalt	0.002	0.001	<0.001
Copper	0.0010	0.0020	0.0015
Fluoride	0.090	0.051	0.04
Iron(Fe^{2+})	0.0040	0.0309	0.0167
Iron(total)	0.0089	0.0394	0.0207
Lead	<0.0005	<0.0005	<0.0005
Lithium	0.0158	0.0038	0.0047
Magnesium	3.845	1.70	1.545
Manganese	0.0673	0.0156	0.0061
Molybdenum	0.0191	0.0192	0.0150
Nickel	0.00600	0.00225	0.00090
Potassium	1.49	0.705	0.689
Selenium	<0.002	<0.002	<0.002
Silica	22.1	13.2	12.9
Sodium	7.88	2.92	2.87
Strontium	0.186	0.0885	0.0839
Sulfate	19.7	5.41	2.36
Thallium	<0.001	<0.001	<0.001
Vanadium	0.001	0.001	0.001
Zinc	0.0010	0.0010	0.0005
Charge Balance, %	1.02	-2.35	-5.15

COMPARISON OF RESULTS

In the following sections, the determinations of individual elements are discussed, and the various analytical techniques are compared. This report is primarily a presentation of the data. The details of the comparisons are presented in a separate report (Ball and Nordstrom, written commun., April, 1989), which focuses on the methods used. The discussions in this report are limited to identifying the values selected for inclusion in table 3 and briefly explaining why they were selected. On many occasions we refer to the term percent difference ($\Delta\%$) between values determined using alternative methods. This $\Delta\%$ function is calculated by:

$$\Delta\% = \frac{(\text{Method A Concentration - Method B Concentration})*100}{(\text{Method A Concentration + Method B Concentration})/2} \quad (1)$$

Thus, the maximum value of the result of this calculation is ±200. This means that a value for $\Delta\%$ of zero denotes perfect matching of analytical values, and a value approaching ±200 means there is no similarity between values.

Aluminum

For Al concentrations greater than 0.5 mg/L, the ICP and DCP results appear to be equivalent. Since there is a significant interference from Ca at the wavelength used for DCP analysis (Ball and Nordstrom, 1985), all DCP Al values except one have been replaced. For concentrations above 2 mg/L, ICP Al values have replaced the DCP values in table 3, and with one exception, GFAAS determinations for samples with concentrations below 2 mg/L have replaced the remaining DCP values. The exception is sample 82WA143, for which the GFAAS Al concentration estimate of 0.52 mg/L is about 10 times the GFAAS Al concentration of nearby samples of similar chemistry, and hence is believed to be contaminated. Thus, for this sample we have retained the DCP Al estimate of 0.14 mg/L.

Arsenic

In the following discussion, data for As obtained by the various techniques are compared with concentrations of As obtained by the hydride generation technique as the reference method. The hydride data are the most complete, precise and internally consistent, and are therefore the most convenient to use as a reference. However, as the reader will see from the ensuing discussion, no one method for the determination of As is always reliable.

Comparing the ICP with the DCP

Of the 63 samples in the set, seven measurable As concentrations were obtained by ICP, and eighteen by DCP. The three ICP As values less than 25 mg/L yielded $\Delta\%$ values of -64, 190 and 199 with respect to hydride values. The four ICP As values greater than 25 mg/L gave $\Delta\%$ values of -9.3, -2.7, 1.0 and 36.7. The fourteen samples with DCP As less than 25 mg/L yielded $\Delta\%$ values between 7.6 and 199, whereas the four samples with DCP As greater than 25 mg/L gave $\Delta\%$ values of -4.2, -2.6, -1.0 and 22.5. These results suggest that the ICP and DCP have equivalent capabilities to measure As, which evidently do not extend into the sub-mg/L range.

Comparing the GFAAS Technique with the Hydride Technique

Maest and Wing (1987) present evidence that for accurate total As determination by hydride generation, the sample must be pre-reduced before the sodium borohydride addition. The hydride determination procedure of Ball and Nordstrom (1985) did not include a pre-reduction step. This initially suggested that the hydride values of Ball and Nordstrom (1985) may have been erroneously low. Figure 3 is a plot of Δ% between hydride and GFAAS As as a function of hydride As concentration for all data, and illustrates the distinct positive bias in the GFAAS data at low As concentrations. This suggests that the GFAAS method of Maest and Wing (1987) may contain a systematic positive bias in the concentrations determined. Re-analysis of several samples in this set by both the hydride and the GFAAS techniques (table 4) strongly reinforces this hypothesis. For example, sample 82WA125, which gave an initial GFAAS As concentration of 0.022 mg/L, yielded a hydride-with-pre-reduction As value of 0.0016 mg/L. Similarly, sample 82WA126, which gave an initial GFAAS As concentration of 0.062 mg/L, yielded a GFAAS value of 0.006 mg/L upon re-analysis. Several similar examples listed in table 4 demonstrate that for the determination of As, the GFAAS technique is subject to a wide range of variability which is not yet under control.

Table 4.--Results of repeated As determinations for eight samples
[mg/L, milligrams per liter]

Sample	Hydride	GFAAS	GFAAS Reruns	Hydride Reruns
	mg/L			
82WA103	0.002	0.100		0.004, 0.126[1]
82WA125	0.001	0.022		0.0016
82WA126	0.003	0.062	0.006	
82WA141	0.004	0.013, 0.007	0.009	
82WA146	0.001	0.0085, 0.0015	0.002	
82WA156	0.001	0.022		0.0018
82WA163	0.017	0.019, 0.040	0.020	
82WA164	0.032	0.025, 0.069	0.067	

[1]Analysis was done on a separate subsample

GFAAS, ICP, and additional hydride data have been used to revise the initial hydride and DCP As data for the generation of the values in table 3. If initial hydride, GFAAS and additional hydride values approximate each other within ±15 percent above 2 mg/L or within ±150 percent below 2 mg/L they are averaged. If not, individual values for specific samples are examined with respect to what might be expected as a result of mixing and other downstream attenuation processes. Concentrations found by these techniques to be unreasonable are discarded. If no determination can be made, the original hydride values are retained.

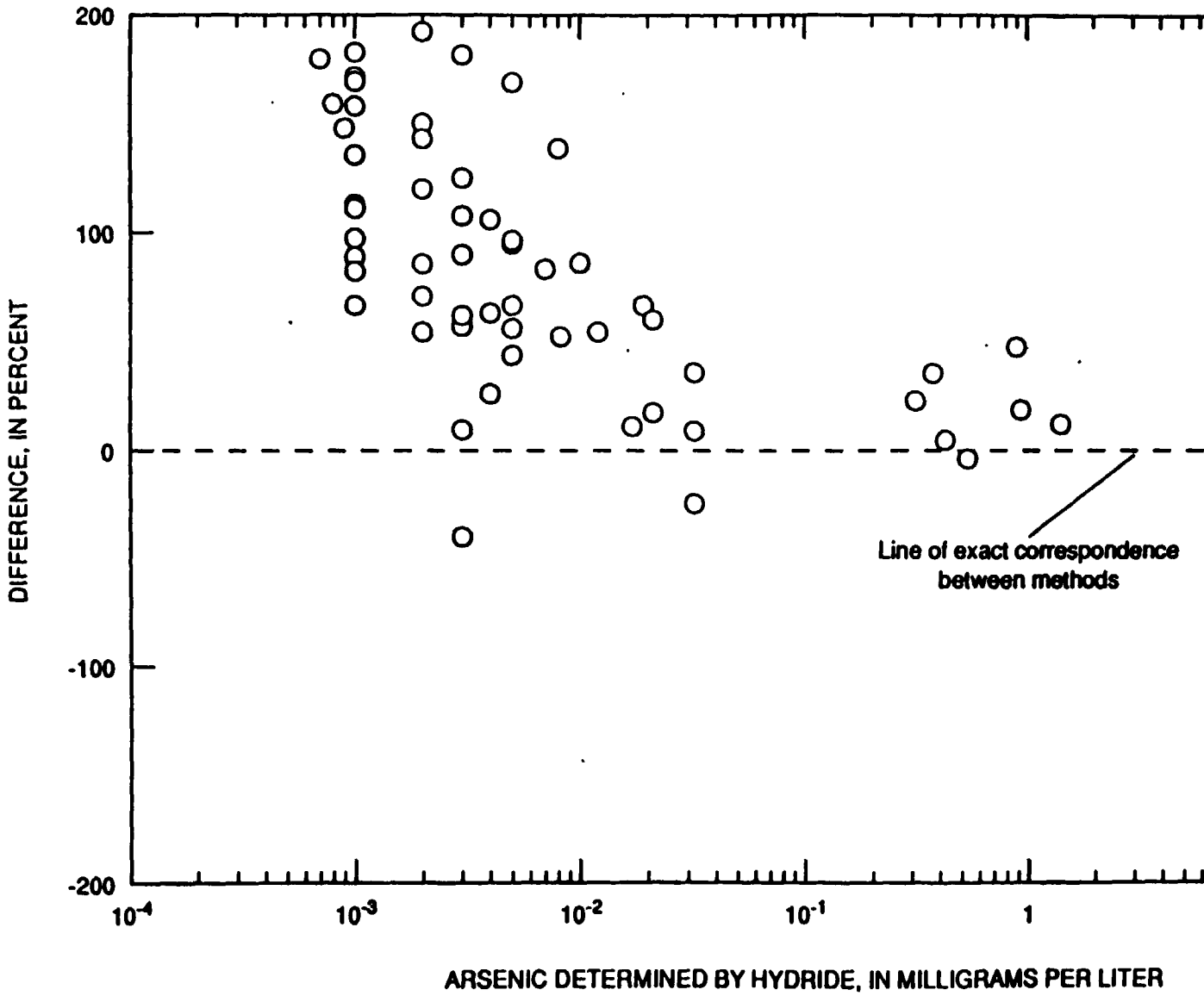

Figure 3. Plot of hydride-graphite furnace atomic absorption spectrometry percen
as compared with hydride arsenic concentration for all data.

Barium

The Ba concentrations in table 3 are the average of the ICP and DCP values, except for samples 82WA118, 119, 132, 165, 167, 168 and 169. These samples were analyzed by ICP only at a dilution of 1/10; hence their concentration values were below the ICP detection limit. DCP data were retained for these 7 samples. The maximum $\Delta\%$ between averaged values was 150, which occurred at the detection limit. More typical $\Delta\%$ values were 10 to 40.

Cadmium, Lead and Vanadium

Since all Cd, Pb and V concentrations were near or below both the ICP and DCP detection limits, GFAAS values for Cd, Pb and V were substituted into table 3 for all samples.

Calcium

For the revisions shown in table 3, ICP and DCP data for Ca were averaged in all but one case. For sample 82WA129, the DCP value was determined by plotting main stem Ca/SO_4 concentration ratios against SO_4 concentration (fig. 4) to be almost certainly in error. The DCP value of 49 mg/L therefore was ignored, and the ICP value of 64 mg/L was substituted.

Chromium

The results of the GFAAS Cr determinations suggest that the inter-element corrections for Fe on Cr determined by ICP and Ca on Cr determined by DCP may be in error. Therefore, GFAAS values for Cr were substituted where available; otherwise, the ICP and DCP concentration values which were computed before inter-element interference correction were retrieved from the intermediate data files and averaged. This was done only for the four most concentrated samples, 82WA118, 119, 132 and 169. The maximum $\Delta\%$ obtained for the values was 9.1.

Cobalt

No significant interferences are apparent in the ICP determination of Co in acid mine water matrix containing high concentrations of Ca, Fe, SiO_2, Al and Mg. The GFAAS and ICP Co determinations strongly suggest that many DCP Co values are inaccurate. Therefore, GFAAS values for Co were substituted where no ICP data were available; ICP values for Co were substituted where no GFAAS data were available; and, where both GFAAS and ICP data were available, the average of ICP and GFAAS was adopted. The maximum $\Delta\%$ calculated was -35.6; a more typical value was 10 to 20.

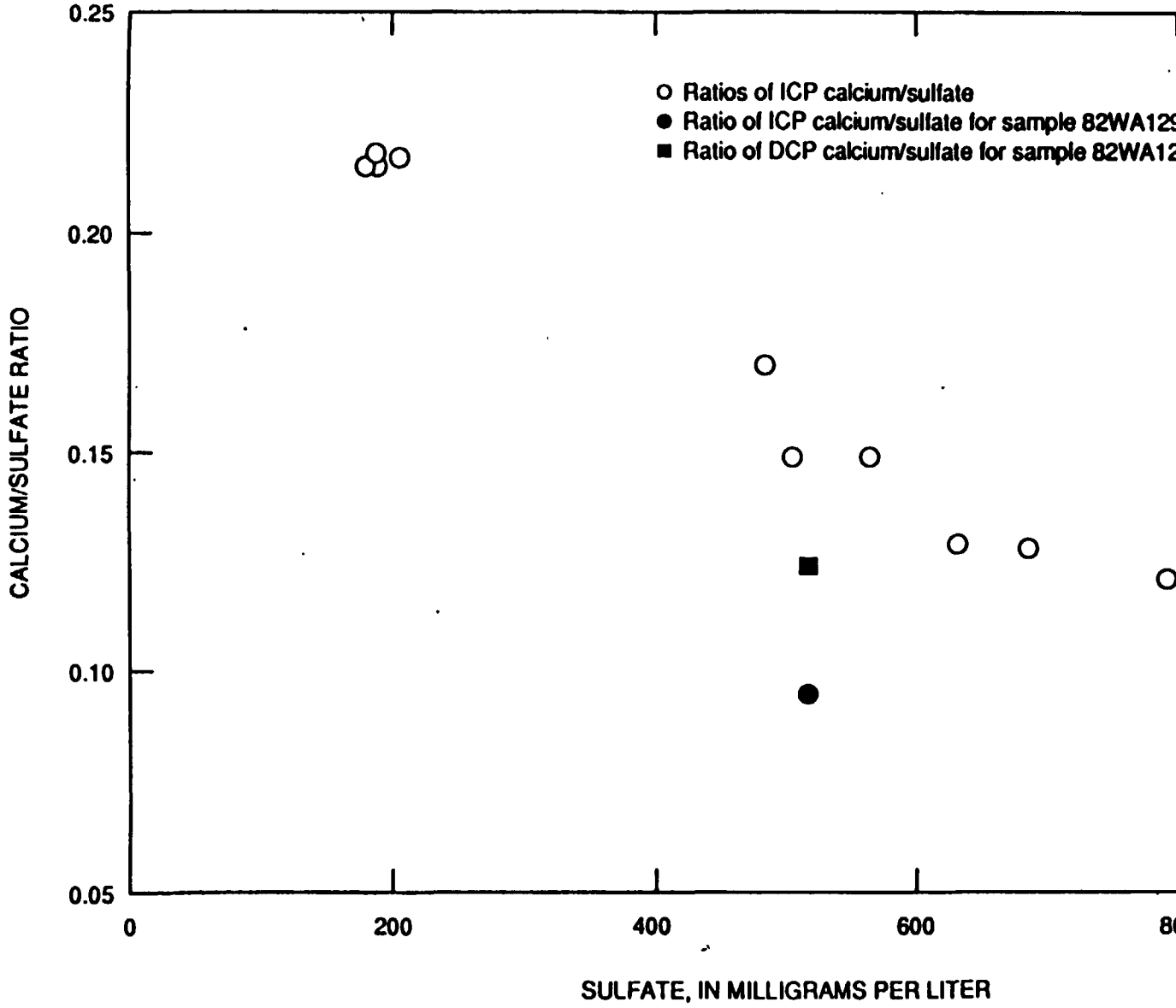

Figure 4. Plot of calcium/sulfate ratio as compared with sulfate concentration-June

Copper

GFAAS Cu concentrations are consistently less than DCP and ICP values above 0.5 mg/L. This difference could not be explained; therefore only GFAAS data for Cu less than 0.5 mg/L were adopted. Because the ICP Cu wavelength selected for the simultaneous element array was a secondary one because of geometric constraints in the construction of the slit plate, ICP Cu values are known with reduced precision and accuracy. Therefore, DCP Cu data have been retained at concentrations above 0.5 mg/L.

Iron

The Fe values of Ball and Nordstrom (1985) are unchanged. Geochemical modeling results from Fe redox species input data are shown in figures 5a and 5b, which are plots of Pt electrode Eh minus the Eh calculated by WATEQ4F from the activities of the Fe^{2+} and Fe^{3+} aqueous species (ΔEh) as a function of the concentration of total Fe and of pH. The outlying data point at a log total Fe concentration of 0.67 and a ΔEh of +0.23 is for an emf measurement and a water sample taken from a turbulent mixing zone where differential precipitation of Fe and Al oxides was occurring, and stable pH and emf readings could not be obtained. The second outlying point on the ΔEh as compared with pH plot, at a ΔEh of -0.14 and a pH of 4.2 is for a sample containing only 0.034 mg/L total Fe. This sample also contained detectable H_2S, the presence of which may significantly lower the emf measured using a Pt electrode. The outlying points at the high Fe, low pH end of the respective plots are more difficult to explain. They may represent measurements obscured by a mixed potential with significant contributions from other dissolved electroactive species. These two plots provide strong supporting evidence that, over the Fe concentration range in which the Fe(II/III) couple is known to determine the Pt electrode Eh (greater than 0.5 mg/L), excellent agreement may be expected between Eh values calculated from the activities of Fe^{2+} and Fe^{3+} and Eh values measured with a Pt electrode at the time of sample collection. These geochemical modeling results provide additional validation of the analytical values obtained for the Fe redox species.

Magnesium

On the basis of careful examination of all available Mg data and upon WATEQ4F charge balance calculations, the mean of the ICP and previously selected DCP value was adopted in all but 7 cases. For samples 82WA118, 119, 132, 165, 167, 168 and 169, the mean of the ICP value and the 1/100 dilution DCP value was adopted. The maximum Δ% value calculated for Mg was -23.3, with more typical values $\leq$15.

Manganese

GFAAS data have been placed in table 3 for all samples having Mn concentrations below 0.5 mg/L. For the remaining samples, all differences between ICP and DCP concentrations determined using the two techniques are less than 13 percent, and most are less than 5 percent. Hence, the average of the values appears in table 3.

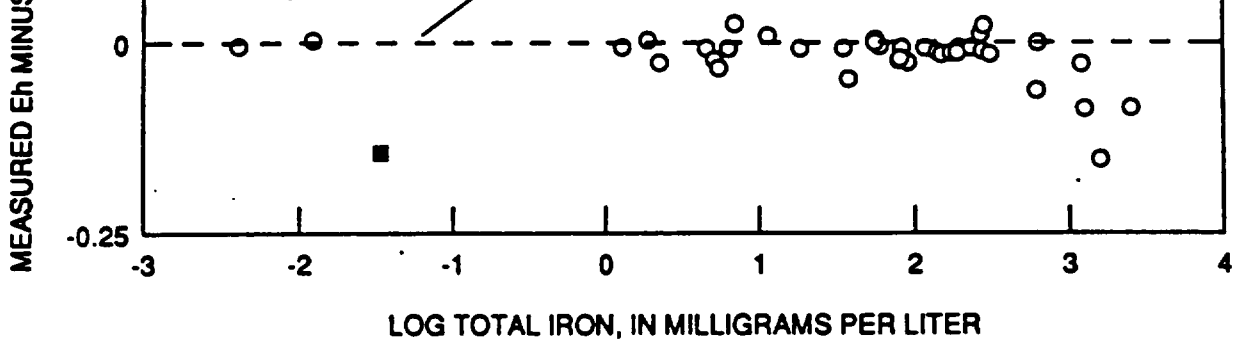

Figure 5a. Plot of Eh difference as compared with total iron - all Leviathan data.

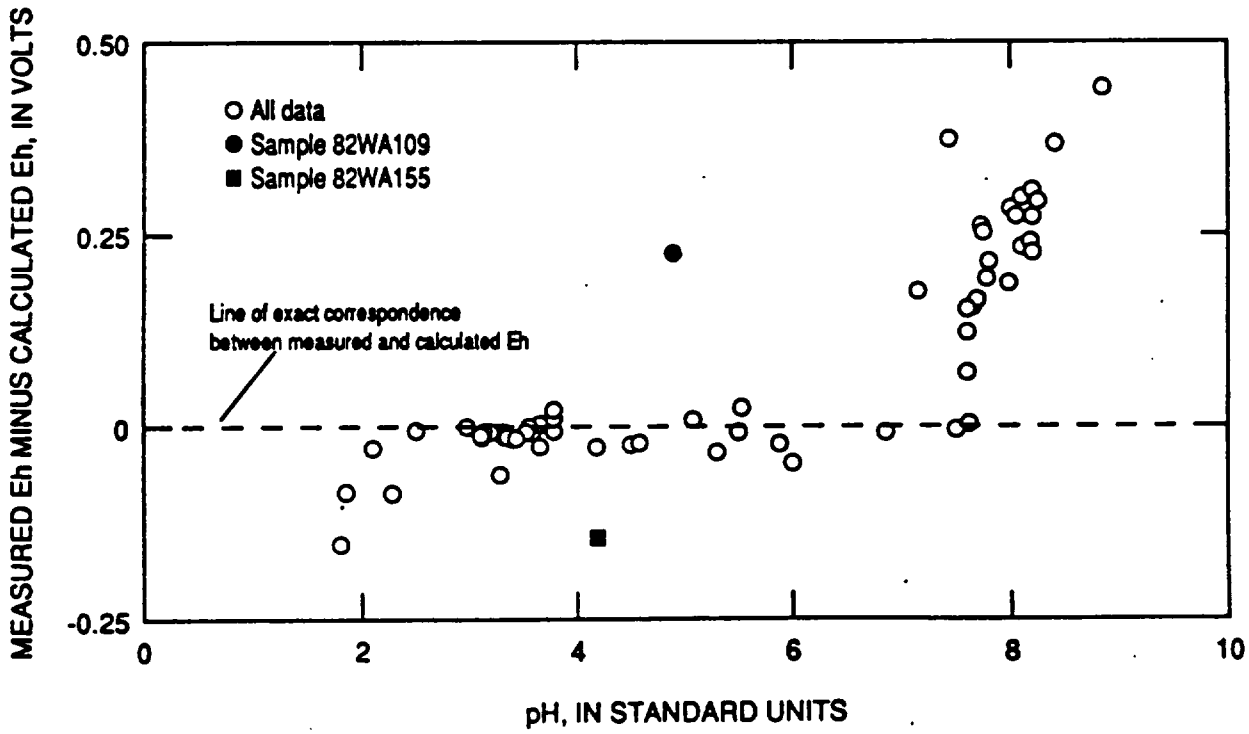

Figure 5b. Plot of Eh difference as compared with pH - all Leviathan data.

Nickel

All DCP values of Ball and Nordstrom (1985) have been replaced. GFAAS data for Ni were determined to be the most accurate because of the more favorable precision and sensitivity of the GFAAS technique, and were adopted when available. When GFAAS, DCP and ICP data were available, the ICP values were found by intercomparison to match the more accurate GFAAS estimates significantly better than the DCP values. Therefore, when Ni concentrations were above the 0.35 mg/L practical upper limit of GFAAS determination, the ICP values were placed in table 3.

Potassium and Sodium

The following selected samples were analyzed by flame AAS for K and Na: 82WA101, 104, 105, 109, 114, 116, 117, 118, 119, 120, 123, 125, 128, 132, 141, 143, 144, 146, 147, 153, 155, 156, 157, 159, 161, 162, 165 and 169. With the compromise torch power and entrance slit alignment settings used for the ICP analyses, the ICP spectrometer is only marginally useful for the analysis of K and Na in this range of matrix and K and Na concentrations. Therefore, all available flame AAS values have been adopted for these samples. For the remaining samples, the DCP K and Na values were retained. The maximum error in the DCP Na and K estimates remaining in table 3 is 20 percent of the concentration reported.

Silicon

No reliable ICP Si data could be obtained. However, the DCP detection limit for Si was redetermined for this investigation, and found to be 1 mg/L rather than the previously used 2 mg/L value. The best values selection procedure was repeated for the DCP determinations using the 1 mg/L detection limit, resulting in the selection of new SiO_2 values for the following 24 samples: 82WA108, 109, 111, 112, 117, 121, 123, 126, 128, 143, 145, 146, 147, 148, 149, 150, 151, 153, 154, 155, 156, 159, 162, 170.

Strontium

The DCP detection limit for Sr was reduced to 1 mg/L, the selection of best values was repeated, and the resulting DCP values and the ICP values were averaged. For two samples, 82WA125 and 82WA156, the ICP concentrations are significantly lower than their DCP counterparts. Strontianite solubility indices calculated using WATEQ4F and comparison of element ratios suggest that the DCP values are more accurate. Therefore, the ICP values were not used for these two samples. The maximum $\Delta\%$ calculated for Sr was 11.

Sulfate

Evaluation techniques additional to the those used to select the best SO_4 values presented by Ball and Nordstrom (1985) were employed to test the validity of those SO_4 values based on the more accurate and precise data for the other elements presented here. The primary technique was comparison of element ratios between sampling sites on the main stem

of Leviathan/Bryant Creek. This technique simplified the identification of conservative and nonconservative constituents and of questionable or erroneous data values. Bencala and others (1987) define conservative behavior as an absence of sources or sinks of dissolved solutes within the water column. Thus, a conservative constituent is one that does not change in concentration by chemical reaction. Using the above techniques, Ba, Ca, Li, Mg, Na, K, SiO_2, Sr and SO_4 tended to be conservative over the stream reach between sampling sites 7.5 and 17.

The October Site 8 (82WA163) SO_4 value of 1,520 mg/L appears to be a reasonably reliable analysis because the charge balance is -1.9 percent and the Site 8/Site 7.5 ratio is 0.97, compared with a mean for all conservative constituents of 0.93 (see table 5 and fig. 6a). The SO_4 value for Site 10.5 (82WA161) of 1,600 mg/L yields a speciated charge balance of +9.4 percent and an element ratio for Site 10.5/Site 8 of 1.05, compared with the average ratio for the other conservative constituents of 1.23 (see table 5 and fig. 6b). If we take 1.23 times the Site 8 SO_4 value of 1,520 = 1,870 mg/L, charge balance is vastly improved from the initial +9.4 percent to -1.89 percent. Furthermore if we use 1,870 mg/L SO_4 for Site 10.5, the SO_4 ratio for Site 11.5/10.5 is reduced from 0.94 to 0.78. The average ratio for all conservative constituents for those two sites is 0.85. However, the earlier value of 1,460 mg/L for SO_4 at site 11.5 appears to be in error because nearly every constituent decreases slightly from site 11.5 to site 15, with an average ratio of 0.96. Hence, if we choose 1,550 mg/L SO_4 for 82WA160 (Site 11.5), its charge balance is greatly improved from +3.10 percent to -1.12 percent, the SO_4 ratio is improved to 0.83 (fig. 6c), and the Site 15/11.5 ratio is improved from 1.01 to 0.95 (figs. 6d and 7). Figures 8a and 8b and figures 9a and 9b show that the charge balance frequency distribution and the correspondence of conductance to SO_4 concentration, respectively, are also improved.

Metal/SO_4 ratios are another set of independent checks of the accuracy of SO_4 determinations. Four metal/SO_4 ratios are plotted as compared with SO_4 in figure 10 and five are plotted as compared with sample site in figure 11. The metal/SO_4 ratios are also improved using these revised SO_4 values. The Cr, Co, Mn and Ni relations shown in figure 10 illustrate that the June Mountaineer Creek site (82WA108) was likely contaminated at the time of collection, probably by airborne particulate matter. This sample was found to contain these four trace metals plus Al and Zn (data not shown) at concentrations 4.25 to 5,100 times higher than those found in the October sample at the same site (82WA147). The ion ratios and metal/SO_4 ratios suggest that Zn, Cd and Li are our most reliable conservative tracers so far. With the above two changes, all charge balances for the October 1982 set of samples are less than ±3.5 percent except those for 82WA165, 168 and 169.

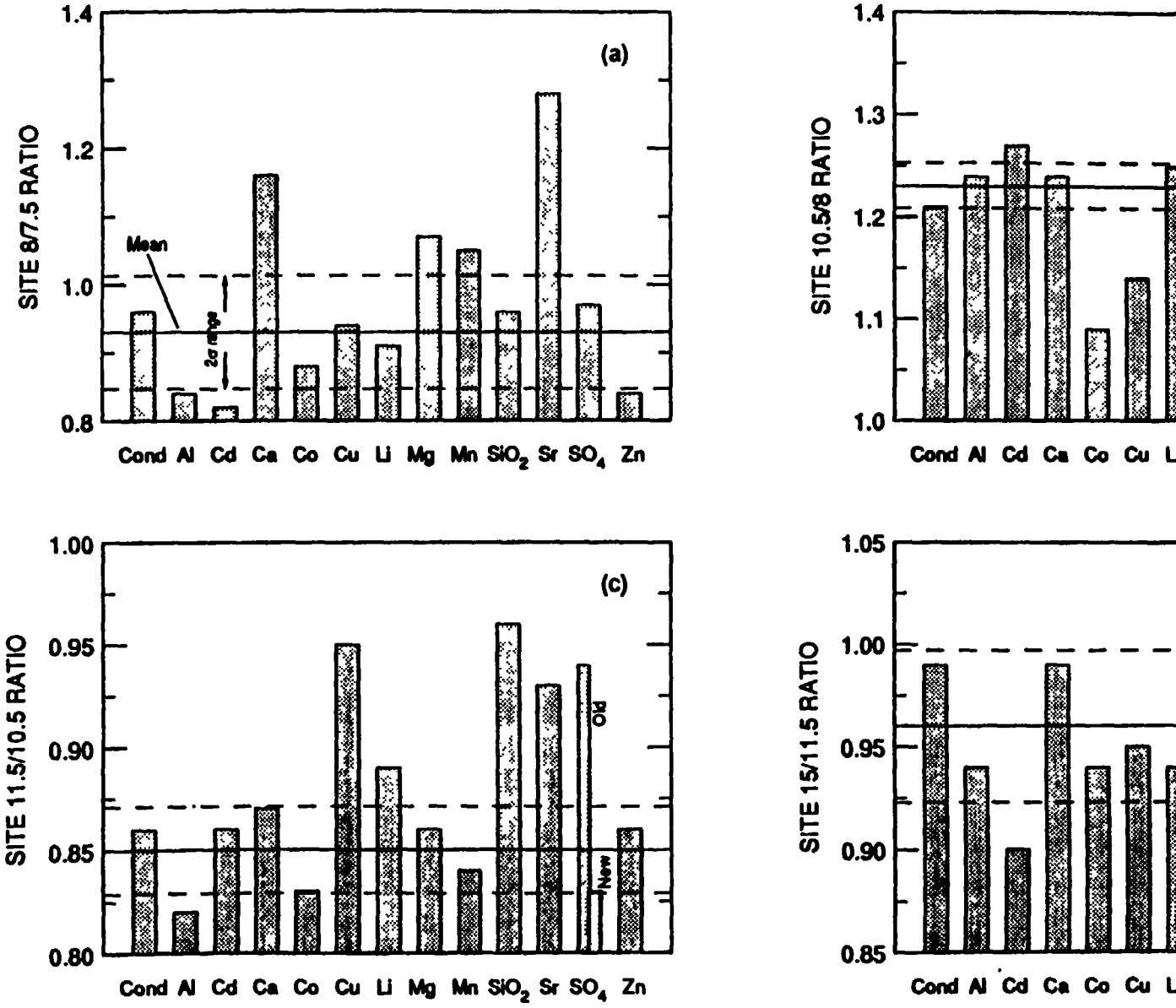

Figure 6. Plots of element ratios for sites 7.5 to 15 - October main ster

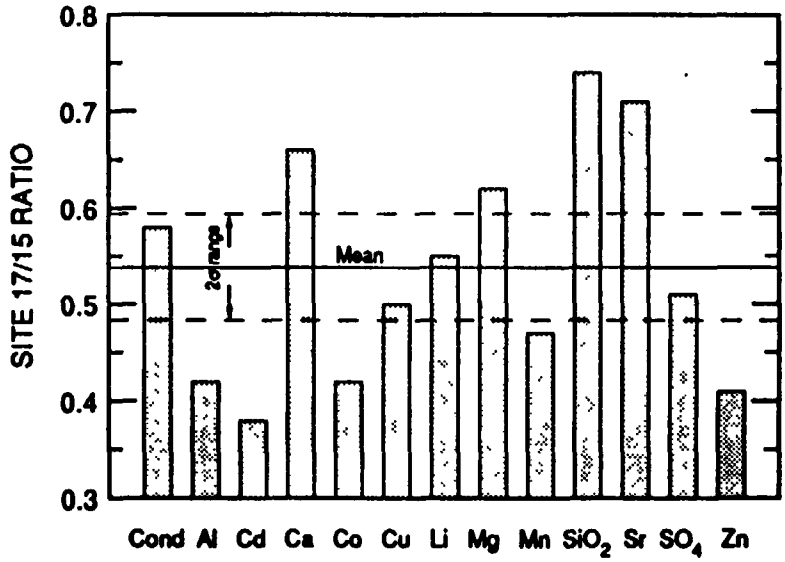

Figure 7. Plot of element ratios for sites 15 and 17 - October main stem

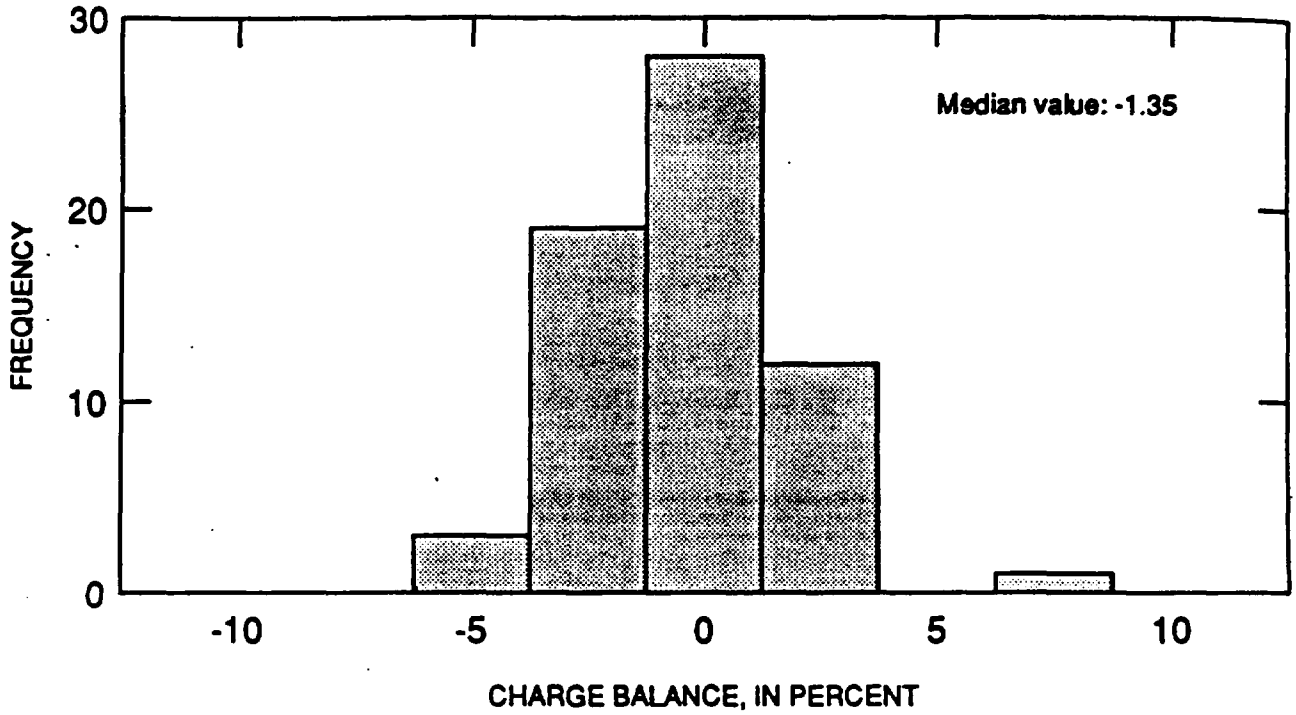

Figure 8a. Frequency plot of speciated charge balance (initial data).

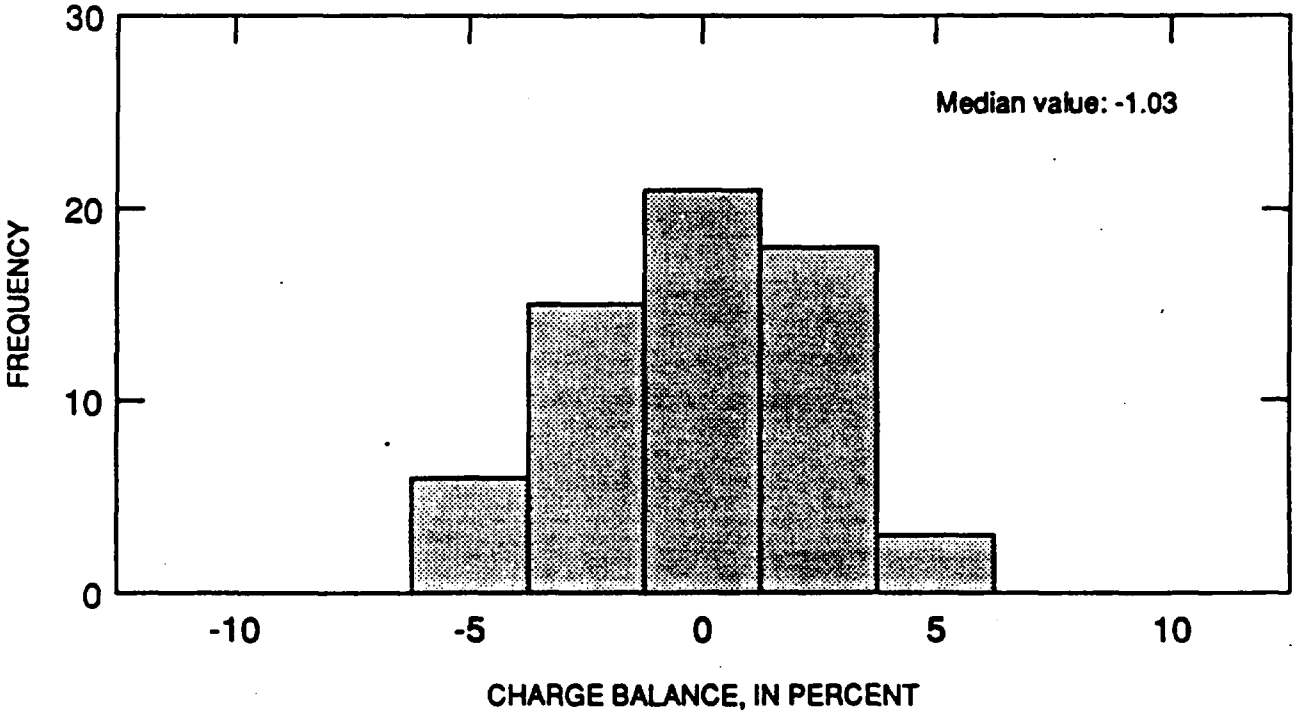

Figure 8b. Frequency plot of speciated charge balance (revised data).

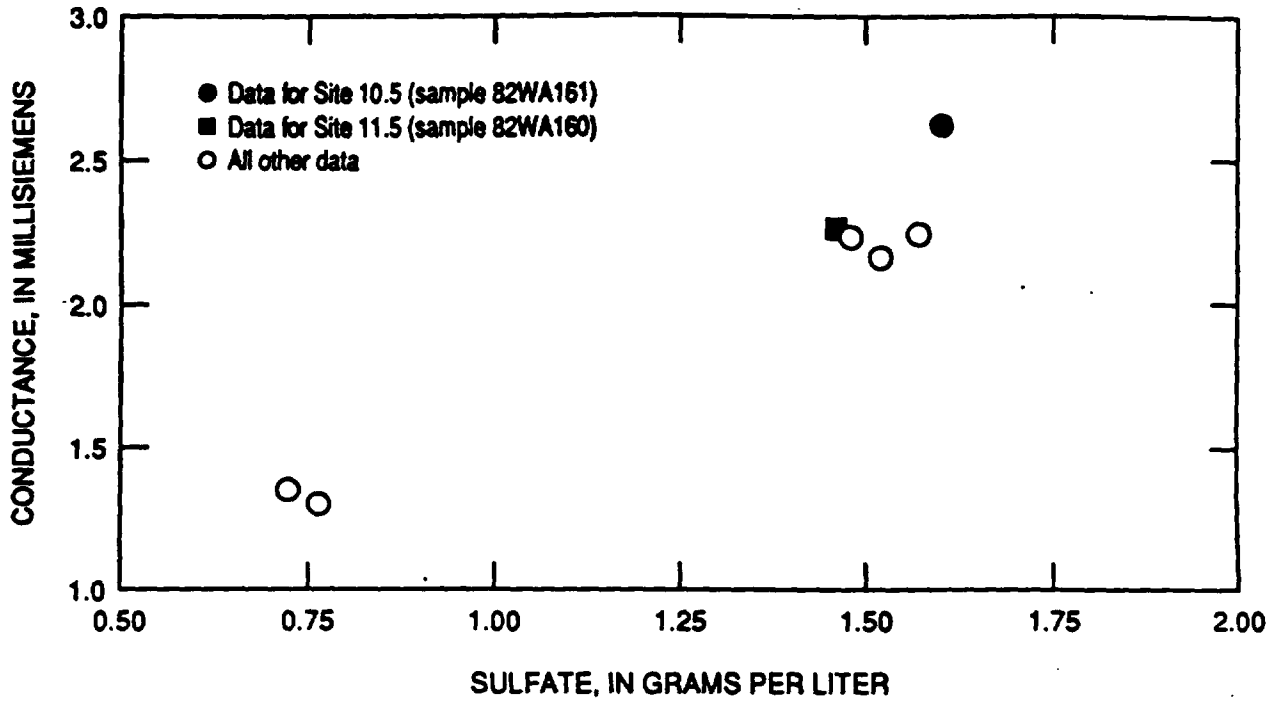

Figure 9a. Plot of conductance as compared with sulfate concentration-October main stem-before sulfate revision.

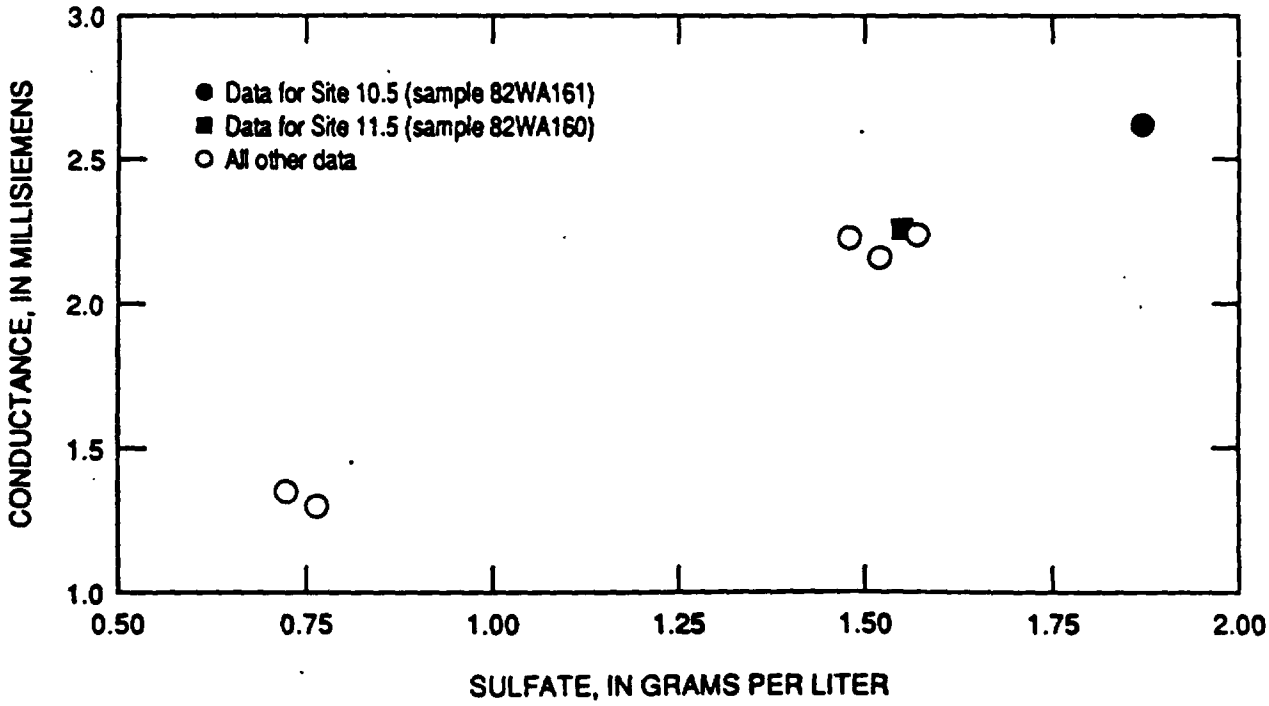

Figure 9b. Plot of conductance as compared with sulfate concentration-October main stem-after sulfate revision.

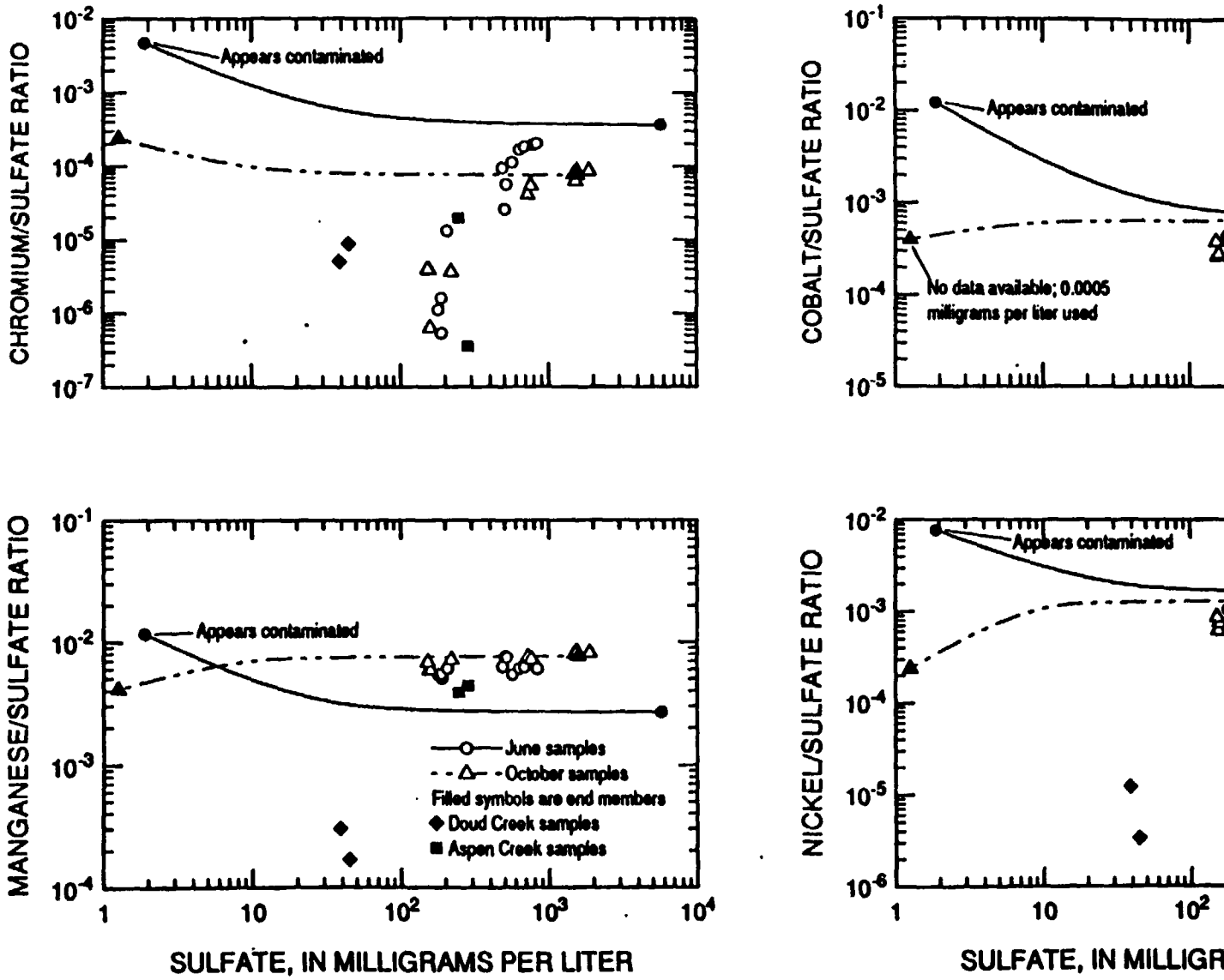

Figure 10. Plots of ideal mixing lines (solid for June, dashed for October samp element/sulfate ratios as compared with sulfate concentration for June a October main stem samples for chromium, cobalt, manganese and nicke

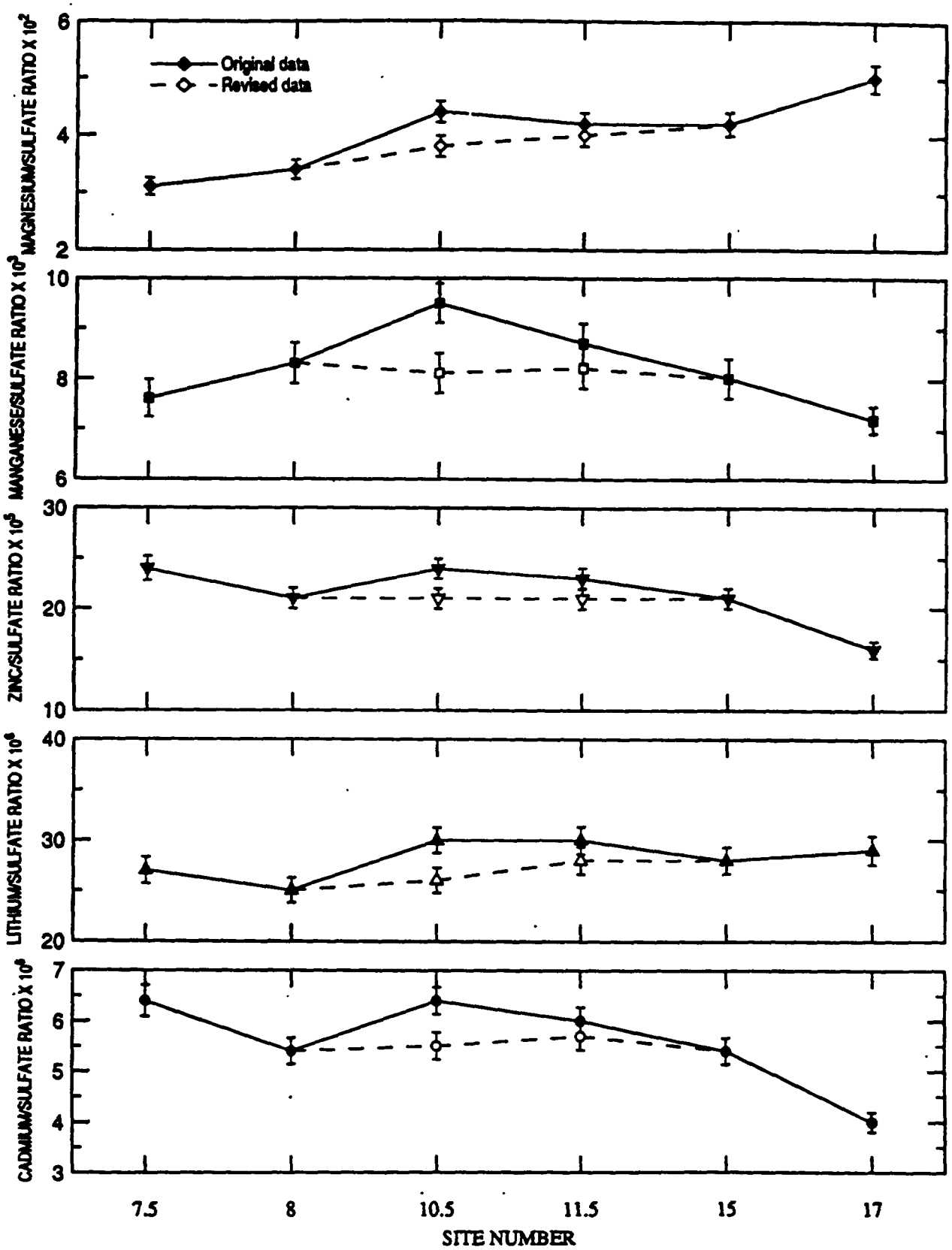

Figure 11. Metal/sulfate ratios for October sample sites 7.5 to 17 for magnesium, manganese, zinc, lithium and cadmium.

Table 5.--Element ratios for October, 1982 main stem sites 7.5 to 17

Measurement	Sites 8/7.5	10.5/8	11.5/10.5	15/11.5	17/15
Conductance	0.96	1.21	0.86	0.99	0.58
Al	0.84	1.24	0.82	0.94	0.42[1]
Cd	0.82	1.27	0.86	0.90	0.38[1]
Ca	1.16[1]	1.24	0.87	0.99	0.66[1]
Co	0.88	1.09[1]	0.83	0.94	0.42[1]
Cu	0.94	1.14[1]	0.95[1]	0.95	0.50
Li	0.91	1.25	0.89	0.94	0.55
Mg	1.07	1.37[1]	0.86	1.00	0.62
Mn	1.05	1.21	0.84	0.93	0.47
SiO_2	0.96	1.11[1]	0.96[1]	0.98	0.74[1]
Sr	1.28[1]	1.23	0.93[1]	1.01	0.71[1]
SO_4	0.97	1.05[12](1.23)[3]	0.94[12](0.83)[3]	1.01[2](0.95)[3]	0.51
Zn	0.84	1.20	0.86	0.92	0.41[1]
Average(s.d.)[4]	0.93(0.083)	1.23(0.022)	0.85(0.021)	0.96(0.037)	0.54(0.056)
2σ Range	0.85-1.01	1.21-1.25	0.83-0.88	0.92-1.00	0.48-0.59

[1]Outlier
[2]Ratio using initial SO_4 values
[3]Ratio using revised SO_4 values
[4]Calculated using conservative constituents only and excluding SO_4

Zinc

For samples containing Zn at a concentration of 50 μg/L or less, GFAAS values were adopted. For the remaining samples, the ICP, DCP cassette 1 and DCP cassette 2 values have been averaged. Several samples had values which were 15 percent or more higher than the other two estimates, and it was concluded that these samples were subject to random contamination at analysis time. The values were therefore ignored when computing the mean values. The maximum Δ% calculated using the above criteria was 15.

SUMMARY

Water samples collected from the Leviathan/Bryant Creek drainage basin during 1981-82 were analyzed shortly after collection for 37 major and trace constituents using direct-current-argon plasma emission spectrometry, flame, hydride generation and graphite furnace atomic absorption spectrometry, UV-visible colorimetry, and ion chromatography. Since the initial analyses, the same samples have been analyzed further by ICP and GFAAS for many metallic constituents. This additional analysis has resulted in many revisions of concentrations, the replacement of previously less-than-detection values for the trace metals, and multiple values for many major constituents, all of which provides a more complete and precise set of concentration estimates.

The constituents for which additional and revised concentration values have been substituted are Al, As, Ba, Cd, Ca, Cr, Co, Cu, K, Mg, Mn, Na, Ni, Pb, SiO_2, Sr, V and Zn. Concentrations remaining unchanged are those for B, Be, Bi, Cl, F, Fe^{2+}, Fe^{total}, Li, Mo, Sb, Se and Tl. Concentrations of Al, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, SiO_2, Sr, V, and Zn were determined by ICP spectrometry to obtain values that could be compared with their DCP counterparts. Elements determined by Zeeman GFAAS to extend the detection limit to levels below those obtainable by ICP or DCP spectrometry were: Al, As, Cd, Cr, Co, Cu, Mn, Ni, Pb, V and Zn. The alkali metals Na and K were determined by flame AAS on a selected subset of samples to obtain revised concentration estimates for those samples.

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PARTIAL SOIL REMEDIATION AND REVEGETATION OF THE LEVIATHAN MINE

(Claassen, 1997)

Soil Quality Results from the Project Database
Claussen (1997)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
25935		B	2.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
25935		bicrbP	37	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
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25935		Ca	20	percent	Sampled in 1995/1996. No adequate location info	CLA-002
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LM054		CEC	55.5	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Cu	4.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Cutot	60	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		EC	1.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Fe	184	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		H	42	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		H	75	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		K	0.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		K	89	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Mg	5.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Mg	348	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Mn	28	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Na	12	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Nitot	11	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		pH	3.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		SO4	448	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		wkbrP	30	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM054		Zn	0.8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		As	130	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		B	1.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Ca	21.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Ca	2970	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		CEC	70.3	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Cu	8.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

LM055		Cutot	67	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		EC	1.5	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Fe	193	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		H	50	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		H	70.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		K	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		K	476	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Mg	7.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Mg	665	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Mn	38	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Nitot	16	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		pH	4.2	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		SO4	339	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		wkbrP	86	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM055		Zn	1.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		As	100	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		B	0.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		buff pH	6.4	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Ca	28.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Ca	630	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		CEC	11.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Cu	97.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Cutot	260	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		EC	0.2	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Fe	70	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		H	6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		H	57.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		K	1.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		K	48	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Mg	12.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Mg	164	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Mn	15	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Na	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		pH	4.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		SO4	74	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		wkbrP	15	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM056		Zn	1.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		B	1.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		B	1.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		bicrbP	70	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		bicrbP	121	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		bicrbP	123	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		buff pH	5.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		buff pH	5.6	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	15	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	29.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	30.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	2200	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	2230	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Ca	2400	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		CEC	35.5	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		CEC	41.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		CEC	74	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Cu	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Cu	18.9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Cu	24.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

LM3-2D		EC	1.3	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		EC	1.7	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		EC	2.3	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Fe	129	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Fe	131	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Fe	142	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	18	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	22	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	50.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	54	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	56	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		H	75	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		K	1.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		K	1.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		K	148	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		K	178	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		K	349	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	8.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	15.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	17.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	752	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	780	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mg	782	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mn	74	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Mn	200	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Na	11	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Na	13	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		NO3	47	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		NO3	48	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		NO3	77	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		OM%	0.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		OM%	2.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		OM%	3.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		pH	3.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		pH	4.6	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		pH	4.7	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		SO4	81	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		SO4	151	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		SO4	184	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		wkbrP	48	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		wkbrP	94	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		wkbrP	106	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Zn	4.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Zn	7.8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2D		Zn	11.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		B	1.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		bicrbP	48	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Ca	14.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Ca	2830	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		CEC	100	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Cu	8.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		EC	1.3	dS	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Fe	185	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		H	75	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		H	75	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		K	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		K	230	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Mg	10.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Mg	1233	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Mn	250	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Na	33	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		NO3	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

LM3-2Dpre		OM%	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		pH	4	su	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		SO4	318	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		wkbrP	28	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
LM3-2Dpre		Zn	5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		B	1.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		bicrbP	29	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		buff pH	4.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Ca	19.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Ca	5440	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		CEC	137	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Cu	3.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		EC	1.8	dS	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Fe	260	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		H	75.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		H	103	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		K	0.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		K	218	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Mg	4.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Mg	780	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Mn	66	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Mo	0.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Na	20	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		OM%	0.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		pH	3.6	su	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		SO4	605	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		wkbrP	46	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
lower tier		Zn	1.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		B	1.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		bicrbP	29	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		buff pH	4.1	su	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Ca	19.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Ca	3720	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		CEC	95.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Cu	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		EC	1.9	dS	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Fe	180	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		H	71	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		H	75	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		K	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		K	209	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Mg	4.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Mg	557	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Mn	71	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Mo	0.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Na	24	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		pH	3.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		SO4	713	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		wkbrP	8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
middle tier		Zn	1.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		As	370	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		B	0.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		bicrbP	58	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Ca	87.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Ca	2140	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		CEC	12.2	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Cu	1.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Cutot	19	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		EC	0.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Fe	18	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

OC C MIDDLE		K	1.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		K	58	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Mg	4.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Mg	73	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Mn	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		pH	6.6	su	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		SO4	5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		wkbrP	32	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OC C MIDDLE		Zn	0.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		As	150	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		B	0.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		bicrbP	32	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		buff pH	4	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Ca	13.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Ca	1330	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		CEC	50.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Cu	2.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Cutot	23	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		EC	0.1	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Fe	43	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		H	38	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		H	75.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		K	0.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		K	152	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Mg	10.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Mg	649	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Mn	31	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Na	36	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		OM%	0.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		pH	4	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		SO4	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		wkbrP	24	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL A upperm		Zn	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		As	330	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		B	0.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		bicrbP	64	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Ca	93.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Ca	1800	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		CEC	9.6	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Cu	0.9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Cutot	14	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		EC	0.2	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Fe	5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		K	1.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		K	46	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Mg	5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Mg	58	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Mn	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Na	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Na	13	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		OM%	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		pH	7.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		SO4	18	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		wkbrP	17	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B EAST		Zn	0.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

OL B FAR EAST		As	630	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		B	0.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		bicrbP	52	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Ca	91.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Ca	1430	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		CEC	7.8	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Cu	1.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Cutot	16	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		EC	0.3	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Fe	16	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		H	54	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		K	1.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		K	46	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Mg	5.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Mg	56	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Mn	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Na	0.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		pH	7.1	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		SO4	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		wkbrP	20	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B FAR EAST		Zn	0.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		As	310	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		B	0.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		bicrbP	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		buff pH	6.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Ca	83.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Ca	1760	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		CEC	10.5	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Cu	1.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Cutot	25	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		EC	0.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Fe	25	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		H	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		H	7.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		K	1.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		K	53	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Mg	7.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Mg	95	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Mn	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Na	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		pH	6.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		SO4	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		wkbrP	17	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B MIDDLE		Zn	0.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		As	720	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		B	0.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		bicrbP	46	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		buff pH	6.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Ca	77.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Ca	2320	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		CEC	14.9	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Cu	1.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Cutot	20	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		EC	0.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Fe	23	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		H	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		H	7.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002

OL B WEST		K	2.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		K	132	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Mg	12.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Mg	223	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Mn	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Na	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		OM%	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		pH	6.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		SO4	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		wkbrP	16	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL B WEST		Zn	0.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		As	120	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		B	0.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		bicrbP	50	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Ca	93.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Ca	1520	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		CEC	8.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Cu	0.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Cutot	25	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		EC	0.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Fe	6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		K	1.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		K	48	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Mg	4.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Mg	45	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Mn	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Na	0.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Na	8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		pH	7	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		SO4	31	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		wkbrP	11	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C EAST		Zn	0.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		As	320	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		B	0.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		bicrbP	93	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		buff pH	6.1	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Ca	35.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Ca	1430	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		CEC	20.2	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Cu	1.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Cutot	17	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		EC	0.1	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Fe	27	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		H	11	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		K	1.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		K	114	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Mg	9.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Mg	223	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Mn	12	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Na	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		pH	4.6	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		SO4	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		wkbrP	134	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL C WEST		Zn	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		As	170	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

OL D SOUTH		B	0.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		bicrbP	40	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		buff pH	6.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Ca	29	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Ca	820	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		CEC	14.1	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Cu	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Cutot	9.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		EC	0.1	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Fe	27	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		H	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		H	66	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		K	1.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		K	70	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Mg	10.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Mg	182	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Mn	12	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Na	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		pH	4.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		SO4	41	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		wkbrP	40	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D SOUTH		Zn	1.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		As	40	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		B	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		bicrbP	98	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		buff pH	5.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Ca	34	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Ca	2240	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		CEC	32.9	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Cu	1.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Cutot	8.8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		EC	0.2	dS	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Fe	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		H	19	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		H	58.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		K	1.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		K	189	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Mg	6.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Mg	256	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Mn	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Na	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Nitot	10	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		pH	4.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		SO4	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		wkbrP	46	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
OL D WEST		Zn	0.8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		B	0.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		bicrbP	29	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		buff pH	4.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Ca	16.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Ca	1210	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		CEC	35.8	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Cu	1.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		EC	0.9	dS	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Fe	104	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		H	27	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		H	75.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		K	0.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002

p1N slope		K	75	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Mg	7.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Mg	327	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Mn	18	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		NO3	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		OM%	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		pH	3.4	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		SO4	449	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		wkbrP	8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1N slope		Zn	0.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		B	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		bicrbP	40	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		buff pH	5.1	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Ca	30.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Ca	3520	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		CEC	56.8	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Cu	3.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		EC	1.6	dS	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Fe	220	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		H	38	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		H	66	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		K	0.7	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		K	150	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Mg	2.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Mg	155	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Mn	8	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Mo	0.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Na	17	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		pH	4.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		SO4	750	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		wkbrP	13	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u1-pad		Zn	1.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		B	0.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		bicrbP	17	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		buff pH	4.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Ca	21.5	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Ca	1350	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		CEC	31.4	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Cu	6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		EC	1.7	dS	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Fe	300	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		H	24	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		H	75.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		K	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		K	73	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Mg	2.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Mg	108	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Mn	12	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Mo	0.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Na	9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		pH	3.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		SO4	720	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		wkbrP	37	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
p1u2-north		Zn	1.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		B	0.9	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		bicrbP	35	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002

P2UES		Ca	29.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Ca	3030	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		CEC	51.4	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Cu	4.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		EC	0.4	dS	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Fe	145	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		H	30	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		H	58	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		K	1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		K	195	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Mg	11.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Mg	723	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Mn	49	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Na	6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		NO3	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		pH	4.5	su	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		SO4	134	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		wkbrP	25	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
P2UES		Zn	2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		B	2.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		bicrbP	14	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		buff pH	4.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Ca	20	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Ca	4980	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		CEC	124	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Cu	6.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		EC	1.9	dS	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Fe	240	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		H	74.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		H	92	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		K	0.6	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		K	315	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Mg	5.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Mg	792	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Mn	190	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Mo	0.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Na	24	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		NO3	4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		OM%	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		pH	4.1	su	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		SO4	583	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		wkbrP	30	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
upper tier		Zn	4.3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		B	1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		bicrbP	88	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Ca	17.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Ca	2240	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		CEC	64.8	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Cu	2.2	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		EC	0.3	dS	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Fe	82	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		H	49	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		H	75	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		K	0.8	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		K	210	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Mg	6.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Mg	541	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Mn	42	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Na	0	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Na	7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

Soil Quality Results from the Project Database
Claussen (1997)
Leviathan Mine Site
Alpine County, California

x079		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x079		pH	3.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
x079		SO4	133	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		wkbrP	40	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x079		Zn	1.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		B	1.5	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		bicrbP	64	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Ca	19.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Ca	1570	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		CEC	40.7	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Cu	4.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		EC	2	dS	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Fe	165	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		H	31	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		H	74.9	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		K	0.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		K	45	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Mg	5.3	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Mg	264	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Mn	31	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Na	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Na	13	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		OM%	0.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x081		pH	2.9	su	Sampled in 1995/1996. No adequate location info	CLA-002
x081		SO4	438	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		wkbrP	37	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x081		Zn	0.7	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		B	1.4	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		bicrbP	93	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		buff pH	4.8	su	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Ca	14	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Ca	1300	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		CEC	46.2	cmol/kg	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Cu	8.1	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		EC	2.6	dS	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Fe	97	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		H	35	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		H	75.1	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		K	0.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		K	73	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Mg	10.4	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Mg	586	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Mn	49	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Na	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Na	16	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		NO3	3	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		OM%	0.2	percent	Sampled in 1995/1996. No adequate location info	CLA-002
x082		pH	3.3	su	Sampled in 1995/1996. No adequate location info	CLA-002
x082		SO4	434	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		wkbrP	31	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002
x082		Zn	1.6	ug/g	Sampled in 1995/1996. No adequate location info	CLA-002

Notes:

Informaton obtained from database source code CLA-002 within the project database. The original source was from *Partial Soil Remeditaion and Revegetation of the Leviathan Mine,* Vic Claassen and Michael Hogan, Univ CA, Davis (1997)

Ca = Calcium, Cu = Copper, EC = Electrical Conductivity, Fe = Iron, K = Potassium, Mg = Magnesium, Mn = Manganese, Na = Sodium, NO3 = Nitrate, SO4 = Sulfate, Zn = Zinc, su= standard units, CEC = cation exchange capacity, cmol/kg = centimole per kilogram, dS = deciseimens, ug/g = microgram per gram

TRACE ELEMENT ERICHMENT IN STREAMBED SEDIMENT AND CRAYFISH, CARSON AND TRUCKEE RIVERS, NEVADA AND CALIFORNIA, SEPTEMBER 1992

(USGS, 1998)

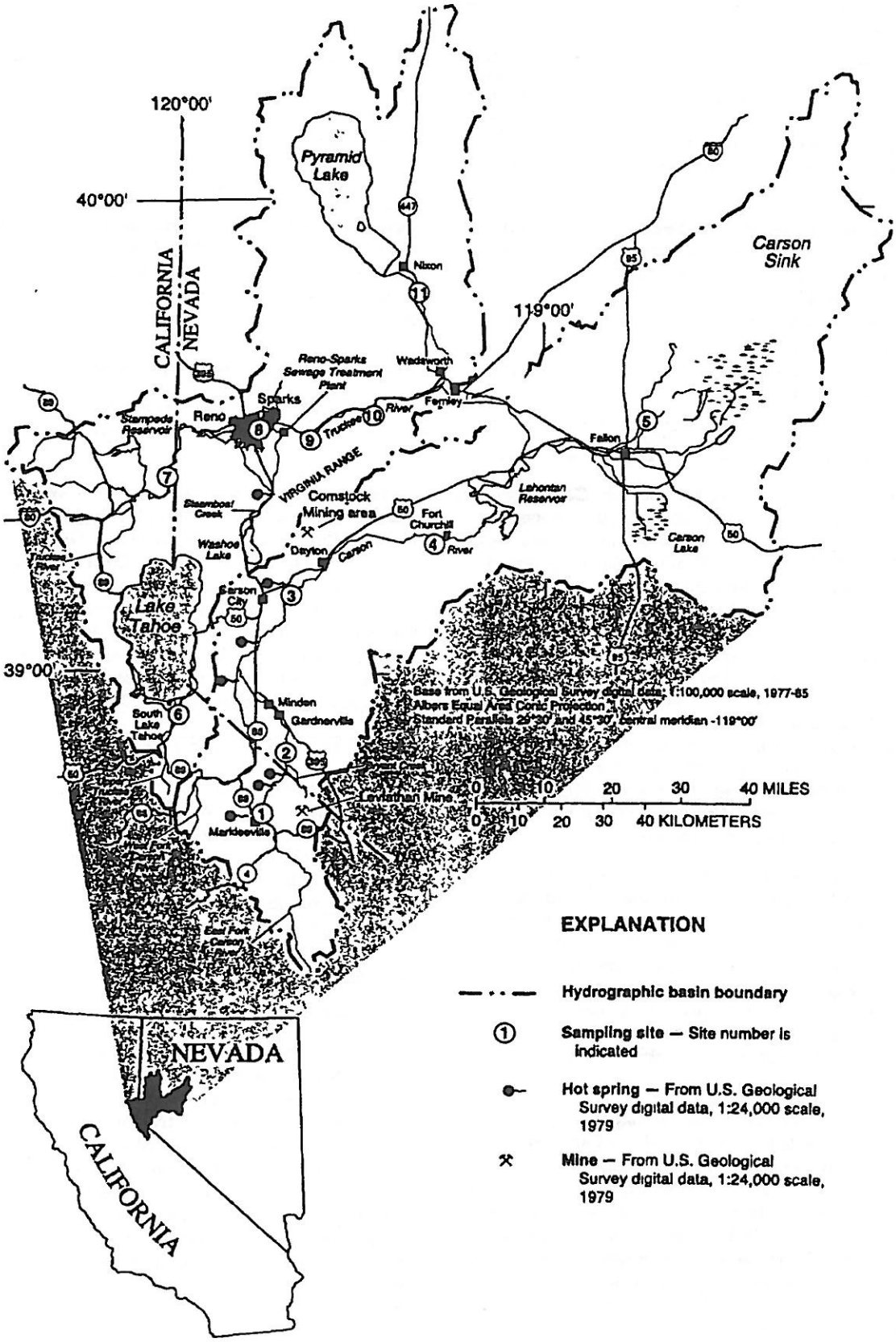


Figure 1. Carson and Truckee River Basins in Nevada and California, with sampling sites identified.

TRACE ELEMENTS

Concentrations of 11 trace elements determined from bed-sediment samples in both river basins, including element concentrations adjusted for TOC, are shown in table 2. Median arsenic and mercury concentrations were markedly higher in the Carson River bed-sediment samples than in those of the Truckee River. The PCA showed that seven trace-element components accounted for 98 percent of the variability in the trace-elements measured in the Carson River and Truckee River bed-sediment samples (pie chart, fig. 2). The remaining 2 percent is variability associated with sampling and analytical error.

The PCA results show that the nickel and cobalt component, and the vanadium component scored high in bed sediments at the two background sites: Carson River near Markleeville, Calif. (site 1), and Truckee River at Farad, Calif. (site 7). The aluminum and iron component also scored high at the Farad site (fig. 6). These trace elements probably were geologically controlled because both background sites are minimally affected by human activities. The decrease in vanadium and cobalt downstream suggests dilution of bed sediments as anthropogenically derived and geologically different sediments are transported to both rivers.

Concentrations of aluminum, arsenic, chromium, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc in crayfish samples from 10 sites on the Carson and Truckee Rivers are shown in table 3. Crayfish were not found at the Fallon site (site 5). Chromium and selenium concentrations were generally less than laboratory reporting limits (table 3). Mean concentrations of aluminum, arsenic, cobalt, copper, iron, lead, mercury, silver, and vanadium in Carson River crayfish were greater than those concentrations in Truckee River crayfish (table 3). Mean nickel and zinc concentrations in Carson River crayfish were similar to those in Truckee River crayfish.

Nonparametric analysis of variance showed that median crayfish length was significantly different among sites (p equals 0.004) and generally increased downstream (fig. 3). The increase in crayfish length paralleled the downstream increase in water temperature (fig. 3). Thus, crayfish were probably larger in the lower reaches of both rivers because of faster growth rather than older ages. This is an important distinction because older individuals tend to have greater trace-element concentrations than younger individuals due to longer accumulation times (Newman and Heagler, 1991). Although nonparametric correlation showed that arsenic, mercury, and silver concentrations increased as the median crayfish length increased (r equals 0.81, p less than 0.005; r equals 0.77, p less than 0.01; and r equals 0.88, p less than 0.0001, respectively), these may be spurious correlations because arsenic, mercury, and silver concentrations in bed sediment also were higher in the lower reaches of both rivers (table 2).

Table 2. Trace-element concentrations in bed-sediment samples for 11 sites in Carson and Truckee River Basins, Nevada and California, September 1992

[Abbreviation: TOC, total organic carbon. Except where indicated, all units are micrograms per gram, dry weight]

Trace constituents	Sampling sites (figure 1 and table 1)												
	Carson River						Truckee River						
	1	2	3	4	5	Median	6	7	8	9	10	11	Median
TOC, in percent, dry weight	2.0	1.4	3.1	1.5	5.7	2.0	3.1	0.8	3.7	3.3	3.3	4.9	3.3
Aluminum, in percent (Al), dry weight	9.2	8.9	7.5	8.7	6.3	8.7	8.6	9.7	8.2	7.4	7.9	3.9	8.1
Aluminum, TOC-adjusted, in percent, dry weight	4.6	6.3	2.1	6.0	1.1	4.6	2.7	12.6	2.2	2.2	2.4	.8	2.3
Arsenic (As)	20	80	40	30	90	40	10	6	10	20	20	10	10
Chromium (Cr)	50	90	50	40	35	50	55	60	40	45	40	20	40
Chromium, TOC-adjusted	40	75	50	25	55	50	60	50	50	50	40	40	50
Cobalt (CO)	20	30	20	20	20	20	20	20	20	15	20	10	20
Copper (Cu)	40	70	40	40	40	40	30	40	60	50	55	25	45
Iron, in percent (Fe), dry weight	5.0	5.0	4.0	4.5	4.0	4.5	5.0	5.0	4.0	4.0	4.5	2.0	4.2
Lead (Pb)	20	30	20	10	30	20	20	10	70	20	20	8	20
Mercury (Hg)	.2	2.2	4.7	.26	5.9	2.2	.02	.02	.17	.6	.45	.05	.11
Nickel (Ni)	30	40	20	20	20	20	20	20	25	20	20	10	20
Selenium (Se)	.6	9.0	.5	.6	1.3	.6	.3	.1	.3	.8	.6	1.5	.45
Silver (Ag)	.2	.1	1.0	.4	1.4	.4	.1	.1	.3	.6	.5	.1	.2
Silver, TOC-adjusted	.1	.1	.3	.3	.2	.2	<.1	.1	.1	.2	.2	<.1	.1
Vanadium (V)	150	150	130	140	110	140	160	170	120	120	120	110	120
Vanadium, TOC-adjusted	140	130	140	120	140	140	160	140	130	120	120	130	130
Zinc (Zn)	110	90	130	130	110	110	90	100	210	140	150	50	120

Carson River

Bed Sediment

Trace-element concentrations in Carson River bed sediments are given in table 2. Although natural mineral deposits might contribute trace elements, several trace elements from past mining practices have clearly enriched the streambed sediments. Silver and mercury were enriched in Carson River bed sediments because of historical mining and milling of gold and silver ore. Mill tailings still exist along the Carson River and probably continue to erode into the river channel.

A Carson River bed-sediment sample was considered enriched when the trace-element concentration was at least 10 percent greater than the concentration in the Markleeville sample (site 1). The Gardnerville and Fallon samples (sites 2 and 5) were enriched in eight trace elements (fig. 4). The Carson City sample (site 3) was enriched in six trace elements. The sample at the Fort Churchill State Park (site 4) was enriched in four trace elements.

The Gardnerville sample was slightly enriched (1.1 to 1.5 times higher than Markleeville) in aluminum and nickel; moderately enriched (1.6 to 2.0 times higher) in chromium, copper, and lead; and greatly enriched (more than 2.0 times higher) in arsenic, mercury, and selenium (fig. 4). The PCA results show that four components scored high in the bed-sediment sample from the Gardnerville site: Pb-Cr-Cu; Se-As-Hg; Al-Fe; and Ni-Co (fig. 2). These results suggest that trace elements at this site probably came from several different sources or were affected by different processes. Three possibilities are (1) erosion and transport of natural mineral deposits, (2) soil erosion and acid mine drainage from Leviathan Mine, or (3) soil erosion and mine drainage from other small, abandoned mines in the Carson River Basin upstream fron the Gardnerville site. Bryant Creek might be a conduit for trace element transport from the Leviathan Mine area to the East Fork Carson River (Hammermeister and Walmsley, 1985). Bryant Cre drains a large part of the Leviathan Mine area and enters the East Fork Carson River about 4.6 mi above the Gardnerville sampling site (Brown and others, 1986). The Leviathan Mine was an open-sulfur mine before it was abandoned in 1962 (Hammermeister an Walmsley, 1985).

The correlated concentrations of arsenic, selenium, and mercury in the Gardnerville sample may result from several possible sources. Research has shown that arsenic and selenium contamin: tion can result from irrigation drainage (Hoffman and others, 199 Seiler, 1996). An area adjacent to the East Fork Carson River, abc 5 mi upstream from the Gardnerville site, is irrigated for hay and pasture production on soils classified as saline and alkaline (Glen W. Hess, U.S. Geological Survey, oral commun., 1997; Candland 1984). Other potential sources of the high arsenic and mercury in the Gardnerville sample include abandoned mines in the basin, ar the discharge of several geothermal springs to the East Fork Cars River upstream from the Gardnerville site (U.S. Geological Surve topographic map, 7.5-minute series, Carters Station, Nev.-Calif., quadrangle). Water from geothermal springs can contain high amounts of arsenic, zinc, and small amounts of mercury and silve (Garside and Schilling, 1979).

The Carson City (site 3) bed-sediment sample was slightly enriched in chromium, lead, and zinc; moderately enriched in arsenic; and greatly enriched in mercury and silver (fig. 4). The PCA results show that two components scored high in the bed-sediment sample at Carson City: V; and Ag-Hg (fig. 2). During th Comstock era, high-grade silver ore was processed in stamp mills

Table 3. Trace-element concentrations and characteristics of composited samples of crayfish (*Pacifastacus leniusculus*) for 10 sites in Carson and Truckee River Basins, Nevada and California, September 1992

[Abbreviation: SD, standard deviation in inches; NA, not applicable. Symbol: --, not determined. Except where indicated, all values are in micrograms per gram, dry weight, based on a composite sample of 6-11 individuals]

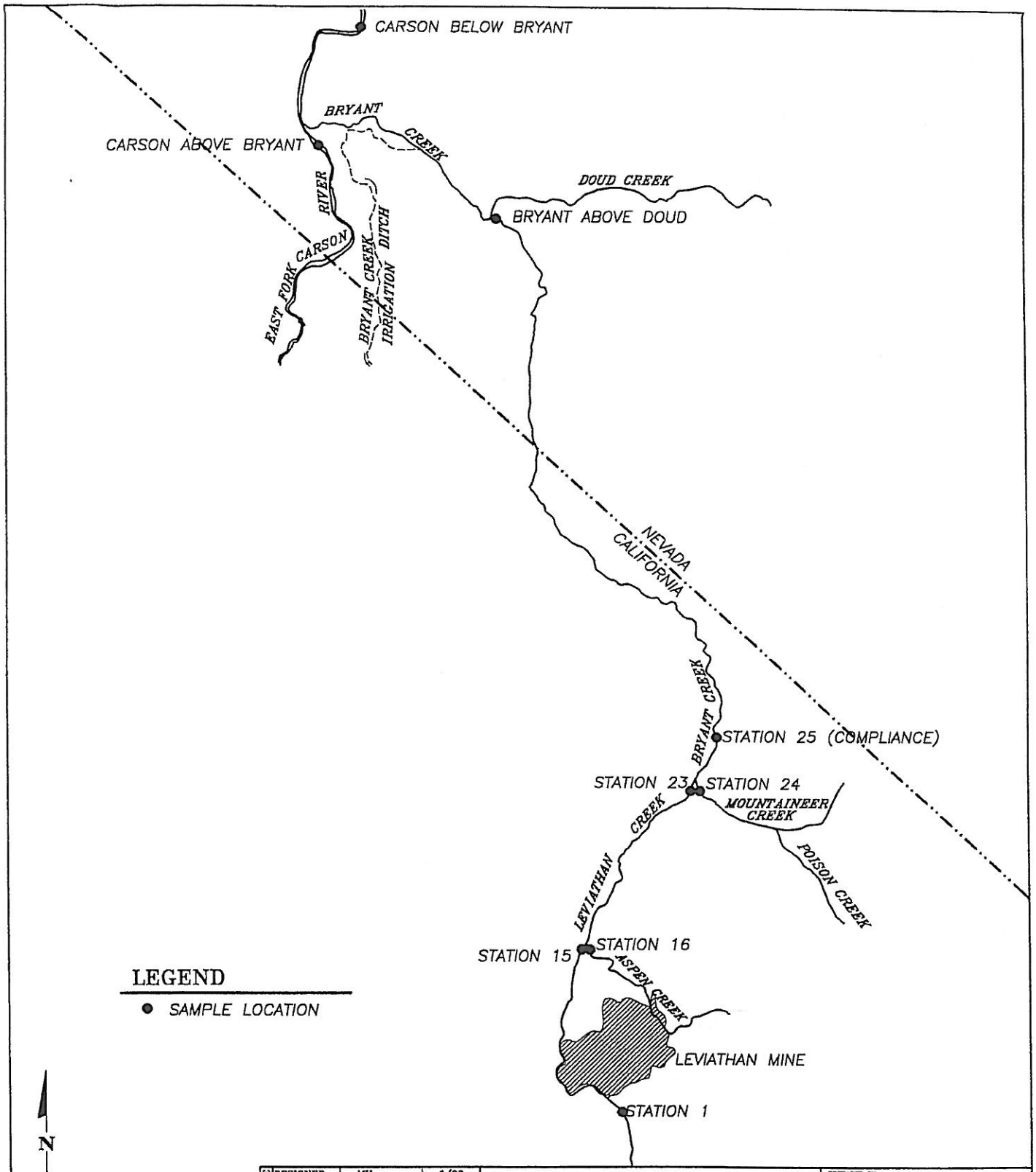
Characteristic or trace element	Sampling sites[1] (figure 1 and table 1)											
	Carson River					Truckee River						
	1	2	3	4	Median	6	7	8	9	10	11	Median
Mean length[2]	3.4	3.7	3.9	4.0	NA	3.4	3.6	3.4	3.7	3.9	3.5	NA
(SD)	(.3)	(.2)	(.5)	(.3)	NA	(.4)	(.3)	(.5)	(.6)	(.5)	(.5)	NA
Percent water	75	72	75	76	75	79	78	75	76	77	78	77
Aluminum (Al)	550	870	60	1,460	710	190	320	190	520	190	70	190
Arsenic (As)	2.7	7.5	4.3	7.1	5.7	1.8	3.2	3.2	3.5	5.7	2.8	3.2
Chromium (Cr)	<1.9	<1.8	0.8	<2.0	--	<2.5	<2.1	.7	<2.1	.8	<2.4	--
Cobalt (Co)	2.2	8.1	1.1	2.3	2.2	1.0	1.6	1.3	1.7	.9	.8	1.2
Copper (Cu)	45	60	80	90	70	40	50	50	28	40	25	40
Iron (Fe)	500	770	86	420	460	360	300	180	530	220	110	260
Lead (Pb)	.2	.3	<.2	1.6	.25	<.3	<.2	.5	.5	<.4	<.2	<.4
Mercury(Hg)	.2	.5	1.9	48	1.2	.2	.2	.1	.5	.3	.4	.25
Nickel (Ni)	3.2	4.9	4.2	3.4	3.9	3.0	3.4	2.4	4.1	1.7	2.9	3.0
Selenium (Se)	--	<1.1	--	<1.2	--	--	<1.3	--	2.1	2.9	<1.4	--
Silver (Ag)	.3	.3	2.2	3.8	1.3	<.3	<.2	<.2	.6	.9	<.2	.4
Vanadium (V)	1.8	2.6	1.1	5.8	2.2	1.3	1.1	.6	1.4	<.4	.8	.95
Zinc (Zn)	77	69	53	75	70	69	80	61	84	207	60	75

[1] No crayfish were found at site 5 (Fallon).

[2] Mean length, in inches (figure 3).

LEVIATHAN MINE, SPRING 1998 SPRING MONITORING PROGRAM

(SRK, 1998)



REFERENCE			
DESIGNED	MH		6/98
DRAWN	TAD		6/98
CHECKED			
APPROVED			

REVISIONS No.	DESCRIPTION	BY	DATE

FIGURE 1

LEVIATHAN MINE
SPRING 1998
STREAM WATER QUALITY
AND FLOW RATE
MONITORING LOCATIONS

PREPARED BY: STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists

SCALE: 1"=5000'

REVISION A

JOB NO. 19333
DWG NAME 19333F1

LEVIATHAN 1998 STREAM SAMPLING

Week 1 - Sample Date: 6/1-2/98

Inorganic Parameter	Method and MRL		Leviathan Creek Station 1	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	*Carson Below Bryant Creek (Horseshoe)
Field pH (SU)			8.1	6.6	6.3	6.7	8.5	7.6	8.1	7.9	7.7
Field TDS (mg/l)			36.6	125.8	313	112	59.5	112	98.6	27.8	28.3
Field Temp (C)			10	13.3	15.6	13.1	13.4	13.4	10.9	8.5	10
Flow Rate (CFS)	Area / veolocity		4.1	9.2	1.7	meter malfunction**	meter malfunction**	meter malfunction**	meter malfunction**	NA	NA
Alkalinity (mg/l)	310.1	2	41	ND	3	ND	66	28	38	28	28
TDS (mg/l)	160.1	5	97	199	500	251	104	183	159	35	55
TSS (mg/l)	160.2	5	8	70	32	68	9	42	29	48	51
Sulfate (mg/l)	300.0	0.2	2.7	121	322	143	1.3	81.3	59.2	2.7	3.5
Hardness $CaCO_3$ (mg/l)	6010A	0.2	30.1	95.4	310	128	55.6	99.6	89.1	28	29.8
Metals				Total Concentrations (ppb) upper value			Dissolved Concentration (ppb) lower value				
Aluminum	6010B	50	1130	5650	2880	5340	213	2830	2080	1490	1800
	6010B	50	195	417	268	ND	ND	ND	68	103	52
Antimony	6010B	50	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	7060A	5	ND	104	ND	ND	ND	49	30	ND	ND
	7060A	5	ND	11	ND	ND	ND	ND	ND	ND	ND
Barium	6010B	5	56	61	50	61	36	50	44	31	34
	6010B	5	48	56	43	53	33	43	33	15	15
Beryllium	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	6010B	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	6010B	50	8190	26200	89800	35500	14000	27100	23500	7370	7830
	6010B	50	8420	27300	91200	35900	13700	26300	22300	6570	7000
Chromium	6010B	5	ND	12	ND	12	ND	7	ND	ND	ND
	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	6010B	10	ND	49	20	42	ND	25	12	ND	ND
	6010B	10	ND	49	19	40	ND	18	ND	ND	ND
Copper	6010B	10	ND	30	185	47	ND	27	18	ND	ND
	6010B	10	ND	ND	134	ND	ND	ND	ND	ND	ND
Iron	6010B	20	671	15900	811	12600	284	6900	4670	1720	2050
	6010B	20	117	9300	104	3600	52	900	74	112	58
Lead	7421	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7421	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	6010B	10	2350	7260	20800	9440	5000	7760	7340	2330	2490
	6010B	10	2350	7460	21000	9450	4860	7540	7040	1760	1870
Manganese	6010B	5	12	778	2000	931	19	549	359	65	69
	6010B	5	6	803	1890	924	ND	512	309	8	8
Nickel	6010B	20	ND	133	74	101	ND	73	48	ND	ND
	6010B	20	ND	ND	82	112	ND	58	33	ND	ND
Potassium	6010B	2000	ND	ND	4800	3300	3000	3300	3600	2200	2400
	6010B	2000	3100	3700	6300	3800	3200	3600	3200	ND	ND
Selenium	7740	5	ND	ND	12	ND	ND	ND	ND	ND	ND
	7740	5	ND	ND	13	ND	ND	ND	ND	ND	ND
Silver	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	6010B	100	5610	7400	12000	7790	6660	7450	7260	3300	3540
	6010B	100	5480	7200	11600	7940	6630	7420	7190	3230	3430
Thallium	7841	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7841	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	6010B	10	ND	11	ND	ND	ND	ND	ND	ND	ND
	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	6010B	10	ND	28	104	36	ND	20	13	ND	ND
	6010B	10	ND	22	98	29	ND	ND	ND	ND	ND

* First Sampling was taken below Horseshoe. ** Based on flow depths and velocity readings from subsequent weeks, estimated flow rates are approximatel 10.5 cfs for Station 23, 6.6 cfs for Station 24, 17 cfs at Station 25, and 18.5 at Bryant above Doud.

LEVIATHAN 1998 STREAM SAMPLING

Week 2 - Sample Date: 6/8-9/98

Inorganic Parameter and Units	Method and MRL	Leviathan Creek Station 1	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	Carson Below Bryant Creek	Doud 1-Dup of Bryant above Doud
Field pH (SU)		7.9	4.5	6.7	4.7	8.4	6.3	7.8	7.9	7.8	
Field TDS (mg/l)		39.4	194	321	183.5	65.1	135	107.6	27.9	27.9	
Field Temp (C)		7	11.4	10.7	14.2	12.7	14.1	10.8	8.3	8.9	
Flow Rate (CFS)	Area / veolocity	4.9	8	1.3	9.1	6.3	15.2	18.6	NA	NA	
Alkalinity (mg/l)	310.1 2	41	ND	4	ND	72	2	16	27	26	2
TDS (mg/l)	160.1 5	117	311	523	328	115	212	168	29	46	172
TSS (mg/l)	160.2 5	ND	90	23	79	13	68	50	63	65	49
Sulfate (mg/l)	300.0 0.2	2.7	189	316	193	1.3	106	79	2.5	3.7	79
Hardness $CaCO_3$ (mg/l)	6010A 0.2	33.2	104	303	126	56.5	99.1	87.9	28.3	28.4	90.3
Metals		Total Concentrations (ppb) upper value				Dissolved Concentration (ppb) lower value					
Aluminum	6010B 50	1190	12500	2300	9250	304	5330	3670	2230	1550	3720
	6010B 50	133	10900	126	6800	60	76	58	158	81	56
Antimony	6010B 50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B 50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	7060A 5	ND	324	ND	263	ND	147	93	ND	ND	96
	7060A 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	6010B 5	62	64	59	65	37	56	50	40	36	51
	6010B 5	46	55	50	57	32	50	40	12	13	39
Beryllium	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	6010B 4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B 4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	6010B 50	9040	28300	88000	35000	14200	26900	23200	7230	7380	23900
	6010B 50	7960	28100	87200	35300	13800	26900	23400	6070	6470	22800
Chromium	6010B 5	ND	40	ND	31	ND	18	12	ND	ND	12
	6010B 5	ND	6	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	6010B 10	ND	98	24	75	ND	46	29	ND	ND	29
	6010B 10	ND	95	22	78	ND	45	26	ND	ND	23
Copper	6010B 10	ND	90	115	81	ND	48	28	ND	ND	30
	6010B 10	ND	88	67	78	ND	12	ND	ND	ND	ND
Iron	6010B 20	785	28800	704	21400	355	12600	8100	2310	1800	8270
	6010B 20	93	9210	130	6640	55	3700	26	146	66	24
Lead	7421 2	ND	2	ND	ND	ND	ND	ND	ND	ND	ND
	7421 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	6010B 10	2580	8010	20300	9420	5100	7780	7260	2480	2430	7470
	6010B 10	2220	7830	19900	9360	4960	7730	7310	1620	1710	7110
Manganese	6010B 5	13	938	1800	960	18	582	410	85	73	420
	6010B 5	5	943	1740	976	ND	583	397	10	9	387
Nickel	6010B 20	ND	243	64	194	ND	113	66	ND	ND	80
	6010B 20	ND	239	56	199	ND	117	62	ND	ND	60
Potassium	6010B 2000	ND	ND	4100	2100	ND	ND	2000	ND	ND	ND
	6010B 2000	ND	ND	4100	ND	ND	ND	ND	ND	ND	ND
Selenium	7740 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7740 5	ND	ND	9	ND	ND	ND	ND	ND	ND	ND
Silver	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	6010B 100	5740	7060	11400	7360	6520	7170	6970	3180	3270	7220
	6010B 100	5050	6890	11100	7410	6440	7220	7100	2860	3020	6870
Thallium	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	6010B 10	ND	20	ND	16	ND	10	ND	ND	ND	ND
	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	6010B 10	ND	47	84	47	ND	28	19	ND	ND	21
	6010B 10	ND	47	80	46	ND	28	ND	ND	ND	ND

LEVIATHAN 1998 STREAM SAMPLING

Week 3 - Sample Date:6/15-16/98

Inorganic Parameter	Method and MRL		Leviathan Creek Station 1	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	Carson Below Bryant Creek
Field pH (SU)			7.5	4.6	6.6	4.8	8.3	6.7	7.8	7.4	7.4
Field TDS (mg/l)			44.3	183.3	302	186.6	66.8	135.6	119.6	23.7	22.1
Field Temp (C)			7.9	13.6	14.4	14	11.5	12.2	9.9	8.8	8.8
Flow Rate (CFS)	Area / veolocity		2.9	4.2	0.9	5	4.5	9.6	14.7	NA	NA
Alkalinity (mg/l)	310.1	2	42	ND	ND	ND	75	16	27	23	24
TDS (mg/l)	160.1	5	106	315	476	314	133	215	204	42	69
TSS (mg/l)	160.2	5	ND	81	29	68	13	46	45	139	142
Sulfate (mg/l)	300.0	0.2	3.4	176	296	193	1.3	120	85.8	2.1	2.7
Hardness $CaCO_3$ (mg/l)	6010A	0.2	36.1	126	280	143	62.5	111	99.7	32.7	32.4
Metals				**Total Concentrations (ppb) upper value**			Dissolved Concentration (ppb) lower value				
Aluminum	6010B	50	726	9840	2600	7200	266	4220	3220	3820	3750
	6010B	50	255	5280	79	1940	ND	63	82	313	418
Antimony	6010B	50	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	7060A	5	ND	219	ND	169	ND	90	71	6	6
	7060A	5	ND	25	ND	ND	ND	ND	ND	ND	ND
Barium	6010B	5	54	62	49	56	35	48	50	62	60
	6010B	5	56	63	44	59	37	49	39	17	18
Beryllium	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	6010B	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	6010B	50	9830	34800	91100	39900	15700	30100	26300	7980	7850
	6010B	50	9890	34800	82300	41600	15700	30900	26300	5760	5760
Chromium	6010B	5	ND	28	ND	19	ND	12	10	ND	ND
	6010B	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	6010B	10	ND	88	16	61	ND	35	24	ND	ND
	6010B	10	ND	85	15	66	ND	35	18	ND	ND
Copper	6010B	10	ND	64	93	58	ND	35	24	ND	ND
	6010B	10	ND	57	47	50	ND	ND	ND	ND	ND
Iron	6010B	20	529	27500	862	18500	315	10600	7780	4050	4160
	6010B	20	134	14500	94	8610	42	3340	70	327	452
Lead	7421	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7421	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	6010B	10	2820	9630	18800	10600	5660	8700	8270	3090	3120
	6010B	10	2840	9550	19000	11000	5660	8900	8310	1580	1630
Manganese	6010B	5	13	1150	1760	1090	16	627	433	147	146
	6010B	5	7	1140	1650	1120	ND	630	393	14	21
Nickel	6010B	20	ND	204	54	141	ND	103	70	ND	ND
	6010B	20	ND	210	65	170	ND	91	52	ND	ND
Potassium	6010B	2000	ND	ND	4500	2500	2400	2500	ND	ND	ND
	6010B	2000	ND	2300	4200	2300	ND	ND	2500	ND	ND
Selenium	7740	5	ND	ND	10	ND	ND	ND	ND	ND	ND
	7740	5	ND	ND	9	ND	ND	ND	ND	ND	ND
Silver	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	6010B	100	5960	8210	11100	8270	7030	7830	8220	3220	3260
	6010B	100	7400	12000	11900	9110	8280	9140	8230	3550	3050
Thallium	7841	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7841	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	6010B	10	ND	19	ND	11	ND	10	ND	ND	ND
	6010B	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	6010B	10	ND	44	77	42	ND	26	21	25	12
	6010B	10	ND	46	69	43	ND	17	ND	ND	ND

LEVIATHAN 1998 STREAM SAMPLING

Week 4 - Sample Date: 6/23-24/98

Inorganic Parameter	Method and MRL	Leviathan Creek Station 1	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	Carson Below Bryant Creek
Field pH (SU)		8	7.4	6.8	7.4	8.5	8	8.2	7.5	7.4
Field TDS (mg/l)		42.4	172.6	307	194	70.2	132.4	120.4	20.9	21.5
Field Temp (C)		15.3	9.9	12.2	5.8	6.9	12.7	8.8	4.7	4.8
Flow Rate (CFS)	Area / veolocity	1.5	2.7	0.8	3.8	4	7.7	10.7	NA	NA
Alkalinity (mg/l)	310.1 2	48	5	3	7	80	43	51	23	23
TDS (mg/l)	160.1 5	104	270	488	306	125	215	206	53	68
TSS (mg/l)	160.2 5	5	62	12	49	8	34	18	132	127
Sulfate (mg/l)	300.0 0.2	3.6	144	288	177	1.3	89.2	77.5	1.8	2.5
Hardness $CaCO_3$ (mg/l)	6010A 0.2	35.9	128	284	170	62.9	114	106	27.6	32
Metals		Total Concentrations (ppb) upper value				Dissolved Concentration (ppb) lower value				
Aluminum	6010B 50	748	3270	2070	3050	176	1790	1340	3380	5730
	6010B 50	157	ND	135	ND	ND	90	66	115	88
Antimony	6010B 50	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	0.09	0.10	0.05	0.07	0.09	0.09	0.08	0.05	0.04
Arsenic	7060A 5	ND	31	ND	24	ND	17	14	ND	ND
	7060A 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	6010B 5	64	58	39	53	35	46	43	52	66
	6010B 5	54	51	33	47	32	40	30	13	13
Beryllium	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	0.45	0.03	<0.04	<0.04	<0.04	<0.04	<0.04	ND
Cadmium	6010B 4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	0.14	0.51	0.28	<0.04	0.27	<0.04	<0.04	ND
Calcium	6010B 50	9710	35500	81900	47500	15700	31000	27800	6830	7740
	6010B 50	9710	35900	78700	46900	15300	31000	23500	5390	5440
Chromium	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	5
	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	6010B 10	ND	50	21	47	ND	24	14	ND	ND
	6010B 10	ND	52	22	44	ND	16	ND	ND	ND
Copper	6010B 10	ND	ND	91	27	ND	16	12	ND	ND
	200.8 0.1	1.1	2.1	57.7	3.6	0.7	2.5	1.8	0.5	1.5
Iron	6010B 20	515	16500	390	12100	228	6330	4470	3480	5690
	6010B 20	95	10200	127	3240	57	109	61	115	92
Lead	7421 2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	ND	ND	<0.04	0.05	<0.04	<0.04	<0.04	0.03
Magnesium	6010B 10	2840	9580	19200	12400	5760	8960	8900	2560	3080
	6010B 10	2800	9820	18500	12300	5650	8970	7530	1460	1460
Manganese	6010B 5	14	1130	1880	1320	14	634	426	132	152
	6010B 5	6	1180	1800	1270	6	582	316	7	7
Nickel	6010B 20	ND	115	65	104	ND	51	31	ND	ND
	200.8 0.2	1.0	108	63	96.7	1.4	39.7	24.4	0.6	1.1
Potassium	6010B 2000	2200	3600	5200	3600	2700	3600	3400	ND	2200
	6010B 2000	2600	2800	5000	2400	2500	2600	2300	ND	ND
Selenium	7740 5	ND	ND	9	ND	ND	ND	ND	ND	ND
	7740 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	ND	ND	<0.04	<0.04	<0.04	<0.04	<0.04	ND
Sodium	6010B 100	6500	8300	11400	9070	6900	8130	8340	2610	3150
	6010B 100	8890	8370	10700	9180	7150	8400	7060	3010	2890
Thallium	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	6010B 10	ND	ND	ND	ND	ND	ND	ND	11	17
	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	6010B 10	ND	25	76	34	ND	18	13	ND	13
	6010B 10	ND	15	71	20	ND	ND	ND	ND	ND

LEVIATHAN 1998 STREAM SAMPLING

Week 5 - Sample Date:6/30-7/1/98

Inorganic Parameter	Method and MRL	Leviathan Creek Station 1*	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	Carson Below Bryant Creek
Field pH (SU)		No data	6.9	6.3	6.9	8.5	8.2	8.4	7.9	7.9
Field TDS (mg/l)		No data	200	280	212	69	143	124	21	22
Field Temp (C)		No data	17.4	16.5	6.7	12.4	8.4	12.4	9.4	10
Flow Rate (CFS)	Area / veolocity	No data	1.5	0.7	2.9	3.4	5.1	7.4	NA	NA
Alkalinity (mg/l)	310.1 2	No data	ND	2	3	79	44	53	24	23
TDS (mg/l)	160.1 5	No data	362	471	353	123	252	212	59	56
TSS (mg/l)	160.2 5	No data	73	7	48	10	21	12	35	34
Sulfate (mg/l)	300.0 0.2	No data	199	310	219	1.2	101	82.7	2.3	3.5
Hardness $CaCO_3$ (mg/l)	6010A 0.2	No data	180	274	206	62	134	116	21	23
Metals		Total Concentrations (ppb) upper value				Dissolved Concentration (ppb) lower value				
Aluminum	6010B 50 6010B 50	No data	4240 ND	1830 250	3180 ND	74 ND	1470 162	997 59	581 ND	603 ND
Antimony	6010B 50 200.8 0.02	No data	ND 0.08	ND 0.06	ND 0.06	ND 0.07	ND 0.09	ND 0.08	ND 0.06	ND 0.05
Arsenic	7060A 5 7060A 5	No data	35 ND	ND ND	20 ND	ND ND	10 ND	9 ND	ND ND	ND ND
Barium	6010B 5 6010B 5	No data	66 64	38 36	55 50	35 35	47 42	42 35	21 13	25 13
Beryllium	6010B 5 200.8 0.02	No data	ND <0.04	ND 0.49	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND ND	ND ND
Cadmium	6010B 4 200.8 0.02	No data	ND 0.15	ND 0.50	ND 0.20	ND <0.04	ND 0.11	ND 0.05	ND 0.04	ND ND
Calcium	6010B 50 6010B 50	No data	50100 51600	79100 78100	57900 57100	15600 16100	36500 36500	30300 30700	5700 5750	6220 5820
Chromium	6010B 5 6010B 5	No data	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND
Cobalt	6010B 10 6010B 10	No data	79 78	20 19	55 53	ND ND	24 24	13 ND	ND ND	ND ND
Copper	6010B 10 200.8 0.1	No data	13 2.1	88 72.3	29 3.2	ND 0.3	15 3.0	ND 1.9	ND 0.5	ND 0.4
Iron	6010B 20 6010B 20	No data	23700 12200	203 108	13700 4630	123 33	6180 1270	3700 76	547 35	579 54
Lead	7421 2 200.8 0.02	No data	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND 0.04	ND 0.02
Magnesium	6010B 10 6010B 10	No data	13300 13800	18400 18200	14900 14800	5620 5860	10500 10500	9730 9860	1650 1550	1810 1570
Manganese	6010B 5 6010B 5	No data	1750 1800	1820 1780	1640 1610	12 ND	777 756	475 439	29 5	35 6
Nickel	6010B 20 200.8 0.2	No data	173 162	64 64.2	141 121	ND 1.3	62 52.9	35 27.7	ND 1.1	ND 0.7
Potassium	6010B 2000 6010B 2000	No data	3800 3100	5100 4900	4100 3400	3100 ND	3100 2800	2900 3200	ND ND	ND ND
Selenium	7740 5 7740 5	No data	ND ND	9 ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND
Silver	6010B 10 200.8 0.02	No data	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND <0.04	ND ND	ND ND
Sodium	6010B 100 6010B 100	No data	9960 10900	10800 10900	10300 10600	6870 7420	8990 9280	9030 9190	2790 2990	3110 3060
Thallium	7841 5 7841 5	No data	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND
Vanadium	6010B 10 6010B 10	No data	11 ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND
Zinc	6010B 10 6010B 10	No data	35 20	72 71	42 27	ND ND	19 ND	11 ND	ND ND	ND ND

LEVIATHAN 1998 STREAM SAMPLING

Week 6 - Sample Date: 7/6-7/98

Inorganic Parameter and Units	Method and MRL	Leviathan Creek Station 1	Leviathan Creek Above Aspen Creek Station 15	Aspen Creek Above Leviathan Creek Station 16	Leviathan Creek Above Mountaineer Creek Station 23	Mountaineer Creek Above Leviathan Creek Station 24	Bryant Creek Compliance Point Station 25	Bryant above Doud Creek	Carson above Bryant Creek	Carson Below Bryant Creek
Field pH (SU)		8.1	6.7	6.1	6.9	8.4	7.7	8.3	8.1	7.7
Field TDS (mg/l)		52.9	262	308	249	71.7	148.9	135.4	23.2	27.5
Field Temp (C)		12.1	17.2	13.8	9.4	10	11	12.1	10.1	11
Flow Rate (CFS)	Area / velocity	0.9	1.3	0.7	1.9	3.1	5.5	7.3	NA	NA
Alkalinity (mg/l)	310.1 2	54	ND	ND	ND	80	43	55	23	47
TDS (mg/l)	160.1 5	105	433	523	410	117	242	221	42	48
TSS (mg/l)	160.2 5	24	62	14	50	11	24	44	28	24
Sulfate (mg/l)	300.0 0.2	4.2	247	311	238	1.1	102	80.8	2.4	5.2
Hardness $CaCO_3$ (mg/l)	6010A 0.2	44.8	215	301	230	70.6	143	130	21.2	23.2
Metals		Total Concentrations (ppb) upper value				Dissolved Concentration (ppb) lower value				
Aluminum	6010B 50	282	5450	2990	3580	119	1640	2300	468	244
	6010B 50	89	ND	421	ND	ND	ND	89	79	64
Antimony	6010B 50	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	0.12	0.05	0.04	0.05	0.09	<0.08	<0.08	<0.04	0.04
Arsenic	7060A 5	ND	40	ND	20	ND	10	17	ND	ND
	7060A 5	ND	5	ND	ND	ND	ND	ND	ND	ND
Barium	6010B 5	70	71	40	60	39	48	64	20	20
	6010B 5	62	62	38	51	33	40	39	12	13
Beryllium	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	0.04	0.48	0.04	<0.08	<0.08	<0.08	<0.04	<0.04
Cadmium	6010B 4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	0.09	0.54	0.62	0.43	<0.08	<0.08	<0.08	0.06	0.06
Calcium	6010B 50	12000	59900	87200	64900	17600	38900	33900	5790	6390
	6010B 50	11700	60000	86200	61800	16500	37200	32100	5590	6120
Chromium	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6010B 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	6010B 10	ND	101	24	70	ND	31	20	ND	ND
	6010B 10	ND	100	24	62	ND	28	ND	ND	ND
Copper	6010B 10	ND	14	116	28	ND	15	16	ND	ND
	200.8 0.1	0.7	2.3	80.6	4.2	1.5	2.4	2.3	0.5	0.5
Iron	6010B 20	293	28200	248	14600	175	6300	6260	468	296
	6010B 20	78	17600	112	4940	51	587	135	69	57
Lead	7421 2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	0.17	<0.04	0.07	<0.04	0.20	<0.08	<0.08	<0.04	<0.04
Magnesium	6010B 10	3600	15800	20300	16600	6440	11100	11000	1640	1750
	6010B 10	3490	15800	20000	15700	5970	10600	10400	1540	1660
Manganese	6010B 5	14	2210	2040	1900	16	848	567	24	28
	6010B 5	8	2230	2010	1800	5	792	403	6	8
Nickel	6010B 20	ND	217	70	155	ND	73	44	ND	ND
	200.8 0.2	1.6	195	60.1	143	2.3	58.1	20.2	1.2	1.3
Potassium	6010B 2000	ND	3900	4600	4400	2900	3700	5100	ND	ND
	6010B 2000	2800	4800	5800	5600	4100	4300	4700	ND	ND
Selenium	7740 5	ND	ND	7	ND	ND	ND	ND	ND	ND
	7740 5	ND	ND	7	ND	ND	ND	ND	ND	ND
Silver	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	200.8 0.02	<0.04	<0.04	ND	<0.04	<0.08	<0.08	<0.08	<0.08	<0.04
Sodium	6010B 100	7340	11000	11600	10700	7540	8990	9440	2770	3390
	6010B 100	7300	10800	10700	9970	6890	8460	9210	2930	3530
Thallium	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7841 5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	6010B 10	ND	11	ND	ND	ND	ND	ND	ND	ND
	6010B 10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	6010B 10	ND	47	88	50	ND	22	19	ND	ND
	6010B 10	ND	34	88	33	ND	ND	ND	ND	ND

DATA ON STREAM-WATER AND BED-SEDIMENT QUALITY IN THE VICINITY OF LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA, AND DOUGLAS COUNTY, NEVADA; SEPTEMBER 1998

(Thomas and Lico, 1998)

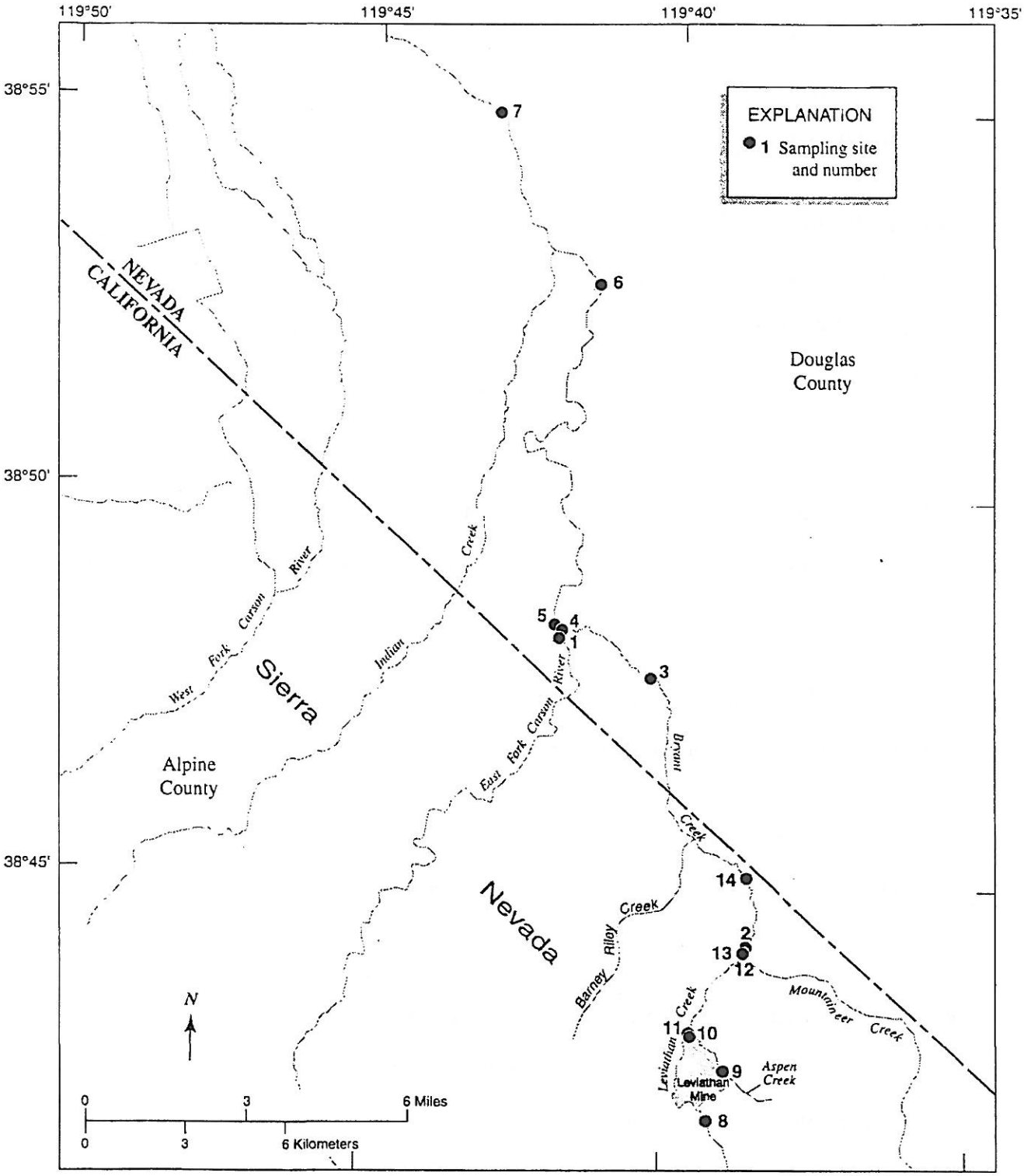


Figure 1. Surface-water sampling sites in the vicinity of Leviathan Mine, Alpine County, California and Douglas County, Nevada. Site numbers correspond with those in table 1.

TABLE 1. Location of sites in the vicinity of Leviathan Mine where water-quality and bed-sediment samples were collected, September 22 -25, 1998.
[Latitude and longitude are relative to Navigational Reference Datum, 1927]

Site Number (fig. 1)	USGS Station Number	Station Name	Latitude	Longitude
			(degrees, minutes, seconds)	
1	10308525	East Fork Carson River above Bryant Creek near Gardnerville, NV	38° 48' 07''	119° 41' 49''
2	10308794	Bryant Creek below Mountaineer Creek near Markleeville, CA	38° 44' 12''	119° 38' 39''
3	10308800	Bryant Creek near Gardnerville, NV	38° 47' 38''	119° 40'18''
4	10308875	Bryant Creek above East Fork Carson River near Gardnerville, NV	38° 48' 13''	119° 41' 47''
5	10308900	East Fork Carson River below Bryant Creek near Gardnerville, NV	38° 48' 17''	119° 42' 03''
6	10309010	East Fork Carson River near Dresslerville, NV	38° 52' 42''	119° 41' 18''
7	10309089	East Fork Carson River at River View Drive Bridge near Dresslerville, NV	38° 55' 25''	119° 43' 01''
8	384157119391301	Leviathan Creek 1200 feet upstream of Station 10308783 above Leviathan Mine	38° 41' 57''	119° 39' 13''
9	384235119385001	Aspen Creek above Leviathan Mine near Markleeville, CA	38° 42' 35''	119° 38' 50''
10	384301119393001	Aspen Creek above Leviathan Creek near Markleeville, CA	38° 43' 01''	119° 39' 30''
11	384303119393901	Leviathan Creek above Aspen Creek near Markleeville, CA	38° 43' 03''	119° 39' 39''
12	384407119384101	Mountaineer Creek above Leviathan Creek near Markleeville, CA	38° 44' 07''	119° 38' 41''
13	384407119384201	Leviathan Creek above Mountaineer Creek near Markleeville CA	38° 44' 07''	119° 38' 42''
14	384505119384001	Bryant Creek above Barney Riley Creek near Markleeville CA	38° 45' 05''	119° 38' 40''

TABLE 2 Concentrations of major ions, nutrients, trace elements, and organic carbon in water samples in the vicinity of Leviathan Mine, September 1998

[Abbreviation and symbol E, estimated, deg C, degrees Celsius, inst , instantaneous, mg/L, milligrams per liter, ng/L, nanograms per liter, µg/L, micrograms per liter, µS/cm, microsiemens per centimeter, NGVD, National Geodetic Vertical Datum, mm of Hg, millimeters of mercury, , no data Method detection limits are located in parenthesis below constituent name]

SITE NUMBER (fig 1)	USGS STATION NUMBER	STATION NAME	DATE	TIME	ELEV OF LAND SURFACE DATUM FT ABOVE NGVD	DIS-CHARGE INST CUBIC FEET PER SECOND	SPE-CIFIC CON-DUCT-ANCE µS/cm	PH FIELD STAND-ARD UNITS	TEMPER-ATURE WATER DEG C	BARO-METRIC PRES-SURE MM OF HG
1	10308525	EAST FORK CARSON RIVER ABOVE BRYANT CREEK NEAR GARDNERVILLE NV	09 24-98	1200	5110	158	142	7 8	13 5	630
2	10308794	BRYANT CREEK BELOW MOUNTAINEER CREEK NEAR MARKLEEVILLE CA	09-23 98	1110	-	2 7	347	7 6	9 5	611
3	10308800	BRYANT CREEK NEAR GARDNERVILLE, NV	09-25-98	1045	5450	4 8	290	8 3	11 5	626
4	10308875	BRYANT CREEK ABOVE EAST FORK CARSON RIVER NEAR GARDNERVILLE NV	09 24 98	1400	5140	4 3	470	8 1	16 0	634
5	10308900	EAST FORK CARSON RIVER BELOW BRYANT CREEK NEAR GARDNERVILLE NV	09 24 98	1200	5100	162	143	7 4	13 0	634
6	10309010	EAST FORK CARSON RIVER NEAR DRESSLERVILLE NV	09-23 98	1150	--	147	152	8 1	15 0	635
7	10309089	EAST FORK CARSON RIVER AT RIVER VIEW DRIVE BRIDGE NEAR DRESSLERVILLE	09-22-98	1300	4820	66	161	8 4	16 5	640
8	384157119391301	LEVIATHAN CREEK 1200 FEET UPSTREAM OF SITE 10308783 ABOVE LEVIATHAN MINE	09-25-98	1130	7200	18	133	7 9	6 5	585
9	384235119385001	ASPEN CREEK ABOVE LEVIATHAN MINE NEAR MARKLEEVILLE CA	09-28-98	1130	7150	29	185	7 8	11 5	587
10	384301119393001	ASPEN CREEK ABOVE LEVIATHAN CREEK NEAR MARKLEEVILLE CA	09-28-98	1340	6640	36	557	5 8	10 5	601
11	384303119393901	LEVIATHAN CREEK ABOVE ASPEN CREEK NEAR MARKLEVILLE CA	09-23-98	1445	6640	33	1320	3 8	12 0	601
12	384407119384101	MOUNTAINEER CREEK ABOVE LEVIATHAN CREEK NEAR MARKLEEVILLE CA	09 22-98	1415	6300	1 4	153	8 4	10 5	610
13	384407119384201	LEVIATHAN CREEK ABOVE MOUNTAINEER CREEK NEAR MARKLEEVILLE CA	09-22-98	1600	6280	76	709	3 7	12 5	607
14	384505119384001	BRYANT CREEK ABOVE BARNEY RILEY CREEK NEAR MARKLEEVILLE CA	09-25-98	1410	5985	2 7	333	7 9	9 5	611

SITE NUMBER (fig 1)	DATE	OXYGEN DIS-SOLVED mg/L (0 1)	OXYGEN, DIS-SOLVED PER-CENT SATUR-ATION	CALCIUM DIS-SOLVED mg/L AS CA (0 02)	MAGNE-SIUM, DIS-SOLVED mg/L AS MG (0 004)	SODIUM DIS-SOLVED mg/L AS NA (0 1)	SODIUM AD-SORP-TION RATIO	POTAS-SIUM DIS-SOLVED mg/L AS K (0 1)	BICAR-BONATE WATER DIS-SOLVED FIELD mg/L AS HCO3	CAR-BONATE WATER DIS-SOLVED FIELD mg/L AS CO3	ALKA-LINITY WATER DIS-SOLVED FIELD mg/L AS CACO3	ACIDITY mg/L AS H	SULFATE DIS-SOLVED mg/L AS SO4 (0 1)	CHLO-RIDE DIS-SOLVED mg/L AS CL (0 1)	FLUO-RIDE, DIS-SOLVED mg/L AS F (1)	SILICA DIS-SOLVED mg/L AS SIO2 (1)	SOLIDS RESIDUE AT 180 DEG C DIS SOLVED mg/L (10 0)
1	09-24-98	9 3	108	14	3 8	9 2	6	1 8	62	-	51	< 1	13	3 1	< 1	24	--
2	09-23-98	8 7	95	39	11	8 5	3	3 0	50	-	41	< 1	110	1 3	3	37	258
3	09-25-98	8 7	98	32	10	8 9	4	3 8	55	--	47	< 1	81	1 6	2	39	221
4	09-24-98	7 3	89	47	15	21	7	5 3	149	--	124	< 1	180	2 4	2	53	365
5	09-24-98	8 1	93	14	3 6	8 8	6	5 4	65	--	53	< 1	13	3 3	< 1	24	104
6	09-23-98	9 7	116	15	3 8	9 8	6	1 7	67	--	55	< 1	14	3 3		25	--
7	09-22-98	9 2	113	16	4.2	10	6	1 9	67	1	57	< 1	15	3 6	< 1	25	--
8	09-25-98	9 5	101	13	4 3	7 8	5	3 4	74	--	61	< 1	4 5	1 7		43	--
9	09-28-98	7 6	91	24	5 3	9 3	4	8	116	--	95	< 1	1 1	8	< 1	26	--
10	09-28-98	8 9	102	69	18	10	3	4 9	2	--	2	2	260	1 3	5	31	--
11	09-23-98	7 7	92	140	39	16	3	6 8	--	--	--	4 3	760	1 3	6	40	--
12	09-22-98	8 5	95	17	6 0	6 8	4	2 3	--	-	--	< 1	9	9	< 1	40	--
13	09-22-98	7 7	91	110	27	12	3	4 9	--	--	--	1 8	450	1 2	--	37	342
14	09 25-98	8 9	98	38	11	8 5	3	3 1	61	--	50	< 1	110	1 5	2	34	248

TABLE 2 Concentrations of major ions, nutrients, trace elements, and organic carbon in water samples in the vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (fig 1)	DATE	SOLIDS SUM OF CONSTI-TUENTS DIS SOLVED mg/L	NITRO-GEN NITRITE DIS-SOLVED mg/L AS N (01)	NITRO GEN NO2+NO3 DIS-SOLVED mg/L AS N (05)	NITRO GEN AMMONIA DIS SOLVED mg/L AS N (02)	NITRO GEN AM MONIA + ORGANIC TOTAL mg/L AS N (1)	NITRO GEN AM MONIA + ORGANIC DIS mg/L AS N (1)	PHOS PHORUS TOTAL mg/L AS P (01)	PHOS PHORUS DIS SOLVED mg/L AS P (01)	PHOS PHORUS ORTHO DIS SOLVED mg/L AS P (01)	ALUM INUM TOTAL RECOV ERABLE µg/L AS AL (2 0)	ALUM INUM DIS SOLVED µg/L AS AL (1 0)	ANTI MONY TOTAL µg/L AS SB (1 4)	ANTI MONY DIS-SOLVED µg/L AS SB (1 0)	ARSENIC TOTAL µg/L AS AS (1 0)
1	09 24 98	100	< 01	07	< 02	1	< 1	E 05	< 05	< 01	290	9	<1	<1	150
2	09 23 98	243	< 01	18	< 02	1	< 1	04	< 01	< 01	1500	42	<1	<1	5
3	09-25-98	205	< 01	20	< 02	2	< 1	11	01	< 01	3400	66	<1	<1	19
4	09 24 98	394	< 01	06	< 02	< 1	< 1	E 02	E 03	< 01	850	262	<1	<1	75
5	09 24 98	104	< 01	09	< 02	1	< 1	04	03	01	250	14	<1	<1	26
6	09-23-98	105	< 01	07	< 02	< 1	1	03	02	02	170	28	<1	<1	190
7	09 22 98	111	< 01	06	< 02	< 1	< 1	E 02	1 1	02	160	27	<1	<1	9
8	09 25 98	115	< 01	05	< 02	1	1	09	09	08	100	3	<1	<1	9
9	09 28 98	128	< 01	52	< 02	1	< 1	E 02	E 02	02	110	3	<1	<1	61
10	09 28 98	402	< 01	< 05	< 02	< 1	< 1	E 01	E 01	< 01	2000	352	<1	<1	39
11	09-23-98	1070	< 01	08	12	1	1	06	< 01	01	12000	11800	<14	<10	91
12	09-22-98		< 01	20	< 02	1	< 1	E 04	02	04	70	<1	<1	<1	21
13	09 22 98	655	< 01	08	02	1	< 1	E 02	03	< 01	5300	5370	<1	<1	100
14	09 25 98	236	< 01	12	< 02	1	< 1	05	< 05	< 01	1500	35	<1	<1	140

SITE NUMBER (fig 1)	DATE	ARSENIC DIS SOLVED mg/L AS AS (1 0)	BARIUM TOTAL RECOV ERABLE µg/L AS BA (0 16)	BARIUM DIS-SOLVED µg/L AS BA (1 0)	BERYL LIUM TOTAL RECOV-ERABLE µg/L AS BE (0 14)	BERYL-LIUM DIS-SOLVED µg/L AS BE (1 0)	BORON DIS-SOLVED µg/L AS B (16 0)	CADMIUM WATER UNFLTRD TOTAL µg/L AS CD (0 1)	CADMIUM DIS-SOLVED µg/L AS CD (1 0)	CHRO MIUM TOTAL RECOV-ERABLE µg/L AS CR (4)	CHRO MIUM DIS SOLVED µg/L AS CR (1 0)	COBALT TOTAL RECOV ERABLE µg/L AS CO (0 08)	COBALT DIS SOLVED µg/L AS CO (1 0)	COPPER TOTAL RECOV ERABLE µg/L AS CU (0 6)	COPPER DIS SOLVED µg/L AS CU (1 0)
1	09-24 98	7	31 5	28	< 1	<1	128	< 10	<1	<4	<1	30	<1	1	<1
2	09 23 98	<1	32 4	30	4	<1	28	16	<1	<4	<1	30	29	11	2
3	09 25 98	1	77 7	34	4	<1	29	20	<1	6	<1	10	5	22	2
4	09 24 98	3	30 0	29	2	<1	46	14	<1	<4	<1	4	3	2	2
5	09 24 98	7	30 5	28	< 1	<1	123	< 10	<1	<4	<1	29	<1	80	<1
6	09 23 98	7	29 7	29	< 1	<1	132	< 10	<1	<4	<1	29	<1	78	<1
7	09 22 98	7	32 3	31	< 1	<1	140	< 10	<1	<4	<1	19	<1	95	<1
8	09 25 98	2	63 7	65	< 1	<1	E11	< 10	<1	<4	<1	15	<1	62	<1
9	09 28 98	<1	11 2	10	< 1	<1	<16	<1	<1	<4	<1	21	<1	60	<1
10	09 28 98	<1	29 4	30	7	<1	39	30	<1	<4	<1	20	20	60	51
11	09 23 98	20	46 7	47	1 9	<10	70	<1	<10	<40	<10	270	280	<6	16
12	09 22 98	1	27 8	28	< 1	<1	E9	< 10	<1	<4	<1	13	<1	< 60	<1
13	09 22 98	<1	38 0	39	1 2	1	58	36	<1	<4	<1	110	109	34	35
14	09 25-98	<1	41 0	30	4	<1	21	20	<1	<4	<1	30	18	12	2

TABLE 2 Concentrations of major ions, nutrients, trace elements, and organic carbon in water samples in the vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (fig 1)	DATE	IRON TOTAL RECOV ERABLE µg/L AS FE (10 0)	IRON DIS-SOLVED µg/L AS FE (10 0)	LEAD TOTAL RECOV-ERABLE µg/L AS PB (0 1)	LEAD DIS-SOLVED µg/L AS PB (1 0)	MANGA NESE TOTAL RECOV-ERABLE µg/L AS MN (0 12)	MANGA-NESE DIS SOLVED µg/L AS MN (1 0)	MERCURY TOTAL RECOV-ERABLE µg/L AS HG (0 1)	MERCURY DIS SOLVED µg/L AS HG (0 1)	MERCURY METHYL TOTAL ng/L (0 010)	MOLYB DENUM TOTAL RECOV ERABLE µg/L AS MO (0 8)	MOLYB DENUM DIS SOLVED µg/L AS MO (1 0)	NICKEL TOTAL RECOV ERABLE µg/L AS NI (0 6)	NICKEL DIS SOLVED µg/L AS NI (1 0)	SELE NIUM TOTAL µg/L AS SE (4 0)
1	09-24-98	300	27	26	<1	31	13	< 1	< 1	096	< 8	<1	90	<1	<4
2	09 23 98	1900	330	< 10	<1	890	920	< 1	< 1	027	< 8	<1	67	63	<4
3	09 25-98	8000	24	2	<1	430	285	< 1	< 1	127	< 8	<1	43	19	<4
4	09 24 98	200	110	< 10	<1	180	146	< 1	< 1	068	<8	<1	13	12	<4
5	09-24-98	170	22	16	<1	28	13	< 1	< 1	124	< 8	<1	1	<1	<4
6	09 23 98	220	33	10	<1	15	7	< 1	< 1	093	< 8	<1	1	<1	<4
7	09 22-98	520	31	10	<1	15	8	< 1	< 1	085	< 8	<1	99	<1	<4
8	09-25-98	340	60	< 10	<1	16	13	< 1	< 1	056	< 8	<1	74	<1	<4
9	09-28-98	120	E8	13	<1	14	2	< 1	< 1	048	< 8	<1	80	<1	<4
10	09-28-98	170	55	< 10	<1	1500	1490	< 1	< 1	019	< 8	<1	44	44	8
11	09 23 98	57000	51000	<10	<10	6700	6900	< 1	< 1	038	<8	<10	560	590	<40
12	09 22 98	120	E9	< 10	<1	10	3	< 1	< 1	027	< 8	<1	80	<1	<4
13	09 22 98	5500	4300	< 10	<1	3400	3550	< 1	< 1	< 010	< 8	<1	230	231	5
14	09 25 98	4800	35	32	<1	770	706	< 1	< 1	045	<8	<1	55	40	<4

SITE NUMBER (fig 1)	DATE	SELE-NIUM DIS SOLVED µg/L AS SE (2 0)	SILVER TOTAL RECOV-ERABLE µg/L AS AG (1 4)	SILVER DIS-SOLVED µg/L AS AG (1 0)	STRON TIUM TOTAL RECOV-ERABLE µg/L AS SR (10 0)	STRON TIUM DIS SOLVED µg/L AS SR (1 0)	THAL-LIUM DIS SOLVED µg/L AS TL (0 5)	TITA NIUM TOTAL µg/L AS TI (0 6)	VANA DIUM DIS SOLVED µg/L AS V (10 0)	ZINC TOTAL RECOV ERABLE µg/L AS ZN (1 0)	ZINC DIS-SOLVED µg/L AS ZN (1 0)	URANIUM TOTAL µg/L AS U308 (0 4)	URANIUM NATURAL DIS SOLVED µg/L AS U (1 0)	CARBON ORGANIC TOTAL mg/L AS C (0 1)	CARBON ORGANIC DIS SOLVED mg/L AS C (0 1)
1	09-24-98	<2	<1	<1	190	200	< 5	< 60	<10	2 0	<1	56	<1	1 9	1 3
2	09 23 98	<2	<1	<1	320	340	1	1	<10	20	13	50	<1	1 5	6
3	09 25 98	<2	<1	<1	220	280	1	2	<10	20	1	1 10	<1	3	9
4	09 24 98	<2	<1	<1	210	410	8	58	<10	8 6	4	< 40	<1	1 6	1 3
5	09 24 98	<2	<1	<1	210		< 5	< 60	<10	1 4	<1	57	<1	1 8	1 2
6	09 23 98	<2	<1	<1	210	200	< 5	< 60	<10	1 5	<1	57	<1	1 8	1 2
7	09-22-98	<2	<1	<1	380	210	9	< 60	<10	1 3	<1	62	<1	1 5	1 3
8	09 25 98	<2	<1	<1	180	210	< 5	< 60	<10	1 7	1	< 40	<1	3 5	2 9
9	09 28 98	<2	<1	<1	280	290	< 5	< 60	<10	1 5	<1	< 40	<1	1 4	6
10	09 28 98	8	<1	<1	410	410	2	2	<10	60	54	48	<1	8	9
11	09 23 98	<2	<14	<10	880	960	10	<6	E6	120	129	<4 00	<10	9	9
12	09-22-98	<2	<1	<1	220	220	< 5	< 60	<10	<1 0	<1	44	<1	1 5	9
13	09 22 98	4	<1	<1	670	650	5	4	<10	70	71	55	<1	9	8
14	09 25 98	<2	<1	<1	340	340	9	1	<10	20	3	49	<1	2 0	8

TABLE 3 Concentrations of trace elements and carbon in the less than 63 micrometer fraction of bed-sediment samples from streams in the vicinity of Leviathan Mine, September 1998

[Abbreviation and symbol µg/g, micrograms per gram, ng/L, nanograms per liter, --, no data Method detection limits are located in parenthesis below constituent name]

SITE NUMBER (fig 1)	USGS STATION NUMBER	STATION NAME	DATE	TIME	ALUMINUM PERCENT (0 005)	ANTIMONY µg/g (0 1)	ARSENIC µg/g (0 1)	BARIUM µg/g (1 0)	BERYLLIUM µg/g (1 0)	BISMUTH µg/g (1 0)
1	10308525	EAST FORK CARSON RIVER ABOVE BRYANT CREEK NEAR GARDNERVILLE NV	09-24-98	1200	9 8	1	17	980	2	<1
			09-24-98	1201	9 8	1	16	1000	1	<1
			09-24-98	1202	9.9	1	16	990	1	<1
2	10308794	BRYANT CREEK BELOW MOUNTAINEER CREEK NEAR MARKLEEVILLE, CA	09-23-98	1110	8.0	2	99	880	5	2
			09-23-98	1111	7 9	3	110	750	5	2
			09-23-98	1112	8 2	3	130	850	6	3
3	10308800	BRYANT CREEK NEAR GARDNERVILLE, NV	09 25 98	1045	8 4	3	130	950	3	3
			09-25-98	1046	8.6	3	140	960	3	3
			09-25-98	1047	8 7	3	150	970	4	3
4	10308875	BRYANT CREEK ABOVE EAST FORK CARSON RIVER NEAR GARDNERVILLE NV	09 24-98	1400	8 0	2	230	910	5	3
			09-24-98	1401	8 9	3	110	1100	3	3
			09-24-98	1402	8 9	3	86	1200	3	4
5	10308900	EAST FORK CARSON RIVER BELOW BRYANT CREEK NEAR GARDNERVILLE NV	09-24-98	1200	9 4	2	20	980	1	<1
			09-24 98	1201	9 8	2	21	1000	2	<1
			09-24-98	1202	9.8	2	19	1000	2	<1
6	10309010	EAST FORK CARSON RIVER NEAR DRESSLERVILLE, NV	09-23-98	1150	9 5	1	16	960	2	<1
			09 23 98	1151	9 9	1	16	1000	2	<1
			09-23-98	1152	10	1	19	970	1	<1
7	10309089	EAST FORK CARSON RIVER AT RIVER VIEW DRIVE BRIDGE NEAR DRESSLERVILLE	09-22-98	1300	9 0	2	21	1000	2	<1
			09-22-98	1301	8 9	2	20	980	2	<1
			09-22 98	1302	9 0	2	20	990	2	<1
8	384157119391301	LEVIATHAN CREEK 1200 FT UPSTREAM OF SITE 10308783 ABOVE LEVIATHAN MINE	09-25-98	1130	9 6	2	18	1100	1	1
			09-25-98	1131	9 8	2	25	1100	2	2
			09 25 98	1132	9 6	2	20	1100	2	1
9	384235119385001	ASPEN CREEK ABOVE LEVIATHAN MINE NEAR MARKLEEVILLE CA	09-28-98	1130	7 5	1	21	970	2	1
			09-28-98	1131	8 0	1	20	1000	1	1
			09-28-98	1132	7 6	1	15	1000	1	2
10	384301119393001	ASPEN CREEK ABOVE LEVIATHAN CREEK NEAR MARKLEEVILLE, CA	09-28-98	1340	9 9	2	43	840	3	3
			09 28-98	1341	10	2	55	800	3	3
			09 28 98	1342	9 5	2	43	840	3	2
11	384303119393901	LEVIATHAN CREEK ABOVE ASPEN CREEK NEAR MARKLEVILLE CA	09-23-98	1445	1 5	5	560	140	4	<1
			09-23 98	1446	73	5	600	63	< 1	<1
			09-23-98	1447	93	5	680	78	2	<1
12	384407119384101	MOUNTAINEER CREEK ABOVE LEVIATHAN CREEK NEAR MARKLEEVILLE CA	09-22-98	1200	8 6	3	9 3	990	2	<1
			09-22-98	1201	8 7	3	12	1000	2	<1
			09-22-98	1202	8 6	3	9 9	970	1	<1
13	384407119384201	LEVIATHAN CREEK ABOVE MOUNTAINEER CREEK NEAR MARKLEEVILLE CA	-09 22 98	1600	8 0	1	200	720	1	2
			09-22-98	1601	6 9	1	280	580	9	3
			09 22 98	1602	6 8	1	220	670	9	2
14	384505119384001	BRYANT CREEK ABOVE BARNEY RILEY CREEK NEAR MARKLEEVILLE CA	09-25-98	1410	8 8	3	110	900	3	3
			09-25-98	1411	8 4	2	120	880	5	2
			09-25-98	1412	8 1	3	110	880	5	2

TABLE 3 Concentrations of trace elements and carbon in the less than 63 micrometer fraction of bed-sediment samples from streams in the vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (Fig 1)	CADMIUM µg/g (0 1)	CALCIUM PERCENT (0 005)	CERIUM µg/g (4 0)	CHROMIUM µg/g (1 0)	COBALT µg/g (1 0)	COPPER µg/g (1 0)	EUROPIUM µg/g (2 0)	GALLIUM µg/g (4 0)	GOLD µg/g (1 0)	HOLMIUM µg/g (1 0)	IRON PERCENT (0 005)	LANTHANUM µg/g (2 0)	LEAD µg/g (4 0)	LITHIUM µg/g (2 0)	MAGNESIUM PERCENT (0 005)
1	2	3 2	57	36	24	34	1	19	<1	<1	4 8	30	16	30	2 5
	2	3 2	58	36	24	34	1	19	<1	<1	4 9	30	16	30	2 4
	2	3 2	56	34	23	33	1	19	<1	<1	4 8	29	16	30	2 5
2	1 2	2 0	84	52	150	200	3	14	<1	2	9 8	41	15	20	85
	1 4	1 9	80	48	110	190	3	13	<1	2	10	39	23	20	78
	9	1 8	88	54	130	200	3	13	<1	3	8 8	42	16	20	85
3	1 7	2 0	72	72	230	160	2	15	<1	2	7 1	37	18	20	96
	1 7	2 1	74	72	230	170	2	16	<1	2	7 3	38	18	20	99
	1 7	2 2	79	74	230	180	3	16	<1	2	6 9	39	16	20	1 0
4	1 9	1 8	76	63	190	100	2	13	<1	2	7 1	38	15	20	82
	1 5	2 1	73	86	100	110	2	18	<1	1	5 9	39	21	20	1 0
	1 2	2 2	73	95	90	96	2	18	<1	1	6 1	39	21	20	1 1
5	2	3 1	56	36	23	35	2	19	<1	1	4 9	30	16	30	2 4
	1	3 2	58	38	24	36	2	20	<1	1	5 1	32	16	30	2 5
	2	3 2	58	36	25	36	2	20	<1	1	5 2	32	16	30	2 6
6	2	2 9	58	35	24	34	1	19	<1	<1	4 8	31	16	30	2 3
	2	3 1	59	36	24	34	1	19	<1	<1	4 9	30	16	30	2 4
	2	3 0	58	36	25	35	1	20	<1	<1	5 0	30	16	30	2 4
7	2	2 8	63	34	25	38	2	19	<1	1	5 1	34	17	30	2 5
	3	2 7	61	33	23	36	2	18	<1	1	5 0	33	17	30	2 4
	2	2 6	63	35	24	38	2	19	<1	1	5 1	35	17	30	2 3
8	2	1 9	70	62	17	41	2	20	<1	1	4 1	39	23	30	83
	2	1 7	70	78	18	51	2	20	<1	<1	4 4	39	28	20	90
	2	1 8	69	60	18	40	2	20	<1	1	4 1	37	24	30	81
9	2	1 8	50	30	12	18	1	16	<1	<1	2 8	29	19	20	51
	2	1 8	49	31	11	18	1	16	<1	<1	2 8	28	19	20	52
	1	1 8	50	31	11	17	1	17	<1	<1	2 7	28	19	20	51
10	2	1 8	66	60	30	260	2	18	<1	2	5 4	36	16	30	1 5
	2	1 6	66	60	35	400	2	18	<1	2	5 5	34	16	30	1 5
	3	1 7	65	63	32	290	2	17	<1	2	5 1	35	16	30	1 5
11	< 1	23	11	35	6	40	<1	3	<1	<1	39	6	4	6	22
	< 1	12	6	33	3	10	<1	2	<1	<1	44	3	2	4	089
	< 1	16	7	41	4	13	<1	2	<1	<1	44	3	2	3	12
12	2	2 6	61	53	22	38	2	18	<1	1	5 0	33	15	20	1 0
	2	2 7	62	54	22	39	2	18	<1	1	5 1	34	15	20	1 0
	2	2 7	63	53	22	38	2	18	<1	1	5 0	34	15	20	1 0
13	1	1 6	47	59	18	90	1	16	<1	<1	16	23	14	20	94
	< 1	1 3	35	59	15	79	<1	13	<1	<1	22	18	13	10	78
	1	1 5	39	55	15	78	1	13	<1	<1	18	19	13	10	81
14	1 2	1 9	78	64	74	180	2	16	<1	2	7 5	41	18	20	97
	1 5	2 0	89	52	240	200	3	14	<1	3	8 8	43	16	20	84
	1 3	2 0	82	52	170	190	3	14	<1	2	8 7	41	15	20	84

TABLE 3 Concentrations of trace elements and carbon in the less than 63 micrometer fraction of bed-sediment samples from streams in the vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (fig 1)	MANGANESE µg/g (4 0)	MERCURY µg/g (0 020)	METHYL MERCURY ng/g (0 1)	MOLYBDENUM µg/g (2 0)	NEODYMIUM µg/g (4 0)	NICKEL µg/g (2 0)	NIOBIUM µg/g (4 0)	PHOSPHORUS PERCENT (0 005)	POTASSIUM PERCENT (0 05)	SCANDIUM µg/g (2 0)	SELENIUM µg/g (0 1)	SILVER µg/g (0 1)	SODIUM PERCENT (0 005)	STRONTIUM µg/g (2 0)
1	1200	06	0 88	7	28	25	7	14	1 3	14	1	< 1	2 0	670
	1200	04		7	28	24	8	14	1 3	14	1	< 1	2 0	690
	1200	03		7	27	24	8	14	1 3	13	1	< 1	2 1	700
2	3500	47	3 2	1	46	250	5	16	97	11	2 6	< 1	1 2	580
	2500	30		9	45	190	4	16	92	10	2 5	< 1	1 1	510
	2800	47		1	50	210	4	16	94	11	1 2	< 1	1 0	540
3	2200	47	12	1	39	320	6	17	1 1	13	4 0	4	1 2	620
	2700	50	-	1	40	330	5	17	1 1	13	4 0	2	1 2	630
	3600	43	--	1	44	330	5	17	1 1	13	3 9	< 1	1 2	640
4	4900	47	22	2	43	240	4	24	86	11	2 7	< 1	79	580
	1200	58		2	36	150	6	16	1 2	14	3 0	< 1	1 2	720
	1400	61	--	2	35	130	6	14	1 2	15	3 3	< 1	1 3	720
5	1100	17	4 2	7	27	22	6	14	1 4	14	1	< 1	2 0	690
	1100	05	4 2	7	29	24	6	14	1 4	15	1	< 1	2 0	700
	1200	05	-	6	29	23	6	14	1 4	16	1	< 1	2 0	710
6	1200	05	3 2	7	29	25	7	14	1 3	14	1	< 1	1 8	650
	1200	06	--	7	29	25	8	15	1 3	15	1	< 1	2 0	680
	1200	06	-	7	29	25	8	15	1 3	15	1	< 1	2 0	680
7	1200	06	7 5	7	31	25	6	15	1 4	15	1	< 1	1 8	630
	990	06		6	31	24	6	14	1 4	15	1	< 1	1 8	610
	1000	07		7	31	25	6	15	1 4	16	2	< 1	1 7	610
8	980	14	0 81	1	38	32	9	12	1 4	12	1 4	< 1	1 4	670
	1100	24		2	37	41	9	13	1 4	14	1 8	< 1	1 3	680
	1200	18	--	1	36	32	9	13	1 3	12	1 4	< 1	1 4	670
9	850	13	0 42	6	23	10	7	13	1 5	9	9	< 1	1 4	540
	710	12	--	7	23	10	7	12	1 6	9	9	< 1	1 6	560
	490	12	-	6	24	10	7	13	1 5	9	9	< 1	1 6	560
10	930	25	0 18	8	36	40	7	12	1 5	16	1 5	< 1	94	440
	1100	46		1	38	43	7	12	1 4	16	2 2	< 1	88	470
	1100	50	--	1	37	42	10	11	1 2	16	2 2	1	85	460
11	160	17	0 17	8	6	10	<4	082	18	<2	1 2	< 1	097	71
	73	10	-	7	3	5	<4	079	08	<2	1 0	< 1	049	39
	86	14		8	4	6	<4	099	10	<2	1 2	< 1	063	51
12	980	03	2 4	7	30	22	6	14	1 3	14	3	< 1	1 7	700
	970	04	--	7	31	22	6	14	1 3	14	3	< 1	1 8	730
	820	04		7	31	22	6	14	1 3	14	4	< 1	1 7	700
13	590	31	0 13	1	25	23	5	14	1 0	12	3 4	<1	1 2	510
	390	37		1	18	20	4	14	86	9	4 0	< 1	97	430
	410	30	--	1	21	20	5	14	91	10	3 7	< 1	1 1	450
14	1000	65	4 4	1	42	120	5	16	1 1	13	4 1	< 1	1 2	640
	4900	40		1	51	390	4	16	1 0	11	3 4	< 1	1 1	580
	2200	39	--	9	47	260	5	16	1 0	11	3 5	< 1	1 2	570

TABLE 3 Concentrations of trace elements and carbon in the less than 63 micrometer fraction of bed-sediment samples from streams in the vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (fig 1)	SULFUR µg/g (0 05)	TANTALUM µg/g (1 0)	THALLIUM µg/g (1 0)	THORIUM µg/g (1 0)	TIN µg/g (1 0)	TITANIUM PERCENT (0 005)	URANIUM µg/g (0 05)	VANADIUM µg/g (2 0)	YTTRIUM µg/g (1 0)	YTTERBIUM µg/g (1 0)	ZINC µg/g (4 0)	CARBON ORGANIC PER CENT (01)	CARBON ORG + PER-CENT (01)	CARBON INORG PER CENT (01)
1	< 05	<1	<1	7 2	2	52	2 2	130	18	2	94	1 03	1 04	01
	< 05	<1	<1	7 0	2	52	2 2	130	18	2	88	92	93	01
	< 05	<1	<1	7 0	2	51	2 1	130	17	2	88	84	85	01
2	12	<1	7	7 4	2	56	5 4	160	43	3	230	3 23	3 31	08
	15	<1	7	6 4	3	50	5 5	150	43	3	230	3 71	3 79	08
	14	<1	6	7 3	3	54	5 6	150	47	4	220	3 46	3 53	07
3	36	<1	7	8 1	3	64	5 0	160	30	3	220	3 59	3 64	05
	29	<1	8	8 4	2	63	5 3	160	32	3	220	3 82	3 87	05
	18	<1	7	7 8	2	63	5 4	170	35	3	230	3 58	3 65	07
4	31	<1	7	7 9	2	48	4 1	130	37	3	280	3 80	3 89	09
	32	<1	6	10	2	73	4 4	180	23	2	160	2 62	2 65	03
	28	<1	6	12	2	85	4 2	200	22	2	160	2 22	2 24	02
5	< 05	<1	<1	6 7	2	67	2 3	140	16	2	95	89	91	02
	< 05	<1	<1	6 7	10	69	2 6	140	17	2	96	1 12	1 14	02
	< 05	<1	<1	6 6	2	69	2 7	140	18	2	97	1 16	1 18	02
6	< 05	<1	<1	7 0	2	51	2 3	130	18	2	88	1 45	1 47	02
	< 05	1	<1	7 1	2	52	2 3	130	19	2	91	1 36	1 38	02
	< 05	1	<1	7 1	2	52	2 3	130	19	2	94	1 42	1 43	01
7	< 05	<1	<1	7 3	2	67	2 8	140	18	2	96	1 64	1 66	02
	< 05	<1	<1	7 4	2	65	2 8	130	18	2	94	1 57	1 58	01
	< 05	<1	<1	7 7	2	67	2 9	140	19	2	99	2 00	2 02	02
8	08	<1	1	10	2	53	3 7	120	22	2	100	2 54	2 55	01
	09	<1	2	11	3	54	3 7	120	20	2	100	2 26	2 27	01
	08	<1	1	9 9	2	51	3 7	120	22	2	100	2 69	2 71	02
9	14	<1	<1	7 2	3	60	3 4	97	14	1	86	7 94	7 99	05
	13	<1	<1	6 5	3	65	3 3	100	14	1	84	6 81	6 83	02
	14	<1	<1	6 6	2	64	3 2	96	13	1	87	6 82	6 84	02
10	09	<1	3	13	3	71	4 8	150	33	3	140	76	77	01
	13	<1	4	12	2	70	5 8	150	36	3	150	99	1 00	01
	12	2	3	12	3	53	4 5	140	33	3	130	90	91	01
11	4 51	<1	1	1 9	2	093	7	130	4	<1	21	1 00	1 01	01
	4 95	<1	<1	<1	<1	038	3	130	1	<1	7	1 00	1 01	01
	4 80	<1	1	1 1	<1	053	3	160	1	<1	9	1 14	1 15	01
12	06	<1	<1	7 5	2	79	3 6	170	18	2	100	4 30	4 32	02
	06	<1	<1	7 6	2	80	3 7	170	18	2	100	4 23	4 25	02
	07	<1	<1	7 6	2	78	4 1	170	19	2	100	4 97	4 99	02
13	1 15	<1	4	6 8	2	46	2 5	160	15	2	85	1 86	1 87	01
	1 73	<1	4	5 9	2	38	1 9	150	10	1	68	1 84	1 85	01
	1 45	<1	4	6 2	2	42	2 0	150	12	1	70	1 89	1 90	01
14	16	<1	8	8 8	2	64	4 9	170	32	3	160	2 94	2 98	04
	21	<1	9	7 5	2	54	5 0	150	47	4	290	3 55	3 65	10
	21	<1	8	6 9	2	56	4 9	140	42	4	260	3 78	3 86	08

TABLE 4 Quality assurance data collected during sampling of water and bed sediment in vicinity of Leviathan Mine, September 1998

[Abbreviations and symbol E, estimated, mg/L, milligrams per liter, µg/L, microgram per liter, --, no data Method detection limits are located in parenthesis below constituent name]

SITE NUMBER (fig 1)	USGS STATION NUMBER	STATION NAME	DATE	TIME	SAMPLE TYPE	CALCIUM DISSOLVED mg/L AS CA (0 02)	MAGNESIUM DISSOLVED mg/L AS MG (0 004)
7	10309089	EAST FORK CARSON RIVER AT RIVER VIEW DRIVE BRIDGE NEAR DRESSLERVILLE	9 22-98	1131	FIELD BLANK	<0 02	E 002
8	384157119191301	LEVIATHAN CREEK 1200 FEET UPSTREAM OF SITE 10308783 ABOVE LEVIATHAN MINE	9-25-98	1200	REPLICATE	13	4 3
12	384407119384101	MOUNTAINEER CREEK ABOVE LEVIATHAN CREEK NEAR MARKLEEVILLE, CA	9-22-98	1438	FIELD BLANK	<0 02	< 004

SITE NUMBER (fig 1)	SODIUM, DISSOLVED mg/L AS NA (0 1)	SODIUM ADSORP-TION RATIO	POTASSIUM, DISSOLVED mg/L AS K (0 1)	BICARBONATE WATER DISSOLVED FIELD mg/L AS HCO_3	ALKALINITY WATER DISSOLVED FIELD mg/L AS $CACO_3$	SULFATE DISSOLVED mg/L AS SO4 (0 1)	CHLORIDE, DISSOLVED mg/L AS CL (0 1)	FLUORIDE, DISSOLVED mg/L AS F (1)	SILICA, DISSOLVED mg/L AS SIO2 (1)	SOLIDS, SUM OF CONSTITUENTS DISSOLVED mg/L
7	< 06	--	< 1			< 1	< 1	< 1	2	
8	7 9	5	3 7	75	62	4 2	1 8	< 1	43	116
12	< 06	-	< 1	-	--	< 1	12	-		--

SITE NUMBER (fig 1)	NITROGEN, NITRITE DISSOLVED mg/L AS N (01)	NITROGEN, NO2+NO3 DISSOLVED mg/L AS N (05)	NITROGEN, AMMONIA DISSOLVED mg/L AS N (02)	NITROGEN AMMONIA + ORGANIC TOTAL mg/L AS N (1)	NITROGEN AMMONIA + ORGANIC DISSOLVED mg/L AS N (1)	PHOS PHORUS TOTAL mg/L AS P (01)	PHOS-PHORUS DISSOLVED mg/L AS P (01)	PHOS PHORUS ORTHO, DISSOLVED mg/L AS P (01)	ALUMINUM, TOTAL µg/L AS AL (2 0)	ALUMINUM, DISSOLVED µg/L AS AL (1 0)
7	< 01	06	< 02	< 1	< 1	< 05	16	< 01	5 20	6
8	< 01	06	< 02	1	1	10	09	08	110	3
12	< 01	06	< 02	< 1	< 1	< 05	< 05	< 01	3 42	<1

SITE NUMBER (fig 1)	ANTIMONY, TOTAL µg/L AS SB (1 4)	ANTIMONY, DISSOLVED µg/L AS SB (1 0)	ARSENIC, TOTAL µg/L AS AS (1 0)	ARSENIC, DISSOLVED µg/L AS AS (1 0)	BARIUM, TOTAL µg/L AS BA (0 16)	BARIUM, DISSOLVED µg/L AS BA (1 0)	BERYLLIUM, TOTAL µg/L AS BE (0 14)	BERYLLIUM, DISSOLVED µg/L AS BE (1 0)	BORON, DISSOLVED µg/L AS B (16 0)	CADMIUM TOTAL µg/L AS CD (0 10)
7	<1	<1	3	<1	18	<1	< 1	<1	<16	< 10
8	<1	<1	12	2	66 1	65	< 1	<1	<16	< 10
12	<1	<1	<1	<1	18	<1	< 1	<1	<16	< 10

TABLE 4 Quality assurance data collected during sampling of water and bed sediment in vicinity of Leviathan Mine, September 1998 -- continued

SITE NUMBER (fig 1)	CADMIUM DISSOLVED µg/L AS CD (1 0)	CHROMIUM, TOTAL µg/L AS CR (4)	CHROMIUM, DISSOLVED µg/L AS CR (1 0)	COBALT, TOTAL µg/L AS CO (0 08)	COBALT, DISSOLVED µg/L AS CO (1 0)	COPPER, TOTAL µg/L AS CU (0 6)	COPPER, DISSOLVED µg/L AS CU (1 0)	IRON, TOTAL µg/L AS FE (10 0)	IRON, DISSOLVED µg/L AS FE (10)	LEAD, TOTAL µg/L AS PB (0 1)
7	<1	<4	<1	< 08	<1	< 60	<1	10	<10	< 10
8	<1	<4	<1	15	<1	71	<1	200	60	< 10
12	<1	<4	<1	< 08	<1	< 60	<1	12	<10	< 10

SITE NUMBER (fig 1)	LEAD, DISSOLVED µg/L AS PB (1 0)	MANGANESE, TOTAL µg/L AS MN (0 12)	MANGANESE, DISSOLVED µg/L AS MN (1 0)	MERCURY, TOTAL µg/L AS HG (0 1)	MERCURY, DISSOLVED µg/L AS HG (0 1)	MERCURY, METHYL, TOTAL NG/L (0 010)	MOLYBDENUM, TOTAL µg/L AS MO (0 8)	MOLYBDENUM, DISSOLVED µg/L AS MO (1 0)	NICKEL, TOTAL µg/L AS NI (0 6)	NICKEL, DISSOLVED µg/L AS NI (1 0)
7	<1	< 12	<1	< 1	< 1	016	< 8	<1	49	<1
8	<1	16	13	< 1	< 1	088	< 8	<1	92	<1
12	<1	< 12	<1	< 1	< 1	--	< 8	<1	52	<1

SITE NUMBER (fig 1)	SELENIUM, TOTAL µg/L AS SE (4 0)	SELENIUM, DISSOLVED µg/L AS SE (2 0)	SILVER, TOTAL µg/L AS AG (1 4)	SILVER, DISSOLVED µg/L AS AG (1 0)	STRONTIUM TOTAL µg/L AS SR (0 08)	STRONTIUM DISSOLVED µg/L AS SR (1 0)	THALLIUM, DISSOLVED µg/L AS TL (0 5)	TITANIUM TOTAL µg/L AS TI (0 6)	VANADIUM, DISSOLVED µg/L AS V (10 0)	ZINC, TOTAL µg/L AS ZN (1 0)
7	<4	<2	<1	<1	< 08	<1	7	< 60	<10	<1 0
8	<4	<2	<1	<1	180	210	< 5	< 60	<10	<1 0
12	<4	<2	<1	<1	20	<1	< 5	< 60	<10	<1 0

SITE NUMBER (fig 1)	ZINC, DISSOLVED µg/L AS ZN (1 0)	URANIUM TOTAL µg/L AS U308 (0 4)	URANIUM NATURAL DISSOLVED µg/L AS U (1 0)	CARBON, ORGANIC TOTAL mg/L AS C (0 1)	CARBON, ORGANIC DISSOLVED mg/L AS C (0 1)
7	<1	< 40	<1	--	6
8	2	< 40	<1	3 7	2 7
12	<1	< 40	<1	--	--

1998-1999 SUMMARY REPORT, ADMINISTRATIVE ORDER ON CONSENT, LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA

(SRK, 1999)

Prepared For:

ARCO Environmental Remediation, L.L.C.

1998 - 1999 Data Summary Report
Administrative Order on Consent
Leviathan Mine
Alpine County, California

Prepared by:

SRK Consulting
Engineers and Scientists

5250 South Neil Road
Suite 3000
Reno, Nevada 89502
(775) 828-6800 (Voice)
(775) 828-6820 (Fax)
Web Address: www.srk.com
e-mail: reno@srk.com

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1 INTRODUCTION

This Data Summary Report (DSR) presents the results of the 1998 and 1999 field investigation at the Leviathan Mine in Alpine County, California (Figure 1.1). These field activities were conducted pursuant to the Administrative Order on Consent (AOC) between ARCO Environmental Remediation, L.L.C. and Region 9 of the U.S. Environmental Protection Agency (EPA).

The field investigation implemented the "Leviathan Mine 1998 Work Plan" (SRK 1998) that was transmitted to EPA on July 1, 1998. The work plan defined four areas of field investigation:

- Geological;
- Groundwater;
- Surface Water; and
- Geotechnical.

Data collection activities commenced in August 1998 and continued through December 1998. Limited data collection activities at the site continued through 1999. The Work Plan was not approved by EPA as required under the AOC. The combined results of all field activities are presented herein.

In addition to field investigation activities, a new topographic map of the Leviathan Mine was developed (Figure 1.2). The ground survey and aerial flight were conducted between October and November 1998. Survey control points for the 1998 survey are shown on Figure 1.3. The base map used throughout the DSR is based on the 1998 topographic information. Control survey information is provided in Appendix A.

2 GEOLOGICAL INVESTIGATION

The scope of the geological investigation included completion of a field reconnaissance of the property. The field reconnaissance was performed in late August 1998.

Figure 2.1 presents the results of the field surface geochemical survey. Approximately 200 surface samples, listed in Table 2.1, were collected for field pH and conductivity measurements. Field sampling activities were conducted in accordance with the 1998 Work Plan. Paste pH and conductivity measurements were taken from an approximately 2:1 volume ratio of de-ionized/distilled water to solid. Field instruments were calibrated in accordance with manufacturer specifications.

3 GROUNDWATER INVESTIGATION

The scope of the groundwater investigation was to collect data related to shallow and deep groundwater quantity and quality at the site. Existing site groundwater data included the 1983 hydrologic investigation (USGS 1985) completed prior to the 1984 abatement action completed by the Lahontan Regional Water Quality Control Board (Brown and Caldwell 1983).

The 1983 investigation included installation of 60 piezometers through the Leviathan Creek and Aspen Creek drainage areas. As a result of the 1984 action and continued movement of the natural landslide near Aspen Creek, the majority of piezometers are no longer accessible. Table 3.1 presents the remaining piezometers identified during the 1998 field program.

A total of 15 new groundwater monitor wells were installed in the Leviathan Creek drainage area between August 1998 and October 1998. Figure 3.1 presents the surveyed locations of each groundwater monitor well. Table 3.2 presents the surveyed coordinates and well completion details for each monitor well.

Well boreholes were advanced using a rotary-vibratory drilling technique (e.g., Sonic Drilling). Drilling fluids were not required during the drilling process. The average borehole diameter is approximately 10 inches. Continuous core samples were collected at each well location, except in shallow boreholes adjacent to deep boreholes.

Core samples are located on-site in a secure storage unit. Chip trays from the drilling program are located in the SRK Reno, Nevada office. Boring logs for each well location are presented in Appendix B.1. Paste pH measurements for core samples are summarized in Appendix B.2.

Each well was constructed using 4 inch diameter Schedule 40 PVC casing. Screen intervals (0.020 inch size) are shown on Table 3.2.

Well development was performed after well installation. Surging and rapid pumping was performed after well completion. Additional bailing was performed until water levels and field parameters stabilized. Well development records are included in Appendix B.3.

3.1 Groundwater Sampling

Groundwater samples were collected during the following sampling periods:

- October 12 – 16, 1998; and
- November 2 – 6, 1998.

Groundwater sampling activities were conducted in accordance with the 1998 Work Plan. Laboratory analyses consist of major ion and metal chemistry. The laboratory deliverable included the Contract Laboratory Program (CLP) data package.

Table 3.3 presents the laboratory results for the groundwater sampling events. Appendix C includes the laboratory data sheets and Appendix D includes the associated CLP data package.

3.2 Water Level Measurements

Water level measurements for each monitor well were collected between September 1998 and December 1998. Additional measurements were recorded in June, August and September 1999. Figures 3.2 through 3.12 present water level readings over time. Table 3.4 summarizes water level measurement data.

Continuous water level recorders were installed at MW-10s and MW-10d on June 14, 1999. Figure 3.13 presents continuous water level data between June 14, 1999 and September 9, 1999. Manual water level measurements in 1999 are also shown on Figure 3.13. Appendix B.4 contains a tabular listing of continuous level readings.

4 SURFACE WATER INVESTIGATION

The surface water investigation included collection of surface water quality and flow data for the Leviathan Mine. Surface water sample locations are shown on Figure 4.1. In general, three surface water sampling events were completed:

- September 24 – 25, 1998;
- October 12 – 16, 1998; and
- November 4 – 5, 1998.

4.1 Surface Water Data

Each surface water sampling event included measurement of field pH, temperature conductivity and flow. Surface water sampling activities were conducted in accordance with the 1998 Work Plan. Table 4.1 presents the surface water flow for the Leviathan Creek and Aspen Creek watershed, respectively. Table 4.2 presents all surface water quality data collected during the three sampling events. Laboratory analytical data are included in Appendix C.

4.2 Climate Data

A light duty weather station was in operation at the property in June 1998. Temperature, precipitation and wind speed data were recorded from June 1998 until early January 1999. The system was unattended as of November 4, 1998. Data collection from the weather station stopped on January 7, 1999 and re-started on July 28, 1999. The last download of weather data was completed on September 10, 1999. The rain gage is unheated; therefore, rainfall data for cold periods may not reflect actual precipitation amounts.

Available climate data for November 1998 through September 1999 are summarized in Table 4.3. Output from the weather station is presented in Appendix E.

5 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included collection of soil samples for geotechnical testing. The soil testing program included standard index properties, permeability and compaction characteristics. The investigation also included installation of nine permanent survey monuments in the active landslide area.

5.1 Test Pit Excavation

Six test pits were excavated at the locations shown on Figure 5.1. The soil testing program is presented in Table 5.1. Test pit logs and results from the test program are included in Appendix F.

5.2 Landslide Monuments

Survey monuments consist of steel posts with a base plate anchored below the surface. Survey monument locations are shown on Figure 5.1. Table 5.2 presents a listing of survey data for each survey monument.

6 REFERENCES

Brown and Caldwell Consulting Engineers. April 1983. Leviathan Mine Pollution Abatement Project, Design Report and Draft Environmental Impact Report, Sacramento, California.

SRK 1998, "Leviathan Mine 1998 Work Plan, Draft," prepared for ARCO Environmental Remediation, L.L.C. for transmittal to U.S. EPA Region 9, June.

USGS 1985, "Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, California, 1981-1983," Open File Report 85-160.

Tables

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19001	386907.4973	2668965.7227	2.3	1750
19002	386881.0478	2668934.8161	3.46	180
19003	386849.6409	2668894.4022	3.21	240
19004	386844.3293	2669044.9120	2.44	1050
19005	386823.1406	2669013.6849	2.88	360
19006	386801.1346	2668990.1618	2.7	580
19007	386764.5350	2668943.7665	4.63	10
19008	386759.1000	2669101.3971	2.04	2800
19009	386732.0653	2669060.2327	4.15	20
19010	386670.5088	2669145.4458	2.13	2400
19011	386649.8605	2669109.5270	5.18	0
19012	386579.4600	2669185.9000	5.37	0
19013	386560.4788	2669156.6296	5.44	0
19014	386489.2747	2669239.7350	4.17	60
19015	386437.9064	2669194.8280	4.16	20
19016	386418.9242	2669290.0261	2.61	770
19017	386384.5166	2669238.2584	5.45	0
19018	386307.8836	2669314.2163	4.6	40
19019	386283.2590	2669248.5242	5.61	0
19020	386229.6709	2669337.9276	3.94	50
19021	386248.7039	2669478.3964	5.09	10
19022	386253.8178	2669505.5459	4.3	40
19023	386332.8325	2669595.9618	3.73	60
19024	386296.8107	2669589.6677	3.8	80
19025	386385.3814	2669708.8424	4.22	20
19026	386330.9595	2669857.8775	4.11	20
19027	386337.2606	2669661.0475	4.39	10
19028	386257.6954	2669721.3348	5.12	0
19029	386425.9834	2669712.8035	4.03	20
19030	386370.1725	2669664.6633	4.14	20
19031	386386.9205	2669636.2875	4.42	20
19032	386456.6310	2669708.2440	4.08	40

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19033	386529.0292	2669755.5478	4	30
19034	386550.8114	2669770.9785	5.08	10
19035	386516.6272	2669854.2979	4.66	20
19036	386568.1106	2669853.1070	4.28	10
19037	386487.4279	2669945.0008	4.72	0
19038	386565.6044	2669946.3998	4.45	80
19039	386533.9635	2670044.0853	4.77	50
19040	386569.4836	2670041.1488	4.76	20
19041	386532.5133	2670142.2084	5.18	0
19042	386587.4257	2670143.3625	4.86	0
19043	386600.7097	2670360.2385	4.68	10
19044	386572.6498	2670240.6279	5.07	0
19045	386798.8740	2670159.0438	4.61	10
19046	386893.5209	2670003.3928	4.82	0
19047	386766.5953	2670066.4525	5.34	0
19048	386855.8890	2669933.0812	4.42	20
19049	386733.6665	2669984.7021	4.63	10
19050	386690.2833	2669892.7795	4.65	20
19051	386658.4485	2669798.8694	4.17	20
19052	386744.7727	2669734.5553	3.88	70
19053	386787.8451	2669801.6593	4.52	10
19054	386889.2117	2669781.6354	4.58	70
19055	386983.7631	2669891.4670	5.2	20
19056	386982.3648	2669779.6026	4.68	30
19057	386829.3217	2669677.1403	6.38	220
19058	386933.8058	2669695.5236	4.37	460
19059	387118.6691	2669630.7580	7.03	30
19060	387214.0900	2669717.2699	4.58	60
19061	387321.0686	2669652.3544	4.64	60
19062	387462.6165	2669616.9004	4.88	10
19063	387427.5227	2669537.1354	4.68	10
19064	387362.0710	2669582.2341	2.38	1440

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19065	387382.1729	2669465.7150	4.73	10
19066	387472.0985	2669430.3414	3.83	60
19067	387512.7644	2669409.0535	3.63	80
19068	387560.2847	2669311.0038	6.33	30
19069	387576.5464	2669280.5460	8.11	110
19070	387573.6122	2669191.3630	8.06	50
19071	387580.2357	2669073.6669	6.8	40
19072	387517.0326	2669054.4002	5.68	20
19073	387465.7146	2668985.3964	6.84	60
19074	387417.1109	2669015.5280	8.28	90
19075	387379.2519	2668986.8169	4.7	70
19076	387455.9372	2668702.6760	8.85	70
19077	387485.3796	2668773.3364	6.25	80
19078	387370.3153	2668547.7856	8.77	40
19079	387253.1655	2668435.0994	8.65	50
19080	387350.7603	2668883.2174	4.76	60
19081	387319.9976	2668805.0756	4.85	60
19082	387286.9249	2668699.4782	8.95	110
19083	387209.0255	2668631.2990	8.73	100
19084	387136.4337	2668589.2045	4.55	70
19085	387103.9292	2668606.2253	4.36	30
19086	387084.2316	2668602.3985	1.85	5600
19087	387050.7566	2668627.2522	1.9	4500
19088	387023.7737	2668632.7964	3.96	30
19089	386977.0694	2668652.5171	4.1	10
19090	386951.5007	2668715.1107	2.13	2300
19091	386893.2642	2668683.0866	3.85	50
19092	386836.7259	2668673.2712	4.63	70
19093	386778.8874	2668684.5965	3.27	370
19094	386777.0729	2668767.2010	8.25	60
19095	386891.1559	2668754.8781	4.02	50
19096	386874.2405	2668843.3436	2.62	700

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19097	386905.5668	2668896.2640	2.25	1540
19098	387933.7494	2668010.2198	5.68	20
19099	387762.6699	2668080.4922	3.28	140
19100	387446.4910	2668125.1800	4.13	30
19101	387302.0485	2668119.4624	4.26	30
19102	387238.1406	2668048.7063	1.98	3900
19103	387249.9181	2667910.4809	4.56	20
19104	387496.3064	2667831.4889	4.12	20
19105	387673.8152	2667774.4439	4.93	10
19106	387588.3839	2667753.0254	4.42	30
19107	387516.3932	2667558.5834	3.81	40
19108	387140.3658	2668233.6174	4.02	50
19109	386757.1573	2668587.9681	4.11	20
19110	386814.4377	2668175.8270	4.18	20
19111	386900.8848	2668422.4256	4.26	20
19112	386951.0203	2668171.1096	4.42	20
19113	386993.9624	2667916.8039	4.39	20
19114	386981.3516	2667793.3139	2.85	640
19115	387112.4165	2667738.6796	3.37	990
19116	387244.0483	2667682.4316	5.07	30
19117	387382.3803	2667610.9121	2.23	2300
19118	386940.2337	2667522.6893	2.32	2600
19119	387055.3145	2667489.5662	2.77	560
19120	387220.9723	2667471.0847	4.11	50
19121	387516.7110	2667414.7849	3.91	60
19122	387703.9287	2667177.5971	2.9	380
19123	387753.5003	2667300.0959	4.52	30
19124	387699.1688	2667382.5282	3.82	50
19125	388289.2044	2669436.9531	4.95	50
19126	388317.6788	2669660.8081	4.31	40
19127	388343.6743	2669911.7250	2.84	670
19128	388427.3418	2670144.7638	4.31	40

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19129	388329.8590	2670435.9105	3.8	70
19130	388158.2144	2670786.9109	3.51	80
19131	388333.5799	2669140.2530	4.16	30
19132	388427.1928	2669360.7610	7.08	70
19133	388517.6844	2669456.9441	3.3	160
19134	388523.3153	2669583.5796	4.81	10
19135	388513.9917	2669891.7309	4.56	20
19136	388531.8727	2670055.9339	3.54	90
19137	388555.1681	2670220.8081	4.79	10
19138	388501.5631	2670369.2846	4.83	10
19139	388417.0685	2670658.8271	4.79	10
19140	388307.0440	2670832.7669	4.73	10
19141	388057.5058	2670944.2351	4.19	10
19142	387876.6015	2670905.1618	4.42	10
19143	387784.8733	2670922.3917	4.14	30
19144	387349.6181	2671088.6570	5.7	20
19145	387312.1376	2671002.5585	4.63	10
19146	387440.1615	2670551.9368	4.88	10
19147	387559.5625	2670194.2045	4.48	50
19148	387610.9880	2670405.5319	4.81	0
19149	387775.9073	2670253.4927	4.5	20
19150	387886.3929	2670241.0250	4.64	10
19151	387686.6728	2670683.3752	3.93	50
19152	387867.1450	2670709.7397	7.2	150
19153	387852.4211	2670447.3004	4.03	40
19154	387838.2415	2670446.8718	4.58	10
19155	387860.2458	2669936.4789	4.27	20
19156	388165.2141	2669895.5677	4.62	20
19157	388140.5836	2669529.6290	8.14	80
19158	388261.0732	2670240.5565	4.62	20
19159	388170.1647	2670465.1403	4.89	30
19160	387855.4155	2668687.0936	8.29	50

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19161	387969.1326	2668875.3773	2.86	530
19162	388679.4909	2668689.8647	4.05	1400
19163	388626.6342	2668972.7755	4.75	10
19164	388362.1322	2668906.2720	4.41	30
19165	388511.2884	2669274.0557	4.8	90
19166	388580.4084	2669220.8336	6.97	270
19167	388705.4330	2669307.8687	5.5	30
19168	388933.3417	2669501.7645	5.27	30
19169	389083.4078	2669553.7445	4.01	440
19170	389228.9691	2669674.4566	3.69	140
19171	389241.9591	2669951.9667	3.63	100
19172	389249.4117	2670151.2103	5.21	30
19173	389206.6097	2670165.8561	3.46	140
19174	388848.8355	2670029.3580	4.29	30
19175	388679.1562	2669841.6899	4.75	20
19176	388886.2153	2669760.9386	4.84	20
19177	389076.3090	2669944.5826	4.47	30
19178	388793.7081	2670291.8351	5.36	50
19179			No Data	
19180	389151.5560	2668801.1397	6.97	40
19181	388980.3499	2668753.6301	3.11	820
19182	388880.9544	2668618.5275	4.45	20
19183	388973.4192	2668973.7829	7.69	50
19184	388814.5971	2669161.9960	5.27	30
19185	389153.1358	2669183.8450	3.31	360
19186	389198.3390	2668962.3944	3.77	150
19187	389378.7848	2669198.8987	3.99	30
19188	389321.5257	2669506.7005	4.19	20
19189	389129.3424	2669398.7764	4.2	40
19190	389583.0559	2670272.7760	4.71	20
19191	389040.7754	2670460.5313	4.62	40
19192	388822.8190	2670573.5518	3.68	90

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 2.1
Field Geochemical Survey Results

Field I.D.	Northing	Easting	Field pH	Field Conductivity
19193	388655.8511	2670738.6194	5.12	20
19194	388608.6315	2670590.8137	5.31	20
19195	388798.1383	2670442.1574	5.81	80
19196	385867.3816	2668736.7291	3.32	1110
19197	386166.6387	2668986.9781	4.73	10
19198	386335.0223	2668910.7439	4.72	30
19199	385867.4198	2669244.9798	4.51	10
19200	385707.1031	2669058.2317	4.53	20

Note: Coordinates are based on the California State Coordinate System, Zone 2

Table 3.1
Existing USGS Piezometer Inventory
Leviathan Mine

Piezometer I.D.	Total Depth (ft) (Note 1)	Depth to Water (feet)	Casing	Comments
3A	28.65	Dry	2" - PVC	
3B1	77.19	24.68	2" - PVC	On bench in middle of slide area
3B2	15.82	14.17	2" - PVC	
3C	49.48	49.16	2" - PVC	Under tree in depression
19A	-	-	2" - PVC	Plugged with dirt at surface
19B	31.59	14.59	2" - PVC	Near road and above bio-cell
25	109.35	97.16	2" - PVC	Bottom filled with fine mud
33	109.30	24.33	2" - PVC	Near road, "T" in casing

Note:
1. Total depth is depth measured to the apparent bottom of casing.
2. Field survey was completed during week of June 29, 1998.

Table 3.2
1998 Groundwater Well Locations
Leviathan Mine

I.D.	Former Designation (1)	Northing	Easting	Top of Casing (feet asl)	Total Depth (feet)	Screen Interval	
MW-1	LI-1	385,684.2771	2,668,848.4972	7085.27	71.1	7,034.7	7,014.2
MW-2D	P-2D	386,459.4045	2,668,627.7187	7043.84	85	6,973.8	6,959.2
MW-2S	P-2S	386,456.2614	2,668,628.3194	7043.92	49	7,015.9	6,995.9
MW-3	P-3	387,129.3322	2,668,741.9930	7076.39	42	7,050.8	7,035.4
MW-4	P-4	387,505.2247	2,669,358.2167	7160.02	39	7,142.4	7,127.0
MW-5D	P-1D	386,528.4748	2,669,272.1120	7105.14	79	7,041.5	7,026.1
MW-5S	P-1S	386,530.5308	2,669,270.8749	7104.02	46	7,078.0	7,058.0
MW-6	LC-1	386,285.4229	2,668,236.2379	7041.82	95	6,972.7	6,950.3
MW-7	UT-1	385,629.9486	2,667,410.4952	7044.97	34	7,026.0	7,011.0
MW-8	P2-1	386,474.2422	2,667,588.1086	7043.38	151	6,913.4	6,893.4
MW-9	P3-1	386,808.4412	2,667,741.7597	6990.64	40	6,978.8	6,963.6
MW-10D	LC-2D	386,889.1748	2,667,419.1681	6921.38	75	6,866.4	6,846.4
MW-10S	LC-2S	386,890.6238	2,667,417.7338	6919.23	39	6,900.2	6,880.2
MW-11	LT-1	386,689.1813	2,666,950.4112	6924.43	18	6,916.7	6,906.4
MW-12	P4-1	387,656.4263	2,667,189.2576	6898.74	72	6,849.6	6,829.6
USGS-25		387,220.0000	2,671,002.3000				
USGS-33		385,931.6000	2,669,994.9000				

Notes:

1. "Former designations" refers to the preliminary well identifications used in the 1998 Work Plan. Following completion of the drilling program and the field survey, final well identifications were assigned.

2. Survey information is taken from the 1998 Field Survey performed by Summit Engineering Corporation. Coordinates are based on the California State Coordinate System, Zone 2.

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Field pH (SU)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
MW-1												
10/13/98	10139803	7.11	2020	9.2	6.91	378	-0.2	3.5	-1	0.3	-0.2	0.09
11/3/98	11039801	N/A	2170	8.2	7.15	373	-0.2	4.5	-1.0	0.2	-0.2	0.08
MW-2s												
10/19/98	10199804	3.92	4110	12.7	3.56	-2	-1.0	1.3	5.3	-1.0	-1.0	0.29
11/5/98	11059804	3.32	4480		3.48	-2	-1.0	2.0	6.9	-1	1.1	0.43
MW-2d												
10/19/98	10199805	4.23	5080	12.7	3.6	-2	-1.0	2.1	11.3	-1.0	-1.0	0.1
11/5/98	11059805	3.69	5140	11.2	3.62	-2	-1	2.6	11.8	-1	1.3	0.15
MW-3												
10/16/98 Dup.	10199800				2.22	-2	-1.0	1.7	3.1	-1.0	-1.0	0.11
10/19/98	10199803				2.22	-2	-1.0	1.7	3.0	-1.0	-1.0	4.71
11/3/98	11029802	1.88	8180	10.6	5.91	-2	-0.5	2.2	2.7	-0.2	0.9	5.03
MW-4												
10/16/98	10169802		2170	10.3	3.72	-2	-1.0	3.7	4.6	1.3	-1.0	0.02
11/3/98	11039803	4.03	2220	11.6	3.860	-2	-0.2	2.6	6.3	0.4	-0.2	-0.01
MW-5d												
10/19/98	10199801	4.25	5270	15.1	3.05		-1.0	6.8	7.8	1.3	-1.0	-0.01
MW-6												
10/20/98	10209802	4.44	2810	10.3	4.76	-2	-0.5	3.1	4.5	-0.5	-0.5	0.03
11/6/98	11069800	4.26	3030	8.6	4.62	-2	-0.2	5.0	5.0	-0.2	-0.5	0.02
MW-7												
10/20/98	10209800	5.48	330	6	6.42	81	-0.2	1.2	-0.2	-0.2	-0.2	0.13
11/6/98	11069801	5.5	320	7	6.03	61	-0.2	1.3	-0.2	-0.2	-0.2	0.04

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Antimony (ug/L) [ug/L]	C	Q	M	Arsenic (ug/L) [ug/L]	C	Q	M	Barium (ug/L) [ug/L]	C	Q	M	Beryllium (ug/L) [ug/L]	C	Q	M
MW-1																									
10/13/98	10139803	0.15	1820	160	846	60.0	B		P	-18.7	U		P	-2.0	U	W	F	29.3	B		P	-0.70	U		P
11/3/98	11039801	0.22	1580	183	873	-13.5	U		P	-18.7	U		P	1.2	B		F	28.1	B	E	P	-0.70	U		P
MW-2s																									
10/19/98	10199804	0.02	6180	67	8400	294000			P	-18.7	U		P	-1.0	U	+	F	12.5	E		P	9.8			P
11/5/98	11059804	0.16	5890	62	6820	319000			P	66.7			P	17.0	B		F	13.8	B	E	P	10.7			P
MW-2d																									
10/19/98	10199805	0.31	7510	283	8860	283000			P	49.7	B		P	16.5	B		F	16.8	B	E	P	85.1			P
11/5/98	11059805	0.18	7560	166	9900	310000			P	66.7			P	-5.0	U		F	18.4	B	E	P	94.1			P
MW-3																									
10/16/98 Dup.	10199800	7.1	6520	29	7760	306000			P	26.3	B		P	6680			F	16.2	B	E	P	5.2			P
10/19/98	10199803	6.67	6340	12	9370	280000			P	37.4	B		P	6600			F	15.1	B	E	P	4.9	B		P
11/3/98	11029802	6.85	6440	21	6260	299000			P	65.8			P	6520			F	15.1	B	E	P	5.6			P
MW-4																									
10/16/98	10169802	0.21	3100	72	2560	112000			P	-18.7	U		P	11.5		S	F	12.3	B	E	P	10.7			P
11/3/98	11039803	0.1	3000	95	3380	99800			P	-18.7	U		P	7.2	B	W	F	14.0	B	E	P	9.4			P
MW-5d																									
10/19/98	10199801	0.32	5770	1040	6670	128000			P	41.8	B		P	8.8	B	S	F	23.4	B	E	P	25.7			P
MW-6																									
10/20/98	10209802	0.02	3470	25	2390	18700			P	57.5	B		P	305			F	12.6	B	E	P	6.0			P
11/6/98	11069800	0.09	3330	91	3230	20600			P	40.6	B		P	306			F	12.4	B	E	P	6.1			P
MW-7																									
10/20/98	10209800	0.18	217	100	63.7	28.9	B		P	-18.7	U		P	61.2			F	41.9	B	E	P	-0.70	U		P
11/6/98	11069801	0.31	246	317	90.1	103	B		P	-18.7	U		P	26.4			F	28.2	B	E	P	-0.70	U		P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Boron (ug/L)				Cadmium (ug/L)				Calcium (ug/L)				Chromium (ug/L)				Cobalt (ug/L)				Copper (ug/L)				Iron (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-1																													
10/13/98	10139803	69.9			P	-2.2	U		P	282000			P	-3.9	U		P	-3.6	U		P	-1.1	U		P	122			P
11/3/98	11039801	59.1			P	2.7	B		P	272000			P	-3.9	U		P	-3.6	U		P	-1.1	U		P	81.9	B		P
MW-2s																													
10/19/98	10199804	421			P	55.8			P	170000			P	55.2			P	2170		E	P	1880			P	823000			P
11/5/98	11059804	447			P	48.8			P	169000			P	64.5			P	2300			P	1750			P	904000			P
MW-2d																													
10/19/98	10199805	481			P	169			P	379000			P	7.2	B		P	6990		E	P	8490			P	863000			P
11/5/98	11059805	477			P	166			P	428000			P	4.0	B		P	7190			P	9300			P	889000			P
MW-3																													
10/16/98 Dup.	10199800	581			P	23.6			P	212000			P	1410			P	538		E	P	-1.1	U		P	818000			P
10/19/98	10199803	533			P	19.7			P	196000			P	1270			P	497		E	P	-1.1	U		P	788000			P
11/3/98	11029802	63.3			P	11.3			P	209000			P	1350			P	512			P	13.5	B		P	936000			P
MW-4																													
10/16/98	10169802	113			P	13.4			P	404000			P	10.2			P	484		E	P	4620			P	531			P
11/3/98	11039803	113			P	12.2			P	412000			P	9.0	B		P	445			P	3370			P	643			P
MW-5d																													
10/19/98	10199801	588			P	16.4			P	487000			P	80.6			P	1090		E	P	3040			P	297000			P
MW-6																													
10/20/98	10209802	350			P	-2.2	U		P	441000			P	-3.9	U		P	585			P	7.5	B	U CCB	P	347000			P
11/6/98	11069800	351			P	-2.2	U		P	430000			P	-3.9	U		P	602			P	3.1	B		P	340000			P
MW-7																													
10/20/98	10209800	25.2	B		P	-2.2	U		P	34500			P	-3.9	U		P	8.2	B		P	-1.1	U		P	4240			P
11/6/98	11069801	23.8	B		P	-2.2	U		P	35600			P	-3.9	U		P	10.2	B		P	-1.1	U		P	4120			P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Lead (ug/L)				Magnesium (ug/L)				Manganese (ug/L)				Mercury (ug/L)				olybdenum (ug/L				Nickel (ug/L)				Potassium (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-1																													
10/13/98	10139803	-1.0	U		F	129000			P	205			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	13100		E	P
11/3/98	11039801	1.3	B		F	115000			P	147			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	13600			P
MW-2s																													
10/19/98	10199804	-1.0	U	W	F	34800			P	6780			P	-0.10	U		CV	-4.4	U		P	5700			P	14600			P
11/5/98	11059804	1.1	B		F	36900			P	7320			P	-0.10	U		CV	-4.4	U		P	6230			P	15600			P
MW-2d																													
10/19/98	10199805	-1.0	U		F	94100			P	79200			P	-0.10	U		CV	-4.4	U		P	9620			P	20100			P
11/5/98	11059805	2.5	B		F	92600			P	73000			P	-0.10	U		CV	-4.4	U		P	10500			P	21800			P
MW-3																													
10/16/98 Dup.	10199800	16.0		S	F	65900			P	6620			P	0.11	B		CV	-4.4	U		P	2660			P	27400			P
10/19/98	10199803	15.5		S	F	61900			P	6330			P	-0.10	U		CV	-4.4	U		P	2500			P	26400			P
11/3/98	11029802	13.8			F	63000			P	6400			P	-0.10	U		CV	-4.4	U		P	2550			P	27500			P
MW-4																													
10/16/98	10169802	3.1			F	102000			P	15200			P	33.5			CV	-4.4	U		P	792			P	14900			P
11/3/98	11039803	4.6			F	94800			P	13900			P	20.7			CV	-4.4	U		P	701			P	16900			P
MW-5d																													
10/19/98	10199801	2.0	B	W	F	178000			P	19200			P	-0.10	U		CV	-4.4	U		P	1410			P	46500			P
MW-6																													
10/20/98	10209802	-1.0	U		F	80700			P	22400			P	-0.10	U		CV	-4.4	U		P	1280			P	24200			P
11/6/98	11069800	-1.0	U		F	76300			P	21500			P	-0.10	U		CV	-4.4	U		P	1350			P	21600			P
MW-7																													
10/20/98	10209800	-1.0	U		F	7010			P	457			P					-4.4	U		P	19.9	B		P	3250	B		P
11/6/98	11069801	-1.0	U		F	6660			P	405			P	-0.10	U		CV	-4.4	U		P	23.2	B		P	2670	B		P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Selenium (ug/L)				Silver (ug/L)				Sodium (ug/L)				Thallium (ug/L)				Vanadium (ug/L)				Zinc (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-1																									
10/13/98	10139803	7.6		S	F	-1.8	U		P	40500			P	-1.0	U		F	5.4	B		P	3.9	B		P
11/3/98	11039801	10.0		NS	F	-1.8	U		P	41000			P	-1.0	U		F	-2.5	U		P	6.2	B		P
MW-2s																									
10/19/98	10199804	-5.0	U	W	F	-1.8	U		P	21400			P	307			F	482			P	910			P
11/5/98	11059804	-1.0	U	NW	F	-1.8	U		P	22300			P	303			F	558			P	976			P
MW-2d																									
10/19/98	10199805	-5.0	U	W	F	-1.8	U		P	65800			P	30.1			F	84.3			P	2140			P
11/5/98	11059805	1.9	B	NW	F	-1.8	U		P	67500			P	41.6		S	F	115			P	2190			P
MW-3																									
10/16/98 Dup.	10199800	-5.0	U	W	F	-1.8	U		P	30700			P	114			F	647			P	801			P
10/19/98	10199803	-5.0	U	W	F	-1.8	U		P	29700			P	106			F	602			P	744			P
11/3/98	11029802	-5.0	U	NW	F	-1.8	U		P	29200			P	89.6			F	659			P	791			P
MW-4																									
10/16/98	10169802	36.4		S	F	-1.8	U		P	9280			P	15.5			F	-2.5	U		P	1240			P
11/3/98	11039803	37.3		NS	F	-1.8	U		P	9340			P	14.9			F	-2.5	U		P	1140			P
MW-5d																									
10/19/98	10199801	178		S	F	-1.8	U		P	414000			P	148			F	22.2	B		P	1240			P
MW-6																									
10/20/98	10209802	-1.0	U	NW	F	4.4	B		P	25600			P	33.1		S	F	51.8			P	247			P
11/6/98	11069800	2.5	B	NW	F	-1.8	U		P	23700			P	31.6		S	F	25.7	B		P	262			P
MW-7																									
10/20/98	10209800	2.4	B	NW	F	-1.8	U		P	12800			P	4.4	B		F	-2.5	U		P	16.5	B		P
11/6/98	11069801	3.6	B	N	F	-1.8	U		P	13000			P	-1.0	U		F	-2.5	U		P	22.2			P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Field pH (SU)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
MW-8												
10/20/98	10209801	3.31	1800	10	3.83	-2	-0.5	3.1	2.5	-0.5	-0.5	0.11
11/6/98	11069802	3.56	2010	8.4		-2	-0.5	2.9	2.1	-0.5	-0.5	0.09
MW-10s												
10/16/98	10169801	3.67	2480	9.1	3.49	-2	-1.0	6.5	5.2	-1.0	-1.0	-0.01
11/5/98	11059801	3.72	3430	9.7	3.72	-2	-0.2	3.7	5.1	-0.2	-0.5	0.02
MW-10d												
10/14/98	10149802	6.38	1410	10.7	6.93	236	-0.5	4.7	-1.0	1.3	-0.5	0.05
11/5/98	11059802	6.26	2050	9.5	6.36	214	-0.2	4.9	-1.0	0.3	-0.2	0.03
MW-11												
10/14/98	10149801	6.88	410	10.1	7.27	260	-0.2	0.9	-0.2	-0.2	-0.2	0.02
11/5/98	11059800	7.07	490	9.1	7.1	261	-2	1.1	-0.2	-0.2	-0.2	0.03
MW-12												
10/13/98	10139804	5.93	2210	11.8	5.86	85	-0.5	4.2	-1.0	-0.5	-0.5	4.96
11/3/98	11039804	5.6	2160	11.4	6	192	0.4	3.9	1.4	-0.2	-0.2	0.46
11/3/98 Dup.	11039800				6.24	209	0.4	3.5	1.2	-0.2	-0.2	0.06
USGS-33												
11/2/98	11039802	5.64	350	10.7	2.25	17	-0.2	-1.0	-0.2	-0.2	-0.2	0.21
USGS-25												
11/2/98	11029800	4.45	110	9.7	5.07	-2	-0.2	3.0	-0.2	1.9	-0.2	0.01

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Antimony (ug/L) [ug/L]	C	Q	M	Arsenic (ug/L) [ug/L]	C	Q	M	Barium (ug/L) [ug/L]	C	Q	M	Beryllium (ug/L) [ug/L]	C	Q	M
MW-8																									
10/20/98	10209801	0.03	1820	58	1120	29600			P	20..1	B		P	375			F	12.6	B	E	P	3.5	B		P
11/6/98	11069802	0.04	1860	16	1550	29200			P	29.8	B		P	336			F	9.7	B	E	P	3.6	B		P
MW-10s																									
10/16/98	10169801	0.07	3830	84	2440	22000			P	56.2	B		P	690			F	12.3	B	E	P	5.5			P
11/5/98	11059801	0.10	3930	135	2320	23400			P	43.9	B		P	420			F	12.4	B	E	P	5.6			P
MW-10d																									
10/14/98	10149802	0.10	1250	21	617	27.9	B		P	-18.7	U		P	28.2			F	34.2	B		P	-0.70	U		P
11/5/98	11059802	0.20	1700	71	771	17.2	B		P	-18.7	U		P	123			F	27.6	B	E	P	-0.70	U		P
MW-11																									
10/14/98	10149801	0.03	314	-5	24.8	18.2	B		P	-18.7	U		P	-1.0	U		F	109	B		P	-0.70	U		P
11/5/98	11059800	0.12	329	56	25.0	-13.5	U		P	-18.7	U		P	1.1	B		F	114	B	E	P	-0.70	U		P
MW-12																									
10/13/98	10139804	19.22	2340	36700	1140	174	B		P	-18.7	U		P	44.0			F	20.6	B		P	-0.70	U		P
11/3/98	11039804	0.99	1930	1360	1310	184	B		P	19.3	B		P	60.8			F	23.0	B	E	P	-0.70	U		P
11/3/98 Dup.	11039800	0.41	1960	420	1010	203			P	25.5	B		P	56.8			F	21.9	B	E	P	-0.70	U		P
USGS-33																									
11/2/98	11039802	0.22	326	6	155	-13.5	U		P	-18.7	U		P	1.8	B		F	35.2	B	E	P	-0.70	U		P
USGS-25																									
11/2/98	11029800	0.44	107	241	22.3	408			P	-18.7	U		P	4.5	B		F	307		E	P	-0.70	U		P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Boron (ug/L)				Cadmium (ug/L)				Calcium (ug/L)				Chromium (ug/L)				Cobalt (ug/L)				Copper (ug/L)				Iron (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-8																													
10/20/98	10209801	300			P	12.6			P	179000			P	19.1			P	108			P	13.1	B		P	228000			P
11/6/98	11069802	303			P	7.8			P	185000			P	18.5			P	108			P	17.9	B		P	227000			P
MW-10s																													
10/16/98	10169801	547			P	-2.2	U		P	320000			P	-3.9	U		P	504		E	P	-1.1	U		P	463000			P
11/5/98	11059801	584			P	-2.2	U		P	344000			P	4.9	B		P	496			P	4.9	B		P	573000			P
MW-10d																													
10/14/98	10149802	71.5			P	-2.2	U		P	246000			P	-3.9	U		P	3.6	B		P	-1.1	U		P	7220			P
11/5/98	11059802	113			P	-2.2	U		P	302000			P	-3.9	U		P	6.0	B		P	-1.1	U		P	37000			P
MW-11																													
10/14/98	10149801	40.0	B		P	-2.2	U		P	73900			P	-3.9	U		P	-3.6	U		P	-1.1	U		P	62.8	B		P
11/5/98	11059800	33.7	B		P	-2.2	U		P	77200			P	-3.9	U		P	-3.6	U		P	-1.1	U		P	43.6	B		P
MW-12																													
10/13/98	10139804	189			P	-2.2	U		P	281000			P	-3.9	U		P	90.0			P	2.9	B		P	102000			P
11/3/98	11039804	178			P	-2.2	U		P	292000			P	-3.9	U		P	68.4			P	-1.1	U		P	108000			P
11/3/98 Dup.	11039800	179			P	-2.2	U		P	302000			P	-3.9	U		P	81.2			P	-1.1	U		P	117000			P
USGS-33																													
11/2/98	11039802	52.0			P	2.2	B		P	31100			P	-3.9	U		P	-3.6	U		P	3.2	B		P	25.5	B		P
USGS-25																													
11/2/98	11029800	25.2	B		P	-2.2	U		P	5270			P	-3.9	U		P	-3.6	U		P	8.9	B		P	152			P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Lead (ug/L)				Magnesium (ug/L)				Manganese (ug/L)				Mercury (ug/L)				olybdenum (ug/L				Nickel (ug/L)				Potassium (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-8																													
10/20/98	10209801	1.8	B		F	33900			P	10300			P	-0.10	U		CV	-4.4	U		P	313			P	19000			P
11/6/98	11069802	-1.0	U		F	33700			P	10200			P	-0.10	U		CV	-4.4	U		P	313			P	17500			P
MW-10s																													
10/16/98	10169801	2.0	B	W	F	114000			P	21400			P	-0.10	U		CV	-4.4	U		P	1650			P	28300			P
11/5/98	11059801	1.9	B		F	121000			P	22800			P	-0.10	U		CV	-4.4	U		P	1660			P	28100			P
MW-10d																													
10/14/98	10149802	-1.0	U		F	63900			P	1030			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	2040	B	E	P
11/5/98	11059802	1.2	B		F	84600			P	3050			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	4170	B		P
MW-11																													
10/14/98	10149801	3.4			F	15300			P	7.5	B		P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	573	B	E	P
11/5/98	11059800	-1.0	U		F	15800			P	9.8	B		P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	1120	B		P
MW-12																													
10/13/98	10139804	-1.0	U		F	85600			P	20400			P	-0.10	U		CV	-4.4	U		P	89.9			P	12700		E	P
11/3/98	11039804	2.1	B		F	95200			P	21300			P	-0.10	U		CV	-4.4	U		P	70.2			P	12600			P
11/3/98 Dup.	11039800	1.0	B		F	92100			P	21700			P	-0.10	U		CV	-4.4	U		P	81.0			P	13600			P
USGS-33																													
11/2/98	11039802	1.0	B		F	10700			P	26.3			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	7680			P
USGS-25																													
11/2/98	11029800	1.5	B		F	1350	B		P	33.5			P	-0.10	U		CV	-4.4	U		P	-15.1	U		P	2780	B		P

Table 3.3
1998 Groundwater Quality Data
Leviathan Mine

Sample Date	Sample ID	Selenium (ug/L)				Silver (ug/L)				Sodium (ug/L)				Thallium (ug/L)				Vanadium (ug/L)				Zinc (ug/L)			
		[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M	[ug/L]	C	Q	M
MW-8																									
10/20/98	10209801	-1.0	U	NW	F	2.7	B		P	17700			P	199			F	53.7			P	310			P
11/6/98	11069802	3.1	B	NW	F	-1.8	U		P	17300			P	176			F	52.4			P	298			P
MW-10s																									
10/16/98	10169801	-1.0	U	W	F	-1.8	U		P	30400			P	13.0			F	22.5	B		P	362			P
11/5/98	11059801	-1.0	U	NW	F	-1.8	U		P	29900			P	12.2		S	F	36.3	B		P	360			P
MW-10d																									
10/14/98	10149802	9.5		S	F	-1.8	U		P	33600			P	1.1	B		F	4.7	B		P	11.0	B		P
11/5/98	11059802	2.1	B	NW	F	-1.8	U		P	32900			P	-1.0	U		F	3.5	B		P	6.4	B		P
MW-11																									
10/14/98	10149801	-1.0	U		F	-1.8	U		P	22300			P	-1.0	U		F	5.5	B		P	4.9	B		P
11/5/98	11059800	2.0	B	NW	F	-1.8	U		P	22900			P	-1.0	U		F	3.6	B		P	10.2	B		P
MW-12																									
10/13/98	10139804	1.4	B	W	F	-1.8	U		P	26000			P	-1.0	U		F	7.6	B		P	38.0			P
11/3/98	11039804	-1.0	U	NW	F	-1.8	U		P	26200			P	2.2	B		F	2.8	B		P	38.4			P
11/3/98 Dup.	11039800	-1.0	U	NW	F	-1.8	U		P	25700			P	1.2	B		F	3.7	B		P	45.6			P
USGS-33																									
11/2/98	11039802	-1.0	U	NW	F	-1.8	U		P	24200			P	1.2	B		F	-2.5	U		P	20.7		P	
USGS-25																									
11/2/98	11029800	5.7		NS	F	-1.8	U		P	6880			P	2.5	B		F	-2.5	U		P	19.7	B		P

Table 3.4
1998 - 1999 Groundwater Well Levels
Leviathan Mine

Date	Elevation (ASL)	Date	Elevation (ASL)	Date	Elevation (ASL)	Date	Elevation (ASL)	Date	Elevation (ASL)
	MW-1		MW-2s		MW-2d		MW-3		MW-4
9/8/98	7030.86	9/30/98	7016.96	9/29/98	7017.08	8/31/98	7055.31	8/31/98	7135.21
10/9/98	7029.95	10/9/98	7016.88	9/30/98	7015.94	9/15/98	7055.29	9/16/98	7135.24
10/13/98	7029.90	10/16/98	7016.62	10/9/98	7016.8	10/9/98	7055.09	9/17/98	7135.18
10/16/98	7029.78	10/19/98	7016.65	10/16/98	7016.54	10/16/98	7055.05	9/18/98	7135.14
10/19/98	7029.77	11/5/98	7016.40	10/19/98	7016.39	10/19/98	7055.06	10/9/98	7135.13
11/3/98	7029.80	6/14/99	7020.40	11/5/98	7016.06	11/3/98	7054.96	10/16/98	7135.18
6/14/99	7030.87	8/2/99	7017.86	6/14/99	7020.33	6/14/99	7055.72	10/19/98	7135.14
8/2/99	7030.22	9/9/99	7018.79	8/2/99	7017.83	8/2/99	7055.32	11/3/98	7135.17
9/9/99	7030.11			9/9/99	7016.68	9/9/99	7055.12	6/14/99	7135.27
								8/2/99	7131.14
								9/9/99	7135.09
	MW-5s		MW-5d	MW-6			MW-7		MW-8
8/29/98	dry	10/9/98	7028.89	9/30/98	6976.06	10/1/98	7019.84	10/1/98	6957.14
10/9/98	dry	10/16/98	7029.85	10/9/98	6974.84	10/9/98	7019.72	10/9/98	6956.76
10/16/98	dry	10/19/98	7026.33	10/16/98	6974.38	10/16/98	7019.65	10/16/98	6956.46
10/19/98	dry	11/3/98	7028.23	10/19/98	6974.28	10/19/98	7019.63	10/19/98	6956.31
11/3/98	dry	6/14/99	7047.51	10/20/98	6974.34	10/20/98	7019.74	10/20/98	6956.33
6/14/99	dry	8/2/99	7046.46	11/6/98	6974.33	11/6/98	7019.62	11/6/98	6955.78
8/2/99	dry	9/9/99	7045.9	6/14/99	6981.24	6/14/99	7020.65	6/14/99	6959.14
9/9/99	dry			8/2/99	6976.68	8/2/99	7020.3	8/2/99	6957.83
				9/9/99	6974.89	9/9/99	7020.12	9/9/99	6956.34
	MW-9		MW-10s		MW-10d		MW-11		MW-12
8/29/98	dry	9/16/98	6906.06	9/16/98	6904.65	9/17/98	6913.23	9/18/98	6856.41
10/9/98	dry	10/9/98	6904.55	10/9/98	6902.96	10/9/98	6913.27	9/29/98	6855.97
10/16/98	dry	10/14/98	6904.23	10/14/98	6902.8	10/14/98	6913.24	10/9/98	6856.68
10/19/98	dry	10/16/98	8904.23	10/16/98	6902.58	10/16/98	6913.12	10/13/98	6855.7
11/2/98	6961.38	10/19/98	6904.03	10/19/98	6902.36	10/19/98	6913.2	10/16/98	6854.98
6/14/99	6961.38	11/5/98	6903.33	11/5/98	6901.59	11/5/98	6913.24	10/19/98	6855.39
8/2/99	6961.38	6/14/99	6914.61	6/14/99	6914.401	6/14/99	6916.48	11/3/98	6855.36
9/9/99	6961.36	8/2/99	6908.82	8/2/99	6908.23	8/2/99	6914.11	6/14/99	6857.64
		9/9/99	6904.77	9/9/99	6903.42	9/9/99	6912.63	8/2/99	6856.59
								9/9/99	6855.93

Table 4.1
1998 Surface Water Flow Data
Leviathan and Aspen Creek Watersheds

Location	Measurement Date	Flow (cfs)	Method
Upper Leviathan Creek (Station #1)	9/23/98	0.137	Bucket/Stopwatch
	10/13/98	0.163	Bucket/Stopwatch
	11/4/98	0.196	Bucket/Stopwatch
Upper Tributary	9/25/98	0.007	Portable Flume
	10/16/98	Not Measured	
	11/4/98	0.027	Portable Flume
Lower Tributary	9/25/98	Not Measured	
	10/2/98	0.001	Visual Estimate
	11/4/98	No Flow	
Diversion Channel Outlet	9/23/98	0.169	Velocity Area (1)
	10/12/98	0.186	Velocity Area (1)
	11/5/98	0.244	Velocity Area (1)
Channel Underdrain	9/24/98	Not Measured	
	10/12/98	Not Measured	
	11/5/98	0.069	Bucket/Stopwatch
Pond 4 Overflow	9/25/98	0.0001	Bucket/Stopwatch
	10/13/98	0.0001	Bucket/Stopwatch
	11/5/98	No Flow	
Leviathan Below Channel Underdrain	9/24/98	0.259	Velocity Area (1)
	10/12/98	0.252	Velocity Area (1)
	11/05/98	0.458	Velocity Area (1)
Delta Seep	9/25/98	0.034	Portable Flume
	10/16/98	0.03	Portable Flume
	11/05/98	0.027	Portable Flume
Leviathan Creek Below Delta Seep	9/25/98	0.343	Velocity Area (1)
	10/16/98	0.275	Velocity Area (1)
	11/5/98	0.329	Velocity Area (1)

Note: 1. Velocity measurements were recorded with a Marsh-McBirney Model 201D

Table 4.1
1998 Surface Water Flow Data
Leviathan and Aspen Creek Watersheds

Location	Measurement Date	Flow (cfs)	Method
Leviathan Creek Above Aspen Creek (Station #15)	9/23/98	0.291	Velocity Area (1)
	10/12/98	0.371	Velocity Area (1)
	11/4/98	0.483	Velocity Area (1)
Pit Underdrain	9/25/98	0.011	Bucket/Stopwatch
	10/16/98	Not Measured	
	11/4/98	Not Measured	
Adit No. 5 Drainage	9/25/98	0.032	Bucket/Stopwatch
	10/16/98	Not Measured	
	11/4/98	0.042	Bucket/Stopwatch
Upper Aspen Creek at Road Crossing (Station #22)	9/23/98	0.188	Bucket/Stopwatch
	10/14/98	0.301	Bucket/Stopwatch
	11/4/98	0.334	Bucket/Stopwatch
Wetlands Seep	9/23/98	0.034	Portable Flume
	10/14/98	0.05	Portable Flume
	11/5/98	0.03	Portable Flume
Aspen Creek at Head of Landslide	9/24/98	0.483	Velocity Area (1)
	10/14/98	0.477	Velocity Area (1)
	11/4/98	0.597	Velocity Area (1)
Lower Aspen Seep	9/24/98	0.033	Bucket/Stopwatch
	10/14/98	0.03	Bucket/Stopwatch
	11/5/98	0.027	Bucket/Stopwatch
Slide Creek at Jct. Aspen Creek	10/14/98	0.024	Bucket/Stopwatch
	11/4/98	0.024	Bucket/Stopwatch
Aspen Creek Above Leviathan Creek (Station #16)	9/23/98	0.518	Velocity Area (1)
	10/14/98	0.548	Velocity Area (1)
	11/4/98	0.52	Velocity Area (1)

Note: 1. Velocity measurements were recorded with a Marsh-McBirney Model 201D

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	Field pH	Field TDS (mg/l)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
Upper Leviathan Creek (Station #1)														
9/23/98	Dissolved	76215	8.4		91.8	9.66		68						
	Total													
10/13/98	Dissolved	10139801	8.28	68		7.8	7.68	69	-0.2	-0.2	-0.2	-0.2	-0.2	0.14
	Total													
11/4/98	Dissolved	K9807679-011	8.12	63.2		3.8		66	-0.2	0.9	-0.2	-0.2	-0.2	0.09
	Total													
Upper Tributary														
9/25/98	Dissolved	76217	7.81		203	8.67		96						
	Total													
10/16/98	Dissolved	10199810					7.82	100	-0.2	1.4	-0.2	-0.2	-0.2	0.13
	Total													
11/4/98	Dissolved	K9807679-009	7.58	94.3		2.6		97	-0.2	1.1	-0.2	-0.2	-0.2	0.13
	Total													
Lower Tributary														
9/25/98	Dissolved	K9806967-003					7.71	194	-0.2	0.7	-0.2	-0.2	-0.2	0.08
	Total													
10/2/98	Dissolved	10199811	6.82		486	14.7	7.73	280	-0.2	1.0	-0.2	-0.2	-0.2	0.05
	Total													
11/4/98		dry												
Diversion Channel Outlet														
9/23/98	Dissolved	76213	8.19		119	11.1		-2						
	Total													
10/12/98	Dissolved	10129801	8.3	76.3		7.7	8.19	74	-0.2	1.3	-0.2	-0.2	-0.2	0.08
	Total													
11/5/98	Dissolved	K9807679-017	8.17	72.5		2		70	-0.2	0.9	-0.2	-0.2	-0.2	0.03
	Total													

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Hardness CaCO3 (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Method	Antimony (ug/L) [ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																	
9/23/98	Dissolved	76215		114	6	6.9	54.8	51.4	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							120	B		P	(CLP)	-18.7	U		P	(CLP)
10/13/98	Dissolved	10139801	0.11	119	-5	7.5		37.5	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							118	B		P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-011	0.08	114	6	6.1		51				6010B	-0.6	C			200.8
	Total							114				6010B	0.08				200.8
Upper Tributary																	
9/25/98	Dissolved	76217		202	-5	11.1	94.6	125	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							122	B		P	(CLP)	-18.7	U		P	(CLP)
10/16/98	Dissolved	10199810	0.15	175	9	12.0		46.8	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							324			P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-009	0.12	156	6	11.3		-50	ND			6010B	-0.04	C			200.8
	Total							343				6010B	0.09				200.8
Lower Tributary																	
9/25/98	Dissolved	K9806967-003	0.08	224	70	15.1		20.0	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							57.2	B		P	(CLP)	-18.7	U		P	(CLP)
10/2/98	Dissolved	10199811	0.23	344	132	27.0		16.6	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							998			P	(CLP)	-18.7	U		P	(CLP)
11/4/98		dry															
Diversion Channel Outlet																	
9/23/98	Dissolved	76213		72	31	8.6	55.7	131	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							93.4	B		P	(CLP)	-18.7	U		P	(CLP)
10/12/98	Dissolved	10129801	0.12	126	-5	8.5		78.8	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							78.5	B		P	(CLP)	-18.7	U		P	(CLP)
11/5/98	Dissolved	K9807679-017	0.09	120	-5	8.8		53				6010B	0.09				200.8
	Total							89				6010B	0.09				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Arsenic (ug/L)					Barium (ug/L)					Beryllium (ug/L)					Boron (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																						
9/23/98	Dissolved	76215	2.2	B	*	F	(CLP)	69.9	B		P	(CLP)	-0.70	U		P	(CLP)	20.4	B		P	(CLP)
	Total		3.3	B	*	F	(CLP)	70.4	B	E	P	(CLP)	-0.70	U		P	(CLP)	21.4	B		P	(CLP)
10/13/98	Dissolved	10139801	4.1	B		F	(CLP)	69.5	B		P	(CLP)	-0.70	U		P	(CLP)	-15.6	U		P	(CLP)
	Total		6.6	B		F	(CLP)	74.0	B		P	(CLP)	-0.70	U		P	(CLP)	26.6	B		P	(CLP)
11/4/98	Dissolved	K9807679-011	1.6				200.8	61.9				(6010B)	-0.04	C			(200.8)	-50	ND			(CLP)
	Total		1.9				200.8	60.3				(6010B)	-0.04	C			(6010B)	-50	ND			(CLP)
Upper Tributary																						
9/25/98	Dissolved	76217	6.3	B	*	F	(CLP)	139	B		P	(CLP)	0.74	B		P	(CLP)	25.5	B		P	(CLP)
	Total		3.4	B	*	F	(CLP)	135	B	E	P	(CLP)	-0.70	U		P	(CLP)	19.8	B		P	(CLP)
10/16/98	Dissolved	10199810	3.1	B		F	(CLP)	130	B	E	P	(CLP)	-0.70	U		P	(CLP)	19.8	B		P	(CLP)
	Total		2.1	B		F	(CLP)	139	B	E	P	(CLP)	-0.70	U		P	(CLP)	27.0	B		P	(CLP)
11/4/98	Dissolved	K9807679-009	1.3				200.8	110				(6010B)	-0.04	C			(200.8)	-50	ND			(200.8)
	Total		1.7				200.8	113				(6010B)	-0.04	C			(6010B)	-50	ND			(6010B)
Lower Tributary																						
9/25/98	Dissolved	K9806967-003	2.9	B		F	(CLP)	164	B		P	(CLP)	-0.70	U		P	(CLP)	43.5	B		P	(CLP)
	Total		2.9	B		F	(CLP)	166	B		P	(CLP)	-0.70	U		P	(CLP)	33.4	B		P	(CLP)
10/2/98	Dissolved	10199811	3.4	B		F	(CLP)	151	B	E	P	(CLP)	-0.70	U		P	(CLP)	38.0	B		P	(CLP)
	Total		2.9	B		F	(CLP)	165	B	E	P	(CLP)	-0.70	U		P	(CLP)	41.4	B		P	(CLP)
11/4/98		dry																				
Diversion Channel Outlet																						
9/23/98	Dissolved	76213	3.0	B	*	F	(CLP)	70.2	B		P	(CLP)	-0.70	U		P	(CLP)	20.4	B		P	(CLP)
	Total		4.1	B	*	F	(CLP)	65.0	B	E	P	(CLP)	-0.70	U		P	(CLP)	21.4	B		P	(CLP)
10/12/98	Dissolved	10129801	3.2	B		F	(CLP)	74.8	B		P	(CLP)	-0.70	U		P	(CLP)	25.7	B		P	(CLP)
	Total		3.1	B		F	(CLP)	75.9	B		P	(CLP)	-0.70	U		P	(CLP)	21.9	B		P	(CLP)
11/5/98	Dissolved	K9807679-017	2.2				200.8	69.6				(6010B)	-0.02	ND			(200.8)	-50	ND			(200.8)
	Total		2.2				200.8	71.3				(6010B)	-0.02	ND			(6010B)	-50	ND			(6010B)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Cadmium (ug/L)					Calcium (ug/L)					Chromium (ug/L)					Cobalt (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																						
9/23/98	Dissolved	76215	-2.2	U		P	(CLP)	13900			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	14300			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
10/13/98	Dissolved	10139801	-2.2	U		P	(CLP)	14100			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	13900			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
11/4/98	Dissolved	K9807679-011	0.06				(200.8)	13100				(6010B)	-0.4	C			(6010B)	0.11				200.8
	Total		-0.04	C			(6010B)	12900				(6010B)	-0.4	C			(6010B)	0.10				200.8
Upper Tributary																						
9/25/98	Dissolved	76217	-2.2	U		P	(CLP)	28000			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	28900			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
10/16/98	Dissolved	10199810	-2.2	U		P	(CLP)	27900			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U	E	P	(CLP)
	Total		-2.2	U		P	(CLP)	26600			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
11/4/98	Dissolved	K9807679-009	-0.04	C			(200.8)	26600				(6010B)	0.6				(6010B)	0.4				200.8
	Total		-0.04	C			(6010B)	26100				(6010B)	0.8				(6010B)	0.40				200.8
Lower Tributary																						
9/25/98	Dissolved	K9806967-003	-2.2	U		P	(CLP)	71300			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		2.5	B		P	(CLP)	71500			P	(CLP)	-3.9	B		P	(CLP)	-3.6	U		P	(CLP)
10/2/98	Dissolved	10199811	-2.2	U		P	(CLP)	74600			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U	E	P	(CLP)
	Total		-2.2	U		P	(CLP)	73200			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
11/4/98		dry																				
Diversion Channel Outlet																						
9/23/98	Dissolved	76213	-2.2	U		P	(CLP)	15700			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	15000			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
10/12/98	Dissolved	10129801	-2.2	U		P	(CLP)	16100			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	15500			P	(CLP)	-3.9	U		P	(CLP)	3.7	B		P	(CLP)
11/5/98	Dissolved	K9807679-017	-0.02	ND			(200.8)	15800				(6010B)	-0.2	ND			(6010B)	0.06				200.8
	Total		-0.02	ND			(6010B)	15300				(6010B)	-0.2	ND			(6010B)	0.07				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Copper (ug/L)					Iron (Fe+2+Fe+3)(ug/L)					Lead (ug/L)					Magnesium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																						
9/23/98	Dissolved	76215	-1.1	U		P	(CLP)	82.6	B		P	(CLP)	-1.0	U		F	(CLP)	4670	B		P	(CLP)
	Total		-1.1	U		P	(CLP)	215			P	(CLP)	-1.0	U		F	(CLP)	4640	B		P	(CLP)
10/13/98	Dissolved	10139801	-1.1	U		P	(CLP)	93.4	B		P	(CLP)	-1.0	U		F	(CLP)	4720	B		P	(CLP)
	Total		-1.1	U		P	(CLP)	180			P	(CLP)	-1.0	U		F	(CLP)	4740	B		P	(CLP)
11/4/98	Dissolved	K9807679-011	0.2				200.8	96				8010B	-0.04	C			200.8	4310				6010B
	Total		0.5				200.8	197				6010B	0.05				200.8	4230				6010B
Upper Tributary																						
9/25/98	Dissolved	76217	-1.1	U		P	(CLP)	172			P	(CLP)	-1.0	U		F	(CLP)	5560			P	(CLP)
	Total		3.1	B		P	(CLP)	178			P	(CLP)	-1.0	U		F	(CLP)	5470			P	(CLP)
10/16/98	Dissolved	10199810	3.2	B		P	(CLP)	69.4	B		P	(CLP)	1.0	B		F	(CLP)	5170			P	(CLP)
	Total		1.6	B		P	(CLP)	511			P	(CLP)	-1.0	U		F	(CLP)	5020			P	(CLP)
11/4/98	Dissolved	K9807679-009	1.7				200.8	29				6010B	0.04	C			200.8	5090				6010B
	Total		1.7				200.8	447				6010B	0.22				200.8	4890				6010B
Lower Tributary																						
9/25/98	Dissolved	K9806967-003	23.1	B		P	(CLP)	26.7	B		P	(CLP)	1.1	B		F	(CLP)	14700			P	(CLP)
	Total		1.6	B		P	(CLP)	57.8	B		P	(CLP)	-1.0	U		F	(CLP)	14700			P	(CLP)
10/2/98	Dissolved	10199811	1.1	B		P	(CLP)	23.5	B		P	(CLP)	1.4	B		F	(CLP)	15100			P	(CLP)
	Total		3.3	B		P	(CLP)	856			P	(CLP)	-1.0	U		F	(CLP)	15100			P	(CLP)
11/4/98		dry																				
Diversion Channel Outlet																						
9/23/98	Dissolved	76213	1.2	B		P	(CLP)	161			P	(CLP)	-1.0	U		F	(CLP)	4900	B		P	(CLP)
	Total		3.1	B		P	(CLP)	182			P	(CLP)	-1.0	U		F	(CLP)	4400	B		P	(CLP)
10/12/98	Dissolved	10129801	5.2	B		P	(CLP)	157			P	(CLP)	-1.0	U		F	(CLP)	4980	B		P	(CLP)
	Total		1.9	B		P	(CLP)	126			P	(CLP)	-1.0	U		F	(CLP)	4840	B		P	(CLP)
11/5/98	Dissolved	K9807679-017	0.7				200.8	124				6010B	0.05				200.8	4800				6010B
	Total		0.8				200.8	193				6010B	0.06				200.8	4680				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Manganese (ug/L)					Mercury (ug/L)					Molybdenum (ug/L)					Nickel (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																						
9/23/98	Dissolved	76215	9.9	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		10.7	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
10/13/98	Dissolved	10139801	6.0	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		11.7	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
11/4/98	Dissolved	K9807679-011	9				6010B	1.4				7470A	0.25				200.8	1.0				200.8
	Total		12				6010B	-0.5	ND			7470A	0.30				200.8	1.1				200.8
Upper Tributary																						
9/25/98	Dissolved	76217	28.2			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		29.2			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
10/16/98	Dissolved	10199810	20.8			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		70.8			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
11/4/98	Dissolved	K9807679-009	18				6010B	-0.5	ND			7470A	0.09				200.8	2.2				200.8
	Total		30				6010B	-0.5	ND			7470A	0.05				200.8	2.4				200.8
Lower Tributary																						
9/25/98	Dissolved	K9806967-003	40.5			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		43.3			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
10/2/98	Dissolved	10199811	37.1			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		120			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
11/4/98		dry																				
Diversion Channel Outlet																						
9/23/98	Dissolved	76213	9.4	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		9.3	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
10/12/98	Dissolved	10129801	10.2	B		P	(CLP)	0.51			CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		12.0	B		P	(CLP)	-0.10	U		CV	(CLP)	8.3	B		P	(CLP)	-15.1	U		P	(CLP)
11/5/98	Dissolved	K9807679-017	12				6010B	-0.5	ND			7470A	0.25				200.8	0.4				200.8
	Total		12				6010B	-0.5	ND			7470A	0.25				200.8	0.4				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Potassium (ug/L)					Selenium (ug/L)					Silver (ug/L)					Sodium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																						
9/23/98	Dissolved	76215	3220	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	9730			P	(CLP)
	Total		3440	B		P	(CLP)	1.6	B	NW	F	(CLP)	-1.8	U		P	(CLP)	8410			P	(CLP)
10/13/98	Dissolved	10139801	3020	B	E	P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	8530			P	(CLP)
	Total		3190	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	8570			P	(CLP)
11/4/98	Dissolved	K9807679-011	3900				6010B	-5	ND			7740	-0.06	C			200.8	8610				6010B
	Total		3700				6010B	-5	ND			7740	-0.04	C			200.8	8480				6010B
Upper Tributary																						
9/25/98	Dissolved	76217	2310	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	11800			P	(CLP)
	Total		2990	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	10600			P	(CLP)
10/16/98	Dissolved	10199810	1890	B		P	(CLP)	1.1	B	W	F	(CLP)	-1.8	U		P	(CLP)	11200			P	(CLP)
	Total		3000	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	10400			P	(CLP)
11/4/98	Dissolved	K9807679-009	3200				6010B	-5	ND			7740	-0.4	C			200.8	11600				6010B
	Total		5700				6010B	-5	ND			7740	-0.4	C			200.8	10200				6010B
Lower Tributary																						
9/25/98	Dissolved	K9806967-003	676	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	23900			P	(CLP)
	Total		890	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	23400			P	(CLP)
10/2/98	Dissolved	10199811	575	B		P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	22800			P	(CLP)
	Total		2440	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	21600			P	(CLP)
11/4/98		dry																				
Diversion Channel Outlet																						
9/23/98	Dissolved	76213	2940	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	9200			P	(CLP)
	Total		3150	B		P	(CLP)	1.1	B	NW	F	(CLP)	-1.8	U		P	(CLP)	8230			P	(CLP)
10/12/98	Dissolved	10129801	2860	B	E	P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	9200			P	(CLP)
	Total		2500	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	8860			P	(CLP)
11/5/98	Dissolved	K9807679-017	4400				6010B	-5	ND			7740	ND				200.8	9230				6010B
	Total		4100				6010B	-5	ND			7740	ND				200.8	8960				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Thallium (ug/L)					Vanadium (ug/L)					Zinc (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Upper Leviathan Creek (Station #1)																	
9/23/98	Dissolved	76215	-1.0	U		F	(CLP)	4.5	B		P	(CLP)	-2.0	U		P	(CLP)
	Total		-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	-2.0	U		P	(CLP)
10/13/98	Dissolved	10139801	-1.0	U		F	(CLP)	4.0	B		P	(CLP)	5.9	B		P	(CLP)
	Total		2.4	B		F	(CLP)	-2.5	U		P	(CLP)	4.6	B		P	(CLP)
11/4/98	Dissolved	K9807679-011	-0.04	C			200.8	2.2				200.8	-1	C			200.8
	Total		-0.04	C			200.8	2.4				200.8	-1	C			200.8
Upper Tributary																	
9/25/98	Dissolved	76217	-1.0	U		F	(CLP)	3.9	B		P	(CLP)	2.6	B		P	(CLP)
	Total		-1.0	U		F	(CLP)	3.7	B		P	(CLP)	-2.0	U		P	(CLP)
10/16/98	Dissolved	10199810	-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	-2.0	U		P	(CLP)
	Total		-1.0	U		F	(CLP)	3.6	B		P	(CLP)	-2.0	U		P	(CLP)
11/4/98	Dissolved	K9807679-009	-0.04	C			200.8	1.6				200.8	-1	C			200.8
	Total		0.07				200.8	1.9				200.8	1.2				200.8
Lower Tributary																	
9/25/98	Dissolved	K9806967-003	-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	25.4			P	(CLP)
	Total		-1.0	U		F	(CLP)	2.6	B		P	(CLP)	-2.0	U		P	(CLP)
10/2/98	Dissolved	10199811	-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	-2.0	U		P	(CLP)
	Total		-1.0	U		F	(CLP)	5.8	B		P	(CLP)	-2.0	U		P	(CLP)
11/4/98		dry															
Diversion Channel Outlet																	
9/23/98	Dissolved	76213	-1.0	U		F	(CLP)	4.7	B		P	(CLP)	-2.0	U		P	(CLP)
	Total		-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	-2.0	U		P	(CLP)
10/12/98	Dissolved	10129801	-1.0	U		F	(CLP)	3.9	B		P	(CLP)	12.2	B		P	(CLP)
	Total		-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	4.5	B		P	(CLP)
11/5/98	Dissolved	K9807679-017	0.03				200.8	2.1				200.8	0.7				200.8
	Total		0.04				200.8	2.2				200.8	-0.5	ND			200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	Field pH	Field TDS (mg/l)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
Channel Underdrain														
9/24/98	Dissolved	76207	6.65		1795	12		-2						
	Total													
10/12/98	Dissolved	10129802	4.89	1454		11	4.57	-2	-0.5	2.7	4.5	-0.5	-0.5	0.08
	Total													
11/5/98	Dissolved	K9807679-010	4.5	1457				-2	-1.0	4.9	5.2	-1.0	-1.0	0.10
	Total													
1/4/1998 dupl.		K9807679-008						-2.0	-1.0	4.5	4.5	-1.0	-1.0	0.10
Pond 4 Overflow														
9/25/98	Dissolved	76216	2.5		7070	13.3		-2						
	Total													
10/13/98	Dissolved	10139802	2.48	5770		12.1	2.31	-2	-4.0	6.9	15.8	-4.0	-4.0	0.03
	Total													
11/5/98		dry												
Leviathan Below Diversion Channel														
9/24/98	Dissolved	76208	6.66		1032	11.3		-2						
	Total													
10/12/98	Dissolved	10129805	5.41	683		9.1	5.03	-2	-0.2	0.9	0.6	-0.2	-0.2	0.12
	Total													
11/05/98	Dissolved	K9807679-016	5.4	470			5.7	-2	-0.2	1.6	1.5	-0.2	-0.2	0.03
	Total													
Delta Seep														
9/25/98	Dissolved	76209	5.88		1420	9.6		23						
	Total													
10/16/98	Dissolved	10169813	5.7	898		8.5	5.67	20	-0.5	2.3	2.5	-0.5	-0.5	-0.01
	Total													
11/05/98	Dissolved	K9807679-018	5.3	965				32	-0.2	2.7	2.2	-0.2	-0.2	0.01
	Total													

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Hardness CaCO3 (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Method	Antimony (ug/L) [ug/L]	C	Q	M	Method
Channel Underdrain																	
9/24/98	Dissolved	76207		3170	10	2306	1150	42800			P	(CLP)	19.9	B		P	(CLP)
	Total							43500			P	(CLP)	49.7	B		P	(CLP)
10/12/98	Dissolved	10129802	0.04	3230	21	1880		43400			P	(CLP)	28.9	B		P	(CLP)
	Total							43200			P	(CLP)	46.6	B		P	(CLP)
11/5/98	Dissolved	K9807679-010	-0.01	3220	14	1810		43400				6010B	-0.1	C			200.8
	Total							4111				6010B	-0.1				
1/4/1998 dupl.		K9807679-008	0.02	3210	18	3380		42800				6010B	-0.1	C			200.8
								42700				6010B	-0.1	C			200.8
Pond 4 Overflow																	
9/25/98	Dissolved	76216		23500	6	6068	1150	1420000			P	(CLP)	-37.4	U		P	(CLP)
	Total							1550000			P	(CLP)	-37.4	U		P	(CLP)
10/13/98	Dissolved	10139802	0.04	24700	-5	15300		1600000			P	(CLP)	169			P	(CLP)
	Total							1570000			P	(CLP)	176			P	(CLP)
11/5/98		dry															
Leviathan Below Diversion Channel																	
9/24/98	Dissolved	76208		1150	82	672	468	7020			P	(CLP)	37.6	B		P	(CLP)
	Total							16400			P	(CLP)	31.6	B		P	(CLP)
10/12/98	Dissolved	10129805	0.14	1120	66	727		4940			P	(CLP)	-18.7	U		P	(CLP)
	Total							11100			P	(CLP)	-18.7	U		P	(CLP)
11/05/98	Dissolved	K9807679-016	0.14	824	52	645		11600				6010B	0.06				200.8
	Total							1870				6010B	0.07				200.8
Delta Seep								11600									
9/25/98	Dissolved	76209		1860	24	1175	1140	2040			P	(CLP)	29.2	B		P	(CLP)
	Total							3510				(CLP)	23.9	B			(CLP)
10/16/98	Dissolved	10169813	0.03	1820	15	1140		2100			P	(CLP)	21.4	B		P	(CLP)
	Total							2470			P	(CLP)	-18.7	U		P	(CLP)
11/05/98	Dissolved	K9807679-018	-0.01	1740	8	1080											
	Total							2360				6010B	0.02				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Arsenic (ug/L)					Barium (ug/L)					Beryllium (ug/L)					Boron (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																						
9/24/98	Dissolved	76207	412		*	F	(CLP)	20.2	B		P	(CLP)	6.7			P	(CLP)	336			P	(CLP)
	Total		544		*	F	(CLP)	18.3	B	E	P	(CLP)	6.9			P	(CLP)	345			P	(CLP)
10/12/98	Dissolved	10129802	452			F	(CLP)	17.5	B		P	(CLP)	6.7			P	(CLP)	352			P	(CLP)
	Total		550			F	(CLP)	18.1	B		P	(CLP)	6.9			P	(CLP)	328			P	(CLP)
11/5/98	Dissolved	K9807679-010	418				200.8	10.6				(6010B)	6.55				(200.8)	196				(200.8)
	Total		425				200.8	11.5				200.8	6.51				(200.8)	176				6010B
1/4/1998 dupl.		K9807679-008	436				200.8	11.5				(6010B)	6.18				(200.8)	178				(200.8)
			441				200.8	11.8				(6010B)	6.16				(6010B)	184				(6010B)
Pond 4 Overflow																						
9/25/98	Dissolved	76216	392000		*	F	(CLP)	18.1	B		P	(CLP)	54.2			P	(CLP)	1190			P	(CLP)
	Total		41200		*	F	(CLP)	20.5	B	E	P	(CLP)	53.7			P	(CLP)	1220			P	(CLP)
10/13/98	Dissolved	10139802	20500			F	(CLP)	16.5	B		P	(CLP)	58.0			P	(CLP)	1170			P	(CLP)
	Total		42200			F	(CLP)	18.0	B		P	(CLP)	55.4			P	(CLP)	129			P	(CLP)
11/5/98		dry																				
Leviathan Below Diversion Channel																						
9/24/98	Dissolved	76208	138		*	F	(CLP)	56.8	B		P	(CLP)	2.2	B		P	(CLP)	150			P	(CLP)
	Total		202		*	F	(CLP)	60.8	B	E	P	(CLP)	2.5	B		P	(CLP)	140			P	(CLP)
10/12/98	Dissolved	10129805	154			F	(CLP)	53.2	B		P	(CLP)	1.8	B		P	(CLP)	134			P	(CLP)
	Total		110			F	(CLP)	38.0	B		P	(CLP)	2.2	B		P	(CLP)	112			P	(CLP)
11/05/98	Dissolved	K9807679-016	97.6				200.8	53.3				(6010B)	0.66				(200.8)	62				(200.8)
	Total		108				200.8	54.8				(6010B)	1.53	ND			(6010B)	61	ND			(6010B)
Delta Seep																						
9/25/98	Dissolved	76209	52.2		*	F	(CLP)	13.8	B	E	P	(CLP)	1.9	B		P	(CLP)	168			P	(CLP)
	Total		72.2				(CLP)	18.6	B			(CLP)	2.2	B			(CLP)	176				(CLP)
10/16/98	Dissolved	10169813	73.5			F	(CLP)	14.4	B	E	P	(CLP)	1.6	B		P	(CLP)	169			P	(CLP)
	Total		69.0			F	(CLP)	13.6	B	E	P	(CLP)	1.9	B		P	(CLP)	173			P	(CLP)
11/05/98	Dissolved	K9807679-018																				
	Total		63.4				200.8	9.44				(6010B)	1.57				(6010B)	128				(6010B)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Cadmium (ug/L)					Calcium (ug/L)					Chromium (ug/L)					Cobalt (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																						
9/24/98	Dissolved	76207	-2.2	U		P	(CLP)	308000			P	(CLP)	20.6			P	(CLP)	866			P	(CLP)
	Total		-2.2	U		P	(CLP)	330000			P	(CLP)	21.0			P	(CLP)	904			P	(CLP)
10/12/98	Dissolved	10129802	-2.2	U		P	(CLP)	317000			P	(CLP)	20.8			P	(CLP)	862			P	(CLP)
	Total		-2.2	U		P	(CLP)	310000			P	(CLP)	20.1			P	(CLP)	854			P	(CLP)
11/5/98	Dissolved	K9807679-010	0.17				(200.8)	326000				(6010B)	19.6				(6010B)	800				200.8
	Total		0.17				(200.8)	313000				(6010B)	20.4				(200.8)	801				(200.8)
1/4/1998 dupl.		K9807679-008	0.21				(200.8)	334000				(200.8)	21.0				(200.8)	781				200.8
			0.16				(6010B)	331000				(6010B)	20.8				(6010B)	788				200.8
Pond 4 Overflow																						
9/25/98	Dissolved	76216	270			P	(CLP)	478000			P	(CLP)	4910			P	(CLP)	9010			P	(CLP)
	Total		324			P	(CLP)	519000			P	(CLP)	5080			P	(CLP)	9810			P	(CLP)
10/13/98	Dissolved	10139802	287			P	(CLP)	480000			P	(CLP)	5020			P	(CLP)	9700			P	(CLP)
	Total		297			P	(CLP)	465000			P	(CLP)	4950			P	(CLP)	9550			P	(CLP)
11/5/98		dry																				
Leviathan Below Diversion Channel																						
9/24/98	Dissolved	76208	3.6	B		P	(CLP)	130000			P	(CLP)	5.0	B		P	(CLP)	341			P	(CLP)
	Total		-2.2	U		P	(CLP)	135000			P	(CLP)	8.1	B		P	(CLP)	339			P	(CLP)
10/12/98	Dissolved	10129805	-2.2	U		P	(CLP)	123000			P	(CLP)	-3.9	U		P	(CLP)	315			P	(CLP)
	Total		-2.2	U		P	(CLP)	88100			P	(CLP)	6.3	B		P	(CLP)	233			P	(CLP)
11/05/98	Dissolved	K9807679-016	0.03					93800					1.7					187				200.8
	Total		0.04	ND				96300					5.4	ND				185				200.8
Delta Seep																						
9/25/98	Dissolved	76209	2.6	B		P	(CLP)	304000			P	(CLP)	-3.9	U		P	(CLP)	248			P	(CLP)
	Total		-2.2	U			(CLP)	321000				(CLP)	-3.9	U			(CLP)	255				(CLP)
10/16/98	Dissolved	10169813	-2.2	U		P	(CLP)	291000			P	(CLP)	-3.9	U		P	(CLP)	239		E	P	(CLP)
	Total		-2.2	U		P	(CLP)	289000			P	(CLP)	-3.9	U		P	(CLP)	238			P	(CLP)
11/05/98	Dissolved	K9807679-018																				
	Total		0.24				(6010B)	286000				(6010B)	0.4				(6010B)	205				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Copper (ug/L)					Iron (Fe+2+Fe+3)(ug/L)					Lead (ug/L)					Magnesium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																						
9/24/98	Dissolved	76207	9.7	B		P	(CLP)	347000			P	(CLP)	-1.0	U		F	(CLP)	74800			P	(CLP)
	Total		15.7	B		P	(CLP)	365000			P	(CLP)	-1.0	U		F	(CLP)	78000			P	(CLP)
10/12/98	Dissolved	10129802	11.1	B		P	(CLP)	352000			P	(CLP)	-1.0	U		F	(CLP)	77600			P	(CLP)
	Total		11.0	B		P	(CLP)	348000			P	(CLP)	-1.0	U		F	(CLP)	76500			P	(CLP)
11/5/98	Dissolved	K9807879-010	7.7				200.8	355000				6010B	-0.1	C			200.8	80200				6010B
	Total		6.1				200.8	340000				6010B	-0.1				200.8	76400				6010B
1/4/1998 dupl.		K9807679-008	8.0				200.8	360000				6010B	-0.1	C			200.8	80000				6010B
			14.1				200.8	357000				6010B	-0.1	C			200.8	78800				6010B
Pond 4 Overflow																						
9/25/98	Dissolved	76216	12400			P	(CLP)	2080000			P	(CLP)	-1.0	U		F	(CLP)	235000			P	(CLP)
	Total		13000			P	(CLP)	2410000			P	(CLP)	4.3			F	(CLP)	244000			P	(CLP)
10/13/98	Dissolved	10139802	14000			P	(CLP)	2210000			P	(CLP)	2.8	B		F	(CLP)	251000			P	(CLP)
	Total		13900			P	(CLP)	2130000			P	(CLP)	1.7	B		F	(CLP)	249000			P	(CLP)
11/5/98		dry																				
Leviathan Below Diversion Channel																						
9/24/98	Dissolved	76208	5.3	B		P	(CLP)	136000			P	(CLP)	1.0	B		F	(CLP)	32300			P	(CLP)
	Total		10.1	B		P	(CLP)	137000			P	(CLP)	1.1	B		F	(CLP)	31800			P	(CLP)
10/12/98	Dissolved	10129805	5.0	B		P	(CLP)	128000			P	(CLP)	-1.0	U		F	(CLP)	31200			P	(CLP)
	Total		3.9	B		P	(CLP)	92500			P	(CLP)	-1.0	U		F	(CLP)	22000			P	(CLP)
11/05/98	Dissolved	K9807679-016	1.3				200.8	90300				6010B	0.04				200.8	22600				6010B
	Total		2.4				200.8	94500				6010B	0.11				200.8	23400				6010B
Delta Seep																						
9/25/98	Dissolved	76209	11.3	B		P	(CLP)	22900			P	(CLP)	1.0	B		F	(CLP)	87800			P	(CLP)
	Total		35.0				(CLP)	24300				(CLP)	-1.0	U			(CLP)	87200				(CLP)
10/16/98	Dissolved	10169813	1.8	B		P	(CLP)	22500			P	(CLP)	-1.0	U		F	(CLP)	83300			P	(CLP)
	Total		17.8	B		P	(CLP)	22700			P	(CLP)	-1.0	U		F	(CLP)	84500			P	(CLP)
11/05/98	Dissolved	K9807679-018																				
	Total		16.8				200.8	22000				6010B	0.03				200.8	82700				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Manganese (ug/L)					Mercury (ug/L)					Molybdenum (ug/L)					Nickel (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																						
9/24/98	Dissolved	76207	17200			P	(CLP)	0.21			CV	(CLP)	-4.4	U		P	(CLP)	1940			P	(CLP)
	Total		18000			P	(CLP)	0.50			CV	(CLP)	-4.4	U		P	(CLP)	2030			P	(CLP)
10/12/98	Dissolved	10129802	17600			P	(CLP)	0.18	B		CV	(CLP)	-4.4	U		P	(CLP)	1910			P	(CLP)
	Total		17400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	1880			P	(CLP)
11/5/98	Dissolved	K9807679-010	18100				6010B	-0.5	ND			7470A	0.12				200.8	1730				200.8
	Total		17300				6010B	-0.5				7470A	0.12				200.8	1730				200.8
1/4/1998 dupl.		K9807679-008	18400				6010B	-0.5	ND			7470A	-0.1	C			200.8	1640				200.8
			18200				6010B	-0.5	ND			7470A	-0.1	C			200.8	1650				200.8
Pond 4 Overflow																						
9/25/98	Dissolved	76216	43600			P	(CLP)	0.14	B		CV	(CLP)	-8.8	U		P	(CLP)	24600			P	(CLP)
	Total		47600			P	(CLP)	0.17	B		CV	(CLP)	-8.8	U		P	(CLP)	25100			P	(CLP)
10/13/98	Dissolved	10139802	47900			P	(CLP)	0.73			CV	(CLP)	-8.8	U		P	(CLP)	24600			P	(CLP)
	Total		46800			P	(CLP)	0.16	B		CV	(CLP)	-4.4	U		P	(CLP)	24500			P	(CLP)
11/5/98		dry																				
Leviathan Below Diversion Channel																						
9/24/98	Dissolved	76208	6740			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	754			P	(CLP)
	Total		6770			P	(CLP)	0.13	B		CV	(CLP)	-4.4	U		P	(CLP)	766			P	(CLP)
10/12/98	Dissolved	10129805	6360			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	704			P	(CLP)
	Total		4650			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	487			P	(CLP)
11/05/98	Dissolved	K9807679-016	4570				6010B	-0.5	ND			7470A	0.16				200.8	414				200.8
	Total		4730				6010B	-0.5	ND			7470A	0.16				200.8	418				200.8
Delta Seep																						
9/25/98	Dissolved	76209	14700			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	563			P	(CLP)
	Total		15000				(CLP)	-0.10	U			(CLP)	-4.4	U			(CLP)	576				(CLP)
10/16/98	Dissolved	10169813	14300			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	538			P	(CLP)
	Total		14400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	517			P	(CLP)
11/05/98	Dissolved	K9807679-018																				
	Total		13900				6010B	-0.5	ND			7470A	0.03				200.8	492				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Potassium (ug/L)					Selenium (ug/L)					Silver (ug/L)					Sodium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																						
9/24/98	Dissolved	76207	16900			P	(CLP)	-1.0	B	NW	F	(CLP)	5.2	B		P	(CLP)	24800			P	(CLP)
	Total		17500			P	(CLP)	1.6	B	NW	F	(CLP)	5.5	B		P	(CLP)	24000			P	(CLP)
10/12/98	Dissolved	10129802	16500		E	P	(CLP)	1.5	B	W	F	(CLP)	5.1	B		P	(CLP)	25200			P	(CLP)
	Total		16400			P	(CLP)	-1.0	U	NW	F	(CLP)	1.8	B		P	(CLP)	24700			P	(CLP)
11/5/98	Dissolved	K9807679-010	17000				6010B	-5	ND			7740	-0.1	C			200.8	25800				6010B
	Total		18200				6010B	-5				7740	-0.1				200.8	24900				6010B
1/4/1998 dupl.		K9807679-008	16000				6010B	-5	ND			7740	-0.2	C			200.8	25500				6010B
			17400				6010B	-5	ND			7740	-0.3	C			200.8	25000				6010B
Pond 4 Overflow																						
9/25/98	Dissolved	76216	-757	U		P	(CLP)	50.0	B	NW	F	(CLP)	-3.6	U		P	(CLP)	19400			P	(CLP)
	Total		-757	U		P	(CLP)	-25.0	U	NW	F	(CLP)	-3.6	U		P	(CLP)	18500			P	(CLP)
10/13/98	Dissolved	10139802	-757	U	E	P	(CLP)	45.0	B	W	F	(CLP)	6.3	B		P	(CLP)	20700			P	(CLP)
	Total		-757	U		P	(CLP)	6.5	B	NW	F	(CLP)	-3.6	U		P	(CLP)	20200			P	(CLP)
11/5/98		dry																				
Leviathan Below Diversion Channel																						
9/24/98	Dissolved	76208	8390			P	(CLP)	-1.0	U	NW	F	(CLP)	2.6	B		P	(CLP)	15300			P	(CLP)
	Total		10100			P	(CLP)	1.2	B	NW	F	(CLP)	2.0	B		P	(CLP)	13900			P	(CLP)
10/12/98	Dissolved	10129805	7480		E	P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	15600			P	(CLP)
	Total		5650			P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	10700			P	(CLP)
11/05/98	Dissolved	K9807679-016	8900				6010B	-5	ND			7740	ND				200.8	13400				6010B
	Total		6700				6010B	-5	ND			7740	ND				200.8	14000				6010B
Delta Seep																						
9/25/98	Dissolved	76209	5200			P	(CLP)	-1.0	U	N	F	(CLP)	-1.8	U		P	(CLP)	25800			P	(CLP)
	Total		7730				(CLP)	-1.0	U			(CLP)	2.1	B			(CLP)	23800				(CLP)
10/16/98	Dissolved	10169813	5220			P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	24700			P	(CLP)
	Total		4950	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	24700			P	(CLP)
11/05/98	Dissolved	K9807679-018																				
	Total		6300				6010B	-5	ND			7740	ND				200.8	24600				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Thallium (ug/L)					Vanadium (ug/L)					Zinc (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Channel Underdrain																	
9/24/98	Dissolved	76207	43.9		S	F	(CLP)	82.7			P	(CLP)	379			P	(CLP)
	Total		31.3			F	(CLP)	86.7			P	(CLP)	399			P	(CLP)
10/12/98	Dissolved	10129802	36.4		S	F	(CLP)	85.9			P	(CLP)	390			P	(CLP)
	Total		31.4			F	(CLP)	78.9			P	(CLP)	376			P	(CLP)
11/5/98	Dissolved	K9807679-010	26.8				200.8	67.0				200.8	328				200.8
	Total		26.3				200.8	66.3				200.8	324				200.8
1/4/1998 dupl.		K9807679-008	26.9				200.8	63.8				200.8	321				200.8
			29.2				200.8	65.8				200.8	329				200.8
Pond 4 Overflow																	
9/25/98	Dissolved	76216	2.6	B		F	(CLP)	1630			P	(CLP)	4520			P	(CLP)
	Total		1.5	B		F	(CLP)	1700			P	(CLP)	4750			P	(CLP)
10/13/98	Dissolved	10139802	-1.0	U		F	(CLP)	1480			P	(CLP)	4730			P	(CLP)
	Total		-1.0	U		F	(CLP)	1440			P	(CLP)	4640			P	(CLP)
11/5/98		dry															
Leviathan Below Diversion Channel																	
9/24/98	Dissolved	76208	10.8			F	(CLP)	17.9	B		P	(CLP)	145			P	(CLP)
	Total		13.6			F	(CLP)	33.5	B		P	(CLP)	152			P	(CLP)
10/12/98	Dissolved	10129805	9.2	B		F	(CLP)	15.0	B		P	(CLP)	147			P	(CLP)
	Total		8.6	B		F	(CLP)	20.8	B		P	(CLP)	99.4			P	(CLP)
11/05/98	Dissolved	K9807679-016	6.84				200.8	5.4				200.8	79.5				200.8
	Total		7.26				200.8	17.5				200.8	78.6				200.8
Delta Seep																	
9/25/98	Dissolved	76209	2.0	B		F	(CLP)	4.7	B		P	(CLP)	105			P	(CLP)
	Total		3.0	B			(CLP)	6.0	B			(CLP)	109				(CLP)
10/16/98	Dissolved	10169813	1.8	B		F	(CLP)	2.5	B		P	(CLP)	88.8			P	(CLP)
	Total		1.9	B		F	(CLP)	3.1	B		P	(CLP)	86.9			P	(CLP)
11/05/98	Dissolved	K9807679-018															
	Total		1.79				200.8	1.4				200.8	75.4				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	Field pH	Field TDS (mg/l)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
Leviathan Creek Below Delta Seep														
9/25/98	Dissolved	76204	8.37		857	10.1		-2						
	Total													
10/16/98	Dissolved	10169812	5.83	624		6.8	4.68	-2	-0.5	1.8	1.7	-0.5	-0.5	-0.01
	Total													
11/5/1998 A	Dissolved	K9807679-015	5.8	489		5		-2	-0.2	1.6	1.4	-0.2	-0.2	0.02
11/5/98 B	Total	K9807679-019												
	Dissolved													
Leviathan Creek Above Jct. Aspen Creek (Station #15)														
9/23/98	Dissolved	76214	6.49		1110	13		-2						
	Total													
10/12/98	Dissolved	10129804	4.77		542	14.3	3.69	-2	-0.2	1.4	1.1	0.2	-0.2	-0.01
	Total													
11/4/98	Dissolved	K9807679-004	5.84	575		2		-2	-0.2	1.6	1.7	-0.2	-0.2	0.01
	Total													
Upper Aspen Creek at Road Crossing (Station #22)														
9/23/98	Dissolved	76212	7.4		167	13		98						
	Total													
10/14/98	Dissolved	10149810	8.24	16		12.5	7.94	101	-0.2	0.7	-0.2	0.5	-0.2	0.01
	Total													
11/4/98	Dissolved	K9807679-005	8.18	88.7		10.4		97	-0.2	0.7	-0.2	0.5	-0.2	0.02
	Total													
Lower Aspen Seep														
9/24/98	Dissolved	76206	3.29		2250	15.6		-2						
	Total													
10/14/98	Dissolved	10149812	3.18	1464		11.6	3.07	-2	-1.0	5.0	6.4	-1.0	-1.0	0.02
	Total													
11/5/98	Dissolved	K9807679-014	2.9	1428				-2	-1	3.8	6.2	-1	-1	-0.01
	Total													

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Hardness CaCO3 (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Method	Antimony (ug/L) [ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																	
9/25/98	Dissolved	76204		1070	74	667	495	1970			P	(CLP)	32.4	B		P	(CLP)
	Total							14200			P	(CLP)	-18.7	U		P	(CLP)
10/16/98	Dissolved	10169812	0.12	1080	73	586		1550			P	(CLP)	24.2	B		P	(CLP)
	Total							11800			P	(CLP)	-18.7	U		P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	0.12	776	62	836		503				6010B	0.05				200.8
11/5/98 B	Total	K9807679-019						9900				6010B	0.09				200.8
	Dissolved							2150				6010B	-0.02	ND			200.8
Leviathan Creek Above Jct. Aspen Creek (Station #15)																	
9/23/98	Dissolved	76214		964	66	695	470	12100			P	(CLP)	-18.7	U		P	(CLP)
	Total							10300			P	(CLP)	-18.7	U		P	(CLP)
10/12/98	Dissolved	10129804	0.03	938	91	509		6350			P	(CLP)	-18.7	U		P	(CLP)
	Total							10600			P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-004	0.06	1100	62	663		897				6010B	0.03				200.8
	Total							10100				6010B	0.14				200.8
Upper Aspen Creek at Road Crossing (Station #22)																	
9/23/98	Dissolved	76212		106	6	1.2	80.5	148	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							210			P	(CLP)	-18.7	U		P	(CLP)
10/14/98	Dissolved	10149810	0.18	125	16	1.2		18.5	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							113	B		P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-005	0.06	116	31	1.2	80.5	-50	ND			6010B	0.04				200.8
	Total							267				6010B	0.04				200.8
Lower Aspen Seep																	
9/24/98	Dissolved	76206		2840	-5	1649	1380	52500			P	(CLP)	25.6	B		P	(CLP)
	Total							51500			P	(CLP)	32.0	B		P	(CLP)
10/14/98	Dissolved	10149812	-0.01	2950	6	2210		51000			P	(CLP)	-18.7	U		P	(CLP)
	Total							51900			P	(CLP)	23.7	B		P	(CLP)
11/5/98	Dissolved	K9807679-014	-0.01	2860	12	3130		50200				6010B	-0.1	C			200.8
	Total							50200				6010B	-0.1	C			200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Arsenic (ug/L)					Barium (ug/L)					Beryllium (ug/L)					Boron (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																						
9/25/98	Dissolved	76204	95.5		*	F	(CLP)	51.4	B		P	(CLP)	1.5	B		P	(CLP)	126			P	(CLP)
	Total		156		*	F	(CLP)	76.4	B	E	P	(CLP)	2.1	B		P	(CLP)	143			P	(CLP)
10/16/98	Dissolved	10169812	114			F	(CLP)	49.7	B	E	P	(CLP)	-0.70	U		P	(CLP)	135			P	(CLP)
	Total		130			F	(CLP)	50.2	B	E	P	(CLP)	2.2	B		P	(CLP)	142			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	87.5				200.8	46.4				(6010B)	0.37				(200.8)	63				(200.8)
11/5/98 B	Total	K9807679-019	103				200.8	54.2				(6010B)	1.01				(200.8)	65				(200.8)
	Dissolved		62.1				200.8	10.3				(6010B)	1.53				(6010B)	126				(6010B)
Leviathan Creek Above Jct. Aspen Creek (Station #15)																						
9/23/98	Dissolved	76214	6.5	B	*	F	(CLP)	52.8	B		P	(CLP)	2.4	B		P	(CLP)	98.6			P	(CLP)
	Total		44.4		*	F	(CLP)	38.9	B	E	P	(CLP)	1.5	B		P	(CLP)	98.4			P	(CLP)
10/12/98	Dissolved	10129804	40.0			F	(CLP)	55.6	B		P	(CLP)	1.7	B		P	(CLP)	99.6			P	(CLP)
	Total		59.4			F	(CLP)	54.9	B		P	(CLP)	2.2	B		P	(CLP)	100			P	(CLP)
11/4/98	Dissolved	K9807679-004	36.4				200.8	42.9				(6010B)	0.35				(200.8)	73				(200.8)
	Total		45.2				200.8	38.7				(6010B)	1.28				(6010B)	77				(6010B)
Upper Aspen Creek at Road Crossing (Station #22)																						
9/23/98	Dissolved	76212	-1.0	U	*	F	(CLP)	10.4	B		P	(CLP)	-0.70	U		P	(CLP)	22.1	B		P	(CLP)
	Total		2.2	B	*	F	(CLP)	12.2	B	E	P	(CLP)	-0.70	U		P	(CLP)	24.6	B		P	(CLP)
10/14/98	Dissolved	10149810	-1.0	U		F	(CLP)	10.2	B		P	(CLP)	-0.70	U		P	(CLP)	16.8	B		P	(CLP)
	Total		-1.0	U		F	(CLP)	11.8	B		P	(CLP)	-0.70	U		P	(CLP)	23.7	B		P	(CLP)
11/4/98	Dissolved	K9807679-005	0.8				200.8	9.52				(6010B)	-0.02	ND			(200.8)	-50	ND			
	Total		0.9				200.8	12.0				(6010B)	-0.02	ND			(6010B)	-50	ND			
Lower Aspen Seep																						
9/24/98	Dissolved	76206	-1.0	U	*	F	(CLP)	7.4	B		P	(CLP)	10.8			P	(CLP)	328			P	(CLP)
	Total		1.8	B	*	F	(CLP)	8.3	B	E	P	(CLP)	10.8			P	(CLP)	314			P	(CLP)
10/14/98	Dissolved	10149812	-1.0	U		F	(CLP)	6.0	B		P	(CLP)	10.3			P	(CLP)	322			P	(CLP)
	Total		-1.0	U		F	(CLP)	6.9	B		P	(CLP)	10.6			P	(CLP)	323			P	(CLP)
11/5/98	Dissolved	K9807679-014	16.4				200.8	1.71				(6010B)	9.04				(200.8)	256				(200.8)
	Total		15.4				200.8	1.87				(6010B)	9.30				(6010B)	273				(6010B)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Cadmium (ug/L)					Calcium (ug/L)					Chromium (ug/L)					Cobalt (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																						
9/25/98	Dissolved	76204	-2.2	U		P	(CLP)	133000			P	(CLP)	-3.9	U		P	(CLP)	268			P	(CLP)
	Total		3.6	B		P	(CLP)	140000			P	(CLP)	8.6	B		P	(CLP)	272			P	(CLP)
10/16/98	Dissolved	10169812	-2.2	U		P	(CLP)	135000			P	(CLP)	-3.9	U		P	(CLP)	268		E	P	(CLP)
	Total		-2.2	U		P	(CLP)	128000			P	(CLP)	5.6	B		P	(CLP)	258			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	0.11				(200.8)	105000				(6010B)	0.5				(6010B)	152				200.8
11/5/98 B	Total	K9807679-019	0.10				(200.8)	102000				(6010B)	5.2				(6010B)	133				200.8
	Dissolved		0.26				(6010B)	288000				(6010B)	0.4				(6010B)	205				200.8
Leviathan Creek Above Jct. Aspen Creek (Station #15)																						
9/23/98	Dissolved	76214	-2.2	U		P	(CLP)	151000			P	(CLP)	-3.9	U		P	(CLP)	277			P	(CLP)
	Total		-2.2	U		P	(CLP)	135000			P	(CLP)	-3.9	U		P	(CLP)	237			P	(CLP)
10/12/98	Dissolved	10129804	-2.2	U		P	(CLP)	132000			P	(CLP)	-3.9	U		P	(CLP)	229			P	(CLP)
	Total		-2.2	U		P	(CLP)	129000			P	(CLP)	-3.9	U		P	(CLP)	231			P	(CLP)
11/4/98	Dissolved	K9807679-004	0.22				(200.8)	153000				(6010B)	-0.2	ND			(6010B)	175				200.8
	Total		0.19				(6010B)	153000				(6010B)	3.2				(6010B)	169				200.8
Upper Aspen Creek at Road Crossing (Station #22)																						
9/23/98	Dissolved	76212	-2.2	U		P	(CLP)	24200			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	23700			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
10/14/98	Dissolved	10149810	-2.2	U		P	(CLP)	23600			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	23000			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
11/4/98	Dissolved	K9807679-005	0.03					24800					-0.2	ND				0.16				200.8
	Total		-0.02	ND				24500					0.3					0.32				200.8
Lower Aspen Seep																						
9/24/98	Dissolved	76206	-2.2	U		P	(CLP)	380000			P	(CLP)	5.8	B		P	(CLP)	390			P	(CLP)
	Total		-2.2	U		P	(CLP)	396000			P	(CLP)	-3.9	U		P	(CLP)	394			P	(CLP)
10/14/98	Dissolved	10149812	-2.2	U		P	(CLP)	375000			P	(CLP)	-3.9	U		P	(CLP)	366			P	(CLP)
	Total		-2.2	U		P	(CLP)	374000			P	(CLP)	4.1	B		P	(CLP)	381			P	(CLP)
11/5/98	Dissolved	K9807679-014	2.24				(200.8)	360000				(6010B)	6.2				(6010B)	319				200.8
	Total		2.39				(6010B)	356000				(6010B)	6.1				(6010B)	322				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Copper (ug/L)					Iron (Fe+2+Fe+3)(ug/L)					Lead (ug/L)					Magnesium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																						
9/25/98	Dissolved	76204	14.0	B		P	(CLP)	95200			P	(CLP)	1.1	B		F	(CLP)	34400			P	(CLP)
	Total		20.0	B		P	(CLP)	104000			P	(CLP)	1.3	B		F	(CLP)	35400			P	(CLP)
10/16/98	Dissolved	10169812	-1.1	U		P	(CLP)	96200			P	(CLP)	-1.0	U		F	(CLP)	33900			P	(CLP)
	Total		3.9	B		P	(CLP)	94600			P	(CLP)	-1.0	U		F	(CLP)	33600			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	1.4				200.8	72200				6010B	0.04				200.8	27100				6010B
11/5/98 B	Total	K9807679-019	4.3				200.8	79500				6010B	0.37				200.8	26600				6010B
	Dissolved		3.7				200.8	21700				6010B	0.03				200.8	83800				6010B
Leviathan Creek Above Jct. Aspen Creek (Station #15)																						
9/23/98	Dissolved	76214	13.9	B		P	(CLP)	11900			P	(CLP)	-1.0	U		F	(CLP)	39100			P	(CLP)
	Total		6.6	B		P	(CLP)	51100			P	(CLP)	-1.0	U		F	(CLP)	32200			P	(CLP)
10/12/98	Dissolved	10129804	10.1	B		P	(CLP)	53300			P	(CLP)	-1.0	U		F	(CLP)	35000			P	(CLP)
	Total		13.3	B		P	(CLP)	54500			P	(CLP)	-1.0	U		F	(CLP)	34200			P	(CLP)
11/4/98	Dissolved	K9807679-004	5.6				200.8	62300				6010B	0.04				200.6	40400				6010B
	Total		7.8				200.8	63000				6010B	0.14				200.8	39500				6010B
Upper Aspen Creek at Road Crossing (Station #22)																						
9/23/98	Dissolved	76212	-1.1	U		P	(CLP)	31.4	B		P	(CLP)	1.1	B		F	(CLP)	5440			P	(CLP)
	Total		3.6	B		P	(CLP)	228			P	(CLP)	-1.0	U		F	(CLP)	5120			P	(CLP)
10/14/98	Dissolved	10149810	-1.1	U		P	(CLP)	35.2	B		P	(CLP)	-1.0	U	W	F	(CLP)	5300			P	(CLP)
	Total		-1.1	U		P	(CLP)	180			P	(CLP)	-1.0	U		F	(CLP)	5130			P	(CLP)
11/4/98	Dissolved	K9807679-005	0.6				200.8	38				6010B	-0.02	ND			200.8	5540				6010B
	Total		0.8				200.8	441				6010B	0.24				200.8	5400				6010B
Lower Aspen Seep																						
9/24/98	Dissolved	76206	1320			P	(CLP)	92600			P	(CLP)	-1.0	U		F	(CLP)	95700			P	(CLP)
	Total		1290			P	(CLP)	96900			P	(CLP)	-1.0	U		F	(CLP)	95900			P	(CLP)
10/14/98	Dissolved	10149812	1220			P	(CLP)	95700			P	(CLP)	-1.0	U		F	(CLP)	94700			P	(CLP)
	Total		1220			P	(CLP)	96900			P	(CLP)	-1.0	U	W	F	(CLP)	95300			P	(CLP)
11/5/98	Dissolved	K9807679-014	1050				200.8	139000				6010B	-0.1	C			200.8	91200				6010B
	Total		1030				200.8	138000				6010B	-0.1	C			200.8	89600				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Manganese (ug/L)					Mercury (ug/L)					Molybdenum (ug/L)					Nickel (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																						
9/25/98	Dissolved	76204	6520			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	592			P	(CLP)
	Total		6700			P	(CLP)	0.17	B		CV	(CLP)	-4.4	U		P	(CLP)	606			P	(CLP)
10/16/98	Dissolved	10169812	6550			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	584			P	(CLP)
	Total		6400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	548			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	4880				6010B	-0.5	ND			7470A	0.15				200.8	319				200.8
11/5/98 B	Total	K9807679-019	4770				6010B	-0.5	ND			7470A	0.19				200.8	288				200.8
	Dissolved		14000				6010B	0.4				7470A	0.04				200.8	483				200.8
Leviathan Creek Above Jct. Aspen Creek (Station #15)																						
9/23/98	Dissolved	76214	6720			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	637			P	(CLP)
	Total		5730			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	511			P	(CLP)
10/12/98	Dissolved	10129804	5730			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	524			P	(CLP)
	Total		5640			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	500			P	(CLP)
11/4/98	Dissolved	K9807679-004	6410				6010B	-0.5	ND			7470A	0.04				200.8	375				200.8
	Total		6370				6010B	-0.5	ND			7470A	0.04				200.8	363				200.8
Upper Aspen Creek at Road Crossing (Station #22)																						
9/23/98	Dissolved	76212	11.9	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		13.4	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
10/14/98	Dissolved	10149810	3.7	B		P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		13.3	B		P	(CLP)	0.10	B		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
11/4/98	Dissolved	K9807679-005	-5	ND			6010B	-0.5	ND			7470A	0.06				200.8	1.9				200.8
	Total		24				6010B	-0.5	ND			7470A	0.04				200.8	1.8				200.8
Lower Aspen Seep																						
9/24/98	Dissolved	76206	22000			P	(CLP)	0.11	B		CV	(CLP)	-4.4	U		P	(CLP)	612			P	(CLP)
	Total		22300			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	631			P	(CLP)
10/14/98	Dissolved	10149812	21300			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	557			P	(CLP)
	Total		21400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	581			P	(CLP)
11/5/98	Dissolved	K9807679-014	20900				6010B	-0.5	ND			7470A	-0.1	C			200.8	511				200.8
	Total		20800				6010B	-0.5	ND			7470A	-0.1	C			200.8	508				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Potassium (ug/L)					Selenium (ug/L)					Silver (ug/L)					Sodium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																						
9/25/98	Dissolved	76204	6760			P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	15600			P	(CLP)
	Total		8040			P	(CLP)	1.3	B	NW	F	(CLP)	-1.8	U		P	(CLP)	14800			P	(CLP)
10/16/98	Dissolved	10169812	7040			P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	15000			P	(CLP)
	Total		6550			P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	14900			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	7310				6010B	-5	ND			7740	-0.02	ND			200.8	13500				6010B
11/5/98 B	Total	K9807679-019	6500				6010B	-5	ND			7740	-0.02	ND			200.8	13900				6010B
	Dissolved		6300				6010B	-5	ND			7740	ND				200.8	24800				6010B
Leviathan Creek Above Jct. Aspen Creek (Station #15)																						
9/23/98	Dissolved	76214	7510			P	(CLP)	-1.0	U	N	F	(CLP)	-1.8	U		P	(CLP)	16900			P	(CLP)
	Total		6020			P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	13400			P	(CLP)
10/12/98	Dissolved	10129804	5810		E	P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	16700			P	(CLP)
	Total		6180			P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	15900			P	(CLP)
11/4/98	Dissolved	K9807679-004	5300				6010B	-5	ND			7740	-0.02	ND			200.8	17800				6010B
	Total		7900				6010B	-5	ND			7740	-0.02	ND			200.8	17200				6010B
Upper Aspen Creek at Road Crossing (Station #22)																						
9/23/98	Dissolved	76212	910	B		P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	10100			P	(CLP)
	Total		1260	B		P	(CLP)	1.8	B	NW	F	(CLP)	-1.8	U		P	(CLP)	9230			P	(CLP)
10/14/98	Dissolved	10149810	432	B	E	P	(CLP)	-1.0	U		F	(CLP)	-1.8	U		P	(CLP)	10600			P	(CLP)
	Total		656	B		P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	9510			P	(CLP)
11/4/98	Dissolved	K9807679-005	-2000	ND			6010B	-5	ND			7740	-0.02	ND			200.8	10400				6010B
	Total		3100				6010B	-5	ND			7740	-0.02	ND			200.8	9700				6010B
Lower Aspen Seep																						
9/24/98	Dissolved	76206	23100			P	(CLP)	1.7	B	NW	F	(CLP)	-1.8	U		P	(CLP)	16600			P	(CLP)
	Total		23600			P	(CLP)	1.2	B	NW	F	(CLP)	-1.8	U		P	(CLP)	15800			P	(CLP)
10/14/98	Dissolved	10149812	22600		E	P	(CLP)	2.2	B	W	F	(CLP)	-1.8	U		P	(CLP)	18000			P	(CLP)
	Total		22400			P	(CLP)	-1.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	17900			P	(CLP)
11/5/98	Dissolved	K9807679-014	23900				6010B	-5	ND			7740	-0.1	C			200.8	16000				6010B
	Total		23700				6010B	-5	ND			7740	-0.1	C			200.8	15800				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Thallium (ug/L)					Vanadium (ug/L)					Zinc (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Leviathan Creek Below Delta Seep																	
9/25/98	Dissolved	76204	8.6	B		F	(CLP)	8.5	B		P	(CLP)	121			P	(CLP)
	Total		10.3			F	(CLP)	26.7	B		P	(CLP)	119			P	(CLP)
10/16/98	Dissolved	10169812	8.7	B		F	(CLP)	2.9	B		P	(CLP)	109			P	(CLP)
	Total		8.4	B		F	(CLP)	17.2	B		P	(CLP)	105			P	(CLP)
11/5/1998 A	Dissolved	K9807679-015	5.59				200.8	-0.2	ND			200.8	68.1				200.8
11/5/98 B	Total	K9807679-019	5.48				200.8	12.3				200.8	61.2				200.8
	Dissolved		1.82				200.8	1.1				200.8	76.9				200.8
Leviathan Creek Above Jct. Aspen Creek (Station #15)																	
9/23/98	Dissolved	76214	8.6	B		F	(CLP)	3.9	B		P	(CLP)	127			P	(CLP)
	Total		7.6	B		F	(CLP)	8.8	B		P	(CLP)	96.3			P	(CLP)
10/12/98	Dissolved	10129804	6.8	B		F	(CLP)	5.0	B		P	(CLP)	105			P	(CLP)
	Total		10.2			F	(CLP)	13.0	B		P	(CLP)	101			P	(CLP)
11/4/98	Dissolved	K9807679-004	5.67				200.8	0.3				200.8	78.1				200.8
	Total		6.00				200.8	7.2				200.8	69.1				200.8
Upper Aspen Creek at Road Crossing (Station #22)																	
9/23/98	Dissolved	76212	-1.0	U		F	(CLP)	4.2	B		P	(CLP)	-2.0	U		P	(CLP)
	Total		-1.0	U		F	(CLP)	2.6	B		P	(CLP)	-2.0	U		P	(CLP)
10/14/98	Dissolved	10149810	-1.0	U		F	(CLP)	4.1	B		P	(CLP)	6.9	B		P	(CLP)
	Total		-1.0	U		F	(CLP)	3.3	B		P	(CLP)	5.0	B		P	(CLP)
11/4/98	Dissolved	K9807679-005	-0.02	ND			200.8	2.0				200.8	0.5				200.8
	Total		-0.02	ND			200.8	2.9				200.8	1.9				200.8
Lower Aspen Seep																	
9/24/98	Dissolved	76206	9.5	B		F	(CLP)	8.4	B		P	(CLP)	873			P	(CLP)
	Total		11.3			F	(CLP)	7.0	B		P	(CLP)	900			P	(CLP)
10/14/98	Dissolved	10149812	9.9	B		F	(CLP)	10.3	B		P	(CLP)	836			P	(CLP)
	Total		8.6	B	S	F	(CLP)	5.0	B		P	(CLP)	825			P	(CLP)
11/5/98	Dissolved	K9807679-014	12.6				200.8	4.4				200.8	746				200.8
	Total		12.4				200.8	4.7				200.8	728				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	Field pH	Field TDS (mg/l)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
Aspen Creek at Head of Landslide														
9/24/98	Dissolved	76205	4.25		425	11.8		-2						
	Total													
10/14/98	Dissolved	10149813	4.48	240		10.8	4.39	-2	-0.2	1.2	0.8	0.3	-0.2	0.02
	Total													
11/4/98	Dissolved	K9807679-002	4.65	218		6.1		-2	-0.2	1.1	0.8	0.2	-0.2	-0.01
	Total													
Aspen Creek Above Jct. Leviathan Creek (Station #16)														
9/23/98	Dissolved	76210	5.37		483	10.7		-2						
	Total													
10/14/98	Dissolved	10149814					5.9	-2	-0.2	1.2	0.8	0.2	-0.2	-0.01
	Total													
11/4/98	Dissolved	K9807679-006	6.49	252		3.8		6	-0.2	1.1	0.5	0.2	-0.2	0.01
	Total													
Slide Creek at Jct. Aspen Creek														
10/14/98	Dissolved	10149815	8.19	99.3		9.1	8.03	167	-0.5	2.5	1.4	-0.5	-0.5	0.02
	Total													
11/4/98	Dissolved	K9807679-003	8.43	898		3.8		168	-0.2	2.1	1.8	-0.5	-0.2	0.02
	Total													
Pit Underdrain														
9/25/98	Dissolved	76202	2.46		3570	10.9		-2						
	Total													
11/4/98														
Adit No. 5 Drainage														
9/25/98	Dissolved	76203	2.52		3670	12.8		-2						
	Total													
10/16/98	Dissolved	10199812					2.62	-2	-1.0	1.1	4.0	-1.0	1.1	3.69
	Total													
11/4/98	Dissolved	K9807679-007	2.42		2,260	11.7		-2.0	-1.0	-2.0	-2.0	-1.0	-1.0	3.56
	Total													

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description							Hardness		Aluminum (ug/L)					Antimony (ug/L)			
Date		Lab Sample ID#	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	CaCO3 (mg/l)	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																	
9/24/98	Dissolved	76205		358	-5	342	197	3060			P	(CLP)	-18.7	U		P	(CLP)
	Total							3040			P	(CLP)	-18.7	U		P	(CLP)
10/14/98	Dissolved	10149813	0.01	371	-5	272		2700			P	(CLP)	-18.7	U		P	(CLP)
	Total							2940			P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-002	-0.01	334	-5	212		2750				6010B	0.04				200.8
	Total							2890				6010B	0.07				200.8
Aspen Creek Above Jct. Leviathan Creek (Station #16)																	
9/23/98	Dissolved	76210		430	6	273	264	582			P	(CLP)	-18.7	U		P	(CLP)
	Total							1990			P	(CLP)	-18.7	U		P	(CLP)
10/14/98	Dissolved	10149814	-0.01	408	13	264		299			P	(CLP)	-18.7	U		P	(CLP)
	Total							2110			P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-006	-0.01	414	23	241		317				6010B	0.02				200.8
	Total							2400				6010B	0.05				200.8
Slide Creek at Jct. Aspen Creek																	
10/14/98	Dissolved	10149815	0.03	1490	24	1020		51.4	B		P	(CLP)	-18.7	U		P	(CLP)
	Total							460			P	(CLP)	-18.7	U		P	(CLP)
11/4/98	Dissolved	K9807679-003	0.02	1780	18	1020		-50	ND			6010B	0.08				200.8
	Total							764				6010B	0.07				200.8
Pit Underdrain																	
9/25/98	Dissolved	76202		5430	-5	7640	551	258000			P	(CLP)	-18.7	U		P	(CLP)
	Total							253000			P	(CLP)	-18.7	U		P	(CLP)
11/4/98																	
Adit No. 5 Drainage																	
9/25/98	Dissolved	76203		5160	-5	5240	457	247000			P	(CLP)	-18.7	U		P	(CLP)
	Total							256000			P	(CLP)	-18.7	U		P	(CLP)
10/16/98	Dissolved	10199812	7.75	5000	-5	2360		249000			P	(CLP)	53.1	B		P	(CLP)
	Total							236000			P	(CLP)	55.1	B		P	(CLP)
11/4/98	Dissolved	K9807679-007	6.91	5000	-5	4250		262000				6010B	-0.4	C			200.8
	Total							267000				6010B	-0.4	C			200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Arsenic (ug/L)					Barium (ug/L)					Beryllium (ug/L)					Boron (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																						
9/24/98	Dissolved	76205	-1.0	U	*	F	(CLP)	27.2	B		P	(CLP)	1.1	B		P	(CLP)	57.8			P	(CLP)
	Total		2.5	B	*	F	(CLP)	26.9	B	E	P	(CLP)	1.1	B		P	(CLP)	51.6			P	(CLP)
10/14/98	Dissolved	10149813	1.4	B		F	(CLP)	25.8	B		P	(CLP)	0.91	B		P	(CLP)	53.3			P	(CLP)
	Total		4.1	B		F	(CLP)	27.0	B		P	(CLP)	1.1	B		P	(CLP)	50.8			P	(CLP)
11/4/98	Dissolved	K9807679-002	1.0				200.8	21.2				(6010B)	0.64				(200.8)	53				
	Total		6.2				200.8	21.5				(6010B)	0.68				(6010B)	51				
Aspen Creek Above Jct. Leviathan Creek (Station #16)																						
9/23/98	Dissolved	76210	-1.0	U	*	F	(CLP)	32.6	B		P	(CLP)	0.74	B		P	(CLP)	54.4			P	(CLP)
	Total		2.2	B	*	F	(CLP)	33.1	B	E	P	(CLP)	-0.70	U		P	(CLP)	53.5			P	(CLP)
10/14/98	Dissolved	10149814	-1.0	U		F	(CLP)	32.3	B		P	(CLP)	-0.70	U		P	(CLP)	53.3			P	(CLP)
	Total		-1.0	U		F	(CLP)	35.5	B		P	(CLP)	1.1	B		P	(CLP)	49.1	B		P	(CLP)
11/4/98	Dissolved	K9807679-006	1.3				200.8	27.9				(6010B)	0.36				(200.8)	-50	ND			(200.8)
	Total		4.4				200.8	32.1				(6010B)	0.55				(6010B)	51				(6010B)
Slide Creek at Jct. Aspen Creek																						
10/14/98	Dissolved	10149815	3.1	B		F	(CLP)	22.5	B		P	(CLP)	-0.70	U		P	(CLP)	88.1			P	(CLP)
	Total		4.0	B		F	(CLP)	26.6	B		P	(CLP)	-0.70	U		P	(CLP)	93.1			P	(CLP)
11/4/98	Dissolved	K9807679-003	3.2				200.8	16.2				(6010B)	-0.02	ND			(200.8)	66				(200.8)
	Total		4.6				200.8	22.2				(6010B)	0.04				(6010B)	65				(6010B)
Pit Underdrain																						
9/25/98	Dissolved	76202	10500		*	F	(CLP)	14.4	B		P	(CLP)	11.1			P	(CLP)	415			P	(CLP)
	Total		10800		*	F	(CLP)	14.6	B	E	P	(CLP)	10.5			P	(CLP)	393			P	(CLP)
11/4/98																						
Adit No. 5 Drainage																						
9/25/98	Dissolved	76203	12800		*	F	(CLP)	13.1	B		P	(CLP)	8.1			P	(CLP)	362			P	(CLP)
	Total		12800		*	F	(CLP)	13.9	B	E	P	(CLP)	8.0			P	(CLP)	391			P	(CLP)
10/16/98	Dissolved	10199812	12000			F	(CLP)	13.5	B	E	P	(CLP)	6.8			P	(CLP)	388			P	(CLP)
	Total		12600			F	(CLP)	15.1	B	E	P	(CLP)	6.7			P	(CLP)	51.0			P	(CLP)
11/4/98	Dissolved	K9807679-007	12700				200.8	7.35				(6010B)	6.01				(200.8)	116				(200.8)
	Total		11200				200.8	7.10				(6010B)	6.57				(6010B)	114				(6010B)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Cadmium (ug/L)					Calcium (ug/L)					Chromium (ug/L)					Cobalt (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																						
9/24/98	Dissolved	76205	-2.2	U		P	(CLP)	54200			P	(CLP)	-3.9	U		P	(CLP)	29.8	B		P	(CLP)
	Total		-2.2	U		P	(CLP)	57100			P	(CLP)	-3.9	U		P	(CLP)	29.4	B		P	(CLP)
10/14/98	Dissolved	10149813	-2.2	U		P	(CLP)	51600			P	(CLP)	-3.9	U		P	(CLP)	24.7	B		P	(CLP)
	Total		-2.2	U		P	(CLP)	53000			P	(CLP)	-3.9	U		P	(CLP)	28.1	B		P	(CLP)
11/4/98	Dissolved	K9807679-002	0.26					54700					-0.2	ND				21.5				200.8
	Total		0.25					53100					0.3					21.8				200.8
Aspen Creek Above Jct. Leviathan Creek (Station #16)																						
9/23/98	Dissolved	76210	-2.2	U		P	(CLP)	74400			P	(CLP)	-3.9	U		P	(CLP)	22.6	B		P	(CLP)
	Total		-2.2	U		P	(CLP)	75000			P	(CLP)	-3.9	U		P	(CLP)	23.7	B		P	(CLP)
10/14/98	Dissolved	10149814	-2.2	U		P	(CLP)	68900			P	(CLP)	-3.9	U		P	(CLP)	19.6	B		P	(CLP)
	Total		-2.2	U		P	(CLP)	67700			P	(CLP)	-3.9	U		P	(CLP)	21.6	B		P	(CLP)
11/4/98	Dissolved	K9807679-006	0.23				(200.8)	75600				(200.8)	0.4				(6010B)	16.4				200.8
	Total		0.25				(6010B)	73300				(6010B)	0.5				(6010B)	17.1				200.8
Slide Creek at Jct. Aspen Creek																						
10/14/98	Dissolved	10149815	-2.2	U		P	(CLP)	328000			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
	Total		-2.2	U		P	(CLP)	331000			P	(CLP)	-3.9	U		P	(CLP)	-3.6	U		P	(CLP)
11/4/98	Dissolved	K9807679-003	0.04				(200.8)	351000				(200.8)	0.3				(6010B)	1.67				200.8
	Total		0.08				(6010B)	351000				(6010B)	0.5				(6010B)	2.88				200.8
Pit Underdrain																						
9/25/98	Dissolved	76202	59.0			P	(CLP)	147000			P	(CLP)	976			P	(CLP)	1780			P	(CLP)
	Total		26.4			P	(CLP)	146000			P	(CLP)	956			P	(CLP)	1740			P	(CLP)
11/4/98																						
Adit No. 5 Drainage																						
9/25/98	Dissolved	76203	63.8			P	(CLP)	116000			P	(CLP)	1010			P	(CLP)	1960			P	(CLP)
	Total		26.3			P	(CLP)	122000			P	(CLP)	1050			P	(CLP)	2040			P	(CLP)
10/16/98	Dissolved	10199812	34.8			P	(CLP)	113000			P	(CLP)	984			P	(CLP)	1930		E	P	(CLP)
	Total		37.0			P	(CLP)	111000			P	(CLP)	923			P	(CLP)	1850			P	(CLP)
11/4/98	Dissolved	K9807679-007	37.5				(200.8)	124000				(200.8)	870				(200.8)	1790				200.8
	Total		39.0				(6010B)	126000				(6010B)	903				(6010B)	1840				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Copper (ug/L)					Iron (Fe+2+Fe+3)(ug/L)					Lead (ug/L)					Magnesium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																						
9/24/98	Dissolved	76205	81.7			P	(CLP)	570			P	(CLP)	-1.0	U		F	(CLP)	12900			P	(CLP)
	Total		78.7			P	(CLP)	602			P	(CLP)	-1.0	U		F	(CLP)	13300			P	(CLP)
10/14/98	Dissolved	10149813	63.7			P	(CLP)	253			P	(CLP)	-1.0	U		F	(CLP)	12300			P	(CLP)
	Total		72.0			P	(CLP)	831			P	(CLP)	-1.0	U		F	(CLP)	12700			P	(CLP)
11/4/98	Dissolved	K9807679-002	61.8				200.8	236				6010B	0.03				200.8	12600				6010B
	Total		64.9				200.8	1460				6010B	0.03				200.8	12200				6010B
Aspen Creek Above Jct. Leviathan Creek (Station #16)																						
9/23/98	Dissolved	76210	52.6			P	(CLP)	96.3	B		P	(CLP)	-1.0	U		F	(CLP)	18500			P	(CLP)
	Total		58.6			P	(CLP)	233			P	(CLP)	-1.0	U		F	(CLP)	18600			P	(CLP)
10/14/98	Dissolved	10149814	42.0			P	(CLP)	66.1	B		P	(CLP)	-1.0	U		F	(CLP)	17000			P	(CLP)
	Total		54.8			P	(CLP)	342			P	(CLP)	-1.0	U		F	(CLP)	16700			P	(CLP)
11/4/98	Dissolved	K9807679-006	31.5				200.8	61				6010B	0.03				200.8	18200				6010B
	Total		45.2				200.8	1040				6010B	0.18				200.8	17500				6010B
Slide Creek at Jct. Aspen Creek																						
10/14/98	Dissolved	10149815	19.3	B		P	(CLP)	83.7	B		P	(CLP)	-1.0	U		F	(CLP)	87900			P	(CLP)
	Total		14.9	B		P	(CLP)	315			P	(CLP)	-1.0	U		F	(CLP)	88400			P	(CLP)
11/4/98	Dissolved	K9807679-003	5.4				200.8	76				6010B	-0.02	ND			200.8	93200				6010B
	Total		9.3				200.8	629				6010B	0.17				200.8	90500				6010B
Pit Underdrain																						
9/25/98	Dissolved	76202	1170			P	(CLP)	727000			P	(CLP)	7.8			F	(CLP)	45500			P	(CLP)
	Total		1140			P	(CLP)	729000			P	(CLP)	7.0		W	F	(CLP)	45200			P	(CLP)
11/4/98																						
Adit No. 5 Drainage																						
9/25/98	Dissolved	76203	1350			P	(CLP)	690000			P	(CLP)	10.1			F	(CLP)	35000			P	(CLP)
	Total		1420			P	(CLP)	696000			P	(CLP)	10.5		S	F	(CLP)	37000			P	(CLP)
10/16/98	Dissolved	10199812	1240			P	(CLP)	614000			P	(CLP)	7.4		W	F	(CLP)	34600			P	(CLP)
	Total		1170			P	(CLP)	675000			P	(CLP)	8.9		S	F	(CLP)	32800			P	(CLP)
11/4/98	Dissolved	K9807679-007	1110				200.8	697000				6010B	6.44				200.8	37100				6010B
	Total		1150				200.8	711000				6010B	6.84				200.8	37900				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Manganese (ug/L)					Mercury (ug/L)					Molybdenum (ug/L)					Nickel (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																						
9/24/98	Dissolved	76205	1800			P	(CLP)	0.77			CV		-4.4	U		P	(CLP)	58.5			P	(CLP)
	Total		1850			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	54.0			P	(CLP)
10/14/98	Dissolved	10149813	1650			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	56.1			P	(CLP)
	Total		1710			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	46.3			P	(CLP)
11/4/98	Dissolved	K9807679-002	1730				6010B	-0.5	ND			7470A	-0.02	ND			200.8	44.7				200.8
	Total		1680				6010B	-0.5	ND			7470A	0.02				200.8	46.1				200.8
Aspen Creek Above Jct. Leviathan Creek (Station #16)																						
9/23/98	Dissolved	76210	1710			P	(CLP)	0.12	B		CV	(CLP)	-4.4	U		P	(CLP)	48.6			P	(CLP)
	Total		1770			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	45.2			P	(CLP)
10/14/98	Dissolved	10149814	1400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	49.2			P	(CLP)
	Total		1400			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	44.5			P	(CLP)
11/4/98	Dissolved	K9807679-006	1430				6010B	-0.5	ND			7470A	0.02				200.8	39.6				200.8
	Total		1390				6010B	-0.5	ND			7470A	0.02				200.8	39.1				200.8
Slide Creek at Jct. Aspen Creek																						
10/14/98	Dissolved	10149815	20.2			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
	Total		215			P	(CLP)	0.25			CV	(CLP)	-4.4	U		P	(CLP)	-15.1	U		P	(CLP)
11/4/98	Dissolved	K9807679-003	17				6010B	-0.5	ND			7470A	0.08				200.8	29.4				200.8
	Total		218				6010B	-0.5	ND			7470A	0.08				200.8	33.2				200.8
Pit Underdrain																						
9/25/98	Dissolved	76202	9140			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	4790			P	(CLP)
	Total		8970			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	4690			P	(CLP)
11/4/98																						
Adit No. 5 Drainage																						
9/25/98	Dissolved	76203	6800			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	5140			P	(CLP)
	Total		7100			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	5430			P	(CLP)
10/16/98	Dissolved	10199812	6620			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	4980			P	(CLP)
	Total		6420			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	4620			P	(CLP)
11/4/98	Dissolved	K9807679-007	7170				6010B	-0.5	ND			7470A	0.48				200.8	4400				200.8
	Total		7320				6010B	-0.5	ND			7470A	-0.4	C			200.8	4550				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Potassium (ug/L)					Selenium (ug/L)					Silver (ug/L)					Sodium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																						
9/24/98	Dissolved	76205	4900	B		P	(CLP)	7.4		N	F	(CLP)	-1.8	U		P	(CLP)	12500			P	(CLP)
	Total		6060			P	(CLP)	8.3		N	F	(CLP)	-1.8	U		P	(CLP)	9320			P	(CLP)
10/14/98	Dissolved	10149813	3990	B	E	P	(CLP)	7.3			F	(CLP)	-1.8	U		P	(CLP)	9130			P	(CLP)
	Total		4180	B		P	(CLP)	6.8		N	F	(CLP)	-1.8	U		P	(CLP)	9380			P	(CLP)
11/4/98	Dissolved	K9807679-002	5000				6010B	5				7740	0.03				200.8	9440				6010B
	Total		6800				6010B	6				7740	-0.02	ND			200.8	9020				6010B
Aspen Creek Above Jct. Leviathan Creek (Station #16)																						
9/23/98	Dissolved	76210	4370	B		P	(CLP)	8.4		NS	F	(CLP)	-1.8	U		P	(CLP)	10800			P	(CLP)
	Total		3630	B		P	(CLP)	7.3		NS	F	(CLP)	-1.8	U		P	(CLP)	10400			P	(CLP)
10/14/98	Dissolved	10149814	3930	B	E	P	(CLP)	9.2		S	F	(CLP)	-1.8	U		P	(CLP)	10400			P	(CLP)
	Total		4230	B		P	(CLP)	6.8		NS	F	(CLP)	-1.8	U		P	(CLP)	10200			P	(CLP)
11/4/98	Dissolved	K9807679-006	3200				6010B	6				7740	0.02				200.8	11300				6010B
	Total		6800				6010B	6				7740	0.03				200.8	10200				6010B
Slide Creek at Jct. Aspen Creek																						
10/14/98	Dissolved	10149815	4410	B	E	P	(CLP)	13.8		S	F	(CLP)	-1.8	U		P	(CLP)	21400			P	(CLP)
	Total		4940	B		P	(CLP)	11.9			F	(CLP)	-1.8	U		P	(CLP)	21100			P	(CLP)
11/4/98	Dissolved	K9807679-003	4400				6010B	12				7740	-0.02	ND			200.8	21900				6010B
	Total		7500				6010B	9				7740	-0.02	ND			200.8	21000				6010B
Pit Underdrain																						
9/25/98	Dissolved	76202	15500			P	(CLP)	7.8		N+	F	(CLP)	6.1	B		P	(CLP)	26100			P	(CLP)
	Total		15300			P	(CLP)	-5.0	U	NW	F	(CLP)	6.0	B		P	(CLP)	25100			P	(CLP)
11/4/98																						
Adit No. 5 Drainage																						
9/25/98	Dissolved	76203	13500			P	(CLP)	4.4	B	NS	F	(CLP)	5.4	B		P	(CLP)	22000			P	(CLP)
	Total		14300			P	(CLP)	-1.0	U	NW	F	(CLP)	4.8	B		P	(CLP)	22500			P	(CLP)
10/16/98	Dissolved	10199812	12900			P	(CLP)	-5.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	21700			P	(CLP)
	Total		14500			P	(CLP)	-1.0	U	W	F	(CLP)	-1.8	U		P	(CLP)	19800			P	(CLP)
11/4/98	Dissolved	K9807679-007	12600				6010B	-5	ND			7740	-0.4	C			200.8	23400				6010B
	Total		15000				6010B	-5	ND			7740	-0.4	C			200.8	23400				6010B

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Thallium (ug/L)					Vanadium (ug/L)					Zinc (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Aspen Creek at Head of Landslide																	
9/24/98	Dissolved	76205	2.5	B		F	(CLP)	-2.5	U		P	(CLP)	69.6			P	(CLP)
	Total		3.0	B		F	(CLP)	-2.5	U		P	(CLP)	69.0			P	(CLP)
10/14/98	Dissolved	10149813	3.1	B		F	(CLP)	-2.5	U		P	(CLP)	70.2			P	(CLP)
	Total		3.1	B		F	(CLP)	-2.5	U		P	(CLP)	70.4			P	(CLP)
11/4/98	Dissolved	K9807679-002	2.10				200.8	-0.2	ND			200.8	56.2				200.8
	Total		2.10				200.8	-0.2	ND			200.8	54.9				200.8
Aspen Creek Above Jct. Leviathan Creek (Station #16)																	
9/23/98	Dissolved	76210	1.4	B		F	(CLP)	2.7	B		P	(CLP)	62.0			P	(CLP)
	Total		2.2	B		F	(CLP)	-2.5	U		P	(CLP)	58.4			P	(CLP)
10/14/98	Dissolved	10149814	1.6	B		F	(CLP)	2.9	B		P	(CLP)	61.3			P	(CLP)
	Total		-1.0	U		F	(CLP)	-2.5	U		P	(CLP)	58.4			P	(CLP)
11/4/98	Dissolved	K9807679-006	1.44				200.8	0.3				200.8	50.4				200.8
	Total		1.44				200.8	1.0				200.8	51.4				200.8
Slide Creek at Jct. Aspen Creek																	
10/14/98	Dissolved	10149815	-1.0	U		F	(CLP)	3.8	B		P	(CLP)	19.9	B		P	(CLP)
	Total		-1.0	U		F	(CLP)	3.9	B		P	(CLP)	9.5	B		P	(CLP)
11/4/98	Dissolved	K9807679-003	0.55				200.8	0.9				200.8	3.0				200.8
	Total		0.59				200.8	1.3				200.8	7.5				200.8
Pit Underdrain																	
9/25/98	Dissolved	76202	428			F	(CLP)	468			P	(CLP)	846			P	(CLP)
	Total		470			F	(CLP)	458			P	(CLP)	835			P	(CLP)
11/4/98																	
Adit No. 5 Drainage																	
9/25/98	Dissolved	76203	532			F	(CLP)	457			P	(CLP)	701			P	(CLP)
	Total		562			F	(CLP)	475			P	(CLP)	732			P	(CLP)
10/16/98	Dissolved	10199812	510			F	(CLP)	428			P	(CLP)	674			P	(CLP)
	Total		448			F	(CLP)	405			P	(CLP)	656			P	(CLP)
11/4/98	Dissolved	K9807679-007	461				200.8	402				200.8	624				200.8
	Total		463				200.8	411				200.8	657				200.8

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	Field pH	Field TDS (mg/l)	Field Cond. (uS/cm)	Field Temp (deg. C)	Lab pH	Alk as CaCO3 (mg/l)	Bromide (mg/l)	Chloride (mg/l)	Flouride (mg/l)	NO3- as N (mg/l)	NO2- as N (mg/l)	Ortho-P as P (mg/l)
Wetlands Seep														
9/23/98	Dissolved	76211	3.56		892	10.9		-2						
	Total													
10/14/98	Dissolved	10149811	3.77	669		10.6	3.68	-2	-0.5	2.4	1.1	2.2	-0.5	-0.01
	Total													
11/5/98	Dissolved	K9807679-013	3.5	720				-2	-0.2	2.6	1.3	2.2	-0.5	0.01
	Total													
Pond 2 Runoff														
9/24/98	Dissolved	76201						-2						
	Total													

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description Date		Lab Sample ID#	P Total (mg/l)	TDS (mg/l)	TSS (mg/l)	Sulfate (mg/l)	Hardness CaCO3 (mg/l)	Aluminum (ug/L) [ug/L]	C	Q	M	Method	Antimony (ug/L) [ug/L]	C	Q	M	Method
Wetlands Seep																	
9/23/98	Dissolved	76211		1260	-5	795	603	44200			P	(CLP)	-18.7	U		P	(CLP)
	Total							45600			P	(CLP)	-18.7	U		P	(CLP)
10/14/98	Dissolved	10149811	0.01	1280	10	814		44000			P	(CLP)	-18.7	U		P	(CLP)
	Total							44800			P	(CLP)	-18.7	U		P	(CLP)
11/5/98	Dissolved	K9807679-013	0.03	1260	23	1010		44400				6010B	0.20				200.8
	Total							44400				6010B	-0.1	C			200.8
Pond 2 Runoff																	
9/24/98	Dissolved	76201		208	1820	208	265	5010			P	(CLP)	-18.7	U		P	(CLP)
	Total							59200			P	(CLP)	21.2	B		P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Arsenic (ug/L)					Barium (ug/L)					Beryllium (ug/L)					Boron (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																						
9/23/98	Dissolved	76211	-1.0	U	*	F	(CLP)	7.7	B		P	(CLP)	3.4	B		P	(CLP)	64.6			P	(200.8)
	Total		1.3	B	*	F	(CLP)	10.2	B	E	P	(CLP)	3.0	B		P	(CLP)	61.5			P	(6010B)
10/14/98	Dissolved	10149811	-1.0	U		F	(CLP)	8.3	B		P	(CLP)	3.6	B		P	(CLP)	59.9			P	(CLP)
	Total		-1.0	U		F	(CLP)	14.1	B		P	(CLP)	3.7	B		P	(CLP)	64.3			P	(CLP)
11/5/98	Dissolved	K9807679-013	6.3				200.8	6.78				(6010B)	3.19				(200.8)	-50	ND			(200.8)
	Total		5.4				200.8	7.20				(6010B)	3.34				(6010B)	52				(6010B)
Pond 2 Runoff																						
9/24/98	Dissolved	76201	37.0		*	F	(CLP)	22.2	B		P	(CLP)	2.6	B		P	(CLP)	20.4	B		P	(CLP)
	Total		102		*	F	(CLP)	333		E	P	(CLP)	6.9			P	(CLP)	53.7			P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Cadmium (ug/L)					Calcium (ug/L)					Chromium (ug/L)					Cobalt (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																						
9/23/98	Dissolved	76211	6.1			P	(CLP)	155000			P	(CLP)	3.9	B		P	(CLP)	165			P	(CLP)
	Total		-2.2	U		P	(CLP)	159000			P	(CLP)	4.9	B		P	(CLP)	171			P	(CLP)
10/14/98	Dissolved	10149811	2.4	B		P	(CLP)	154000			P	(CLP)	-3.9	U		P	(CLP)	161			P	(CLP)
	Total		2.6	B		P	(CLP)	153000			P	(CLP)	-3.9	U		P	(CLP)	169			P	(CLP)
11/5/98	Dissolved	K9807679-013	3.41				(200.8)	154000				(200.8)	4.5				(200.8)	158				200.8
	Total		3.74				(6010B)	152000				(6010B)	4.6				(6010B)	166				200.8
Pond 2 Runoff																						
9/24/98	Dissolved	76201	2.5	B		P	(CLP)	32400			P	(CLP)	10.6			P	(CLP)	24.5	B		P	(CLP)
	Total		-2.2	U		P	(CLP)	76800			P	(CLP)	113			P	(CLP)	94.0			P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Copper (ug/L)					Iron (Fe+2+Fe+3)(ug/L)					Lead (ug/L)					Magnesium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																						
9/23/98	Dissolved	76211	1050			P	(CLP)	255			P	(CLP)	1.2	B		F	(CLP)	50100			P	(CLP)
	Total		1060			P	(CLP)	306			P	(CLP)	1.1	B		F	(CLP)	49900			P	(CLP)
10/14/98	Dissolved	10149811	1050			P	(CLP)	236			P	(CLP)	1.1	B		F	(CLP)	49500			P	(CLP)
	Total		1060			P	(CLP)	362			P	(CLP)	1.0	B		F	(CLP)	49700			P	(CLP)
11/5/98	Dissolved	K9807679-013	949				200.8	220				6010B	0.53				200.8	50800				6010B
	Total		986				200.8	238				6010B	0.50				200.8	49900				6010B
Pond 2 Runoff																						
9/24/98	Dissolved	76201	84.4			P	(CLP)	1860			P	(CLP)	1.2	B		F	(CLP)	4920	B		P	(CLP)
	Total		302			P	(CLP)	37100			P	(CLP)	9.4			F	(CLP)	17800			P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Manganese (ug/L)					Mercury (ug/L)					Molybdenum (ug/L)					Nickel (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																						
9/23/98	Dissolved	76211	3440			P	(CLP)	7.5			CV	(CLP)	-4.4	U		P	(CLP)	345			P	(CLP)
	Total		3570			P	(CLP)	7.7			CV	(CLP)	-4.4	U		P	(CLP)	347			P	(CLP)
10/14/98	Dissolved	10149811	3450			P	(CLP)	7.5			CV	(CLP)	-4.4	U		P	(CLP)	347			P	(CLP)
	Total		3450			P	(CLP)	7.5			CV	(CLP)	-4.4	U		P	(CLP)	342			P	(CLP)
11/5/98	Dissolved	K9807679-013	3480				6010B	7.5				7470A	-0.1	C			200.8	331				200.8
	Total		3460				6010B	7.9				7470A	-0.1	C			200.8	339				200.8
Pond 2 Runoff																						
9/24/98	Dissolved	76201	640			P	(CLP)	-0.10	U		CV	(CLP)	-4.4	U		P	(CLP)	63.4			P	(CLP)
	Total		2720			P	(CLP)	4.8			CV	(CLP)	-4.4	U		P	(CLP)	178			P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Potassium (ug/L)					Selenium (ug/L)					Silver (ug/L)					Sodium (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																						
9/23/98	Dissolved	76211	6990			P	(CLP)	51.4		NS	F	(CLP)	-1.8	U		P	(CLP)	10500			P	(CLP)
	Total		7400			P	(CLP)	26.2		NS	F	(CLP)	-1.8	U		P	(CLP)	9740			P	(CLP)
10/14/98	Dissolved	10149811	7040		E	P	(CLP)	53.3		S	F	(CLP)	-1.8	U		P	(CLP)	10100			P	(CLP)
	Total		7000			P	(CLP)	39.1		NS	F	(CLP)	-1.8	U		P	(CLP)	10000			P	(CLP)
11/5/98	Dissolved	K9807679-013	8000				6010B	41				7740	-0.1	C			200.8	10300				6010B
	Total		7700				6010B	36				7740	-0.1	C			200.8	10200				6010B
Pond 2 Runoff																						
9/24/98	Dissolved	76201	2720	B		P	(CLP)	1.4	B	N	F	(CLP)	-1.8	U		P	(CLP)	1840	B		P	(CLP)
	Total		7430			P	(CLP)	-5.0	U	NW	F	(CLP)	-1.8	U		P	(CLP)	1900	B		P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Leviathan Mine Site

Sample Description			Thallium (ug/L)					Vanadium (ug/L)					Zinc (ug/L)				
Date		Lab Sample ID#	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method	[ug/L]	C	Q	M	Method
Wetlands Seep																	
9/23/98	Dissolved	76211	17.7			F	(CLP)	2.9	B		P	(CLP)	407			P	(CLP)
	Total		18.8			F	(CLP)	2.5	B		P	(CLP)	410			P	(CLP)
10/14/98	Dissolved	10149811	17.4			F	(CLP)	3.4	B		P	(CLP)	406			P	(CLP)
	Total		17.3			F	(CLP)	-2.5	U		P	(CLP)	396			P	(CLP)
11/5/98	Dissolved	K9807679-013	19.5				200.8	-1	C			200.8	358				200.8
	Total		19.8				200.8	-1	C			200.8	367				200.8
Pond 2 Runoff																	
9/24/98	Dissolved	76201	3.0	B		F	(CLP)	11.3	B		P	(CLP)	52.9			P	(CLP)
	Total		10.6			F	(CLP)	123			P	(CLP)	222			P	(CLP)

Note: Negative values indicate that constituent was not detected at that value.

Table 4.2
1998 Surface Water Quality Data
Addenda

Inorganic CLP SOW Laboratory Result Qualifiers

Concentration Qualifiers

B	Reported value is less than the CRDL but greater than IDL
U	Analyte was analyzed for but not detected

Quality Control Qualifiers

E	Reported value is estimated because of the presence of interference(s)
M	Duplicate injection precision not met for GFAA
N	Spike sample recovery not within control limits
S	Reported value was determined by the method of standard additions (MSA)
W	Post digestion spike for furnace AA analysis is out of control limits
*	Duplicate analysis not within control limits
+	Correlation coefficient for MSA is less than 0.995

Method Qualifiers

P	ICP
A	Flame AA
F	Furnace AA
CV	Manual Cold Vapor AA
AV	Automated Cold Vapor AA
AS	Semi-Automated Spectrophotometric
C	Manual Spectrophotometric
T	Titrimetric
NR	Analyte not required to be analyzed

Table 4.3
Summary of Climate Data
Fall/Winter 1998, Summer 1999
Leviathan Mine

	Temperature (F)		Rainfall (in)			Average
	High	Low	Total	Max Daily		Windspeed (mph)
November 4 - 30, 1998	76.20	16.30	1.17	0.25	(1)	7.30
December 1 - 31, 1998	69.90	(5.20)	0.82	0.37	(1)	6.70
January 1 - 7, 1999	67.30	18.40	-	-	(1)	7.30
July 28 - 31, 1999	99.60	42.50	-	-		5.10
August 1 - 31, 1999	98.00	33.90	7.70	2.50		5.10
September 1 - 9, 1999	93.60	29.90	-	-		4.70

Note:
1. Rain gauge is not heated; therefore, rainfall data during freezing periods may not be accurate.

Table 5.1
1998 Geotechnical Testing Program
Leviathan Mine

Test	Test Pit	Sample Interval
Flexible Wall Permeability	LTP-1	1.0 to 1.5
ASTM D5084-90	LTP-2	0.9 to 1.4
	LTP-4	5.5 to 6.0
	LTP-5	5.5 to 6.0
	LTP-5	5.9 to 6.4
	LTP-6	0.5 to 1.0
Compaction Characteristics	LTP-1	0.0 to 0.5
ASTM D698-91	LTP-3	0.0 to 0.5
	LTP-6	0.0 to 0.5
Particle Size Distribution	LTP-1	0.0 to 0.5
	LTP-3	0.0 to 0.5
	LTP-4	5.5 to 6.0
	LTP-5	5.5 to 6.0
	LTP-6	0.0 to 0.5

Note:
Sample results are presented in Appendix F of the Data Summary Report.

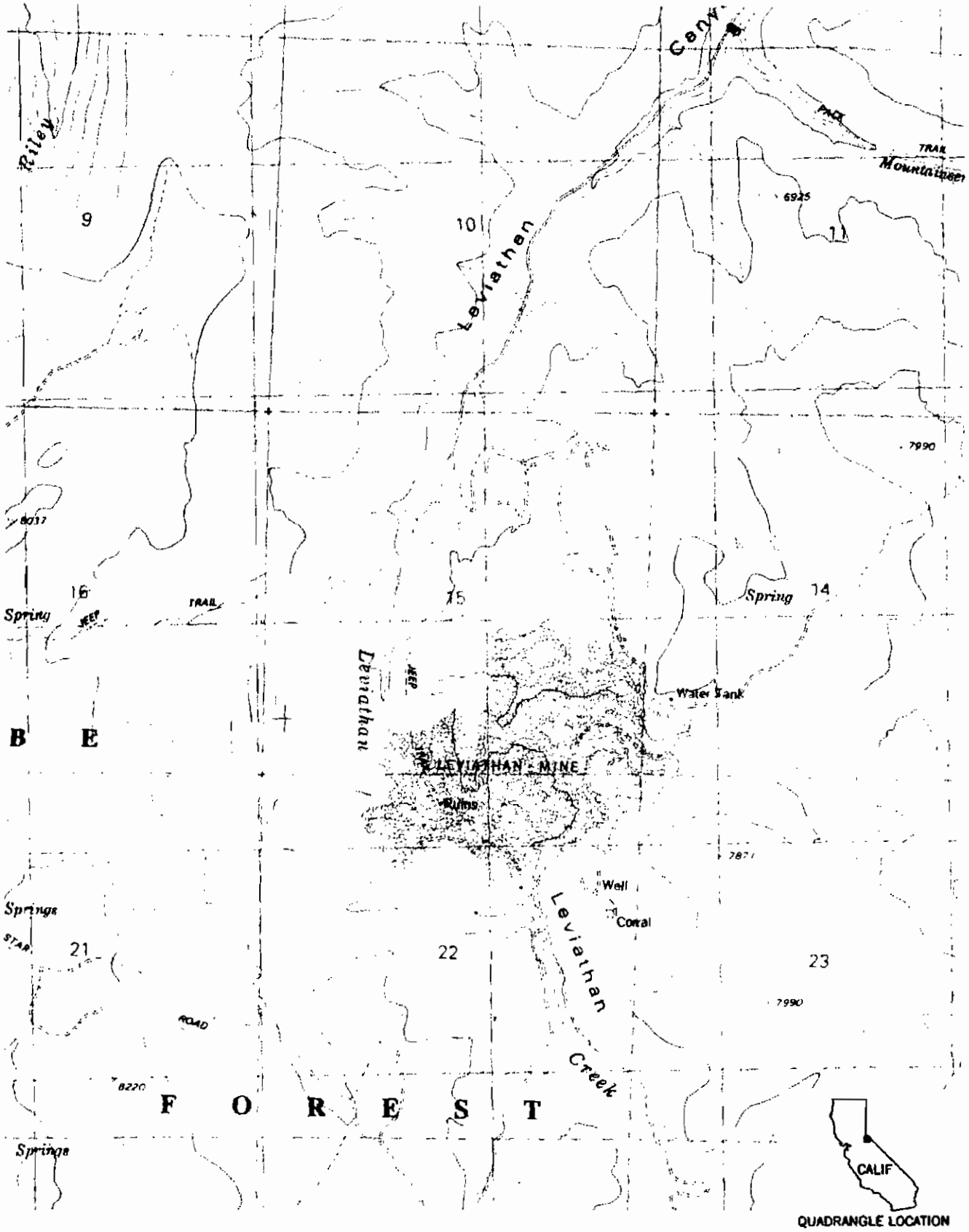
Table 5.2
1998 Test Pit and Landslide Monument Locations
Leviathan Mine Site

I.D.	Northing	Easting	Ground Elevation
LPT1	387,646.2600	2,667,569.7500	6,951.2500
LPT2	387,313.6300	2,667,219.7500	6,910.9700
LPT3	386,951.7200	2,667,590.6000	6,960.3100
LPT4	386,182.3200	2,668,803.0800	7,081.3200
LPT5	387,127.2800	2,668,832.6500	7,072.3600
LPT6	386,908.1600	2,669,333.9400	7,112.1600
LS1	388,121.4200	2,669,519.1800	7,217.4800
LS2	388,244.0600	2,669,895.6700	7,251.3900
LS3	388,363.1400	2,669,738.4300	7,228.8900
LS4	388,374.8500	2,670,122.2300	7,246.8700
LS5	388,391.4900	2,669,517.0000	7,228.3600
LS6	388,415.4400	2,668,740.2300	7,217.2300
LS7	388,661.9000	2,668,945.7500	7,193.0600
LS8	389,240.7100	2,669,664.6800	7,114.4900
LS9	389,152.4700	2,669,471.5000	7,148.0800

Note:

1. Survey information is taken from the 1998 Field Survey performed by Summit Engineering Corporation. Coordinates are based on California State Coordinate System, Zone 2.

Figures

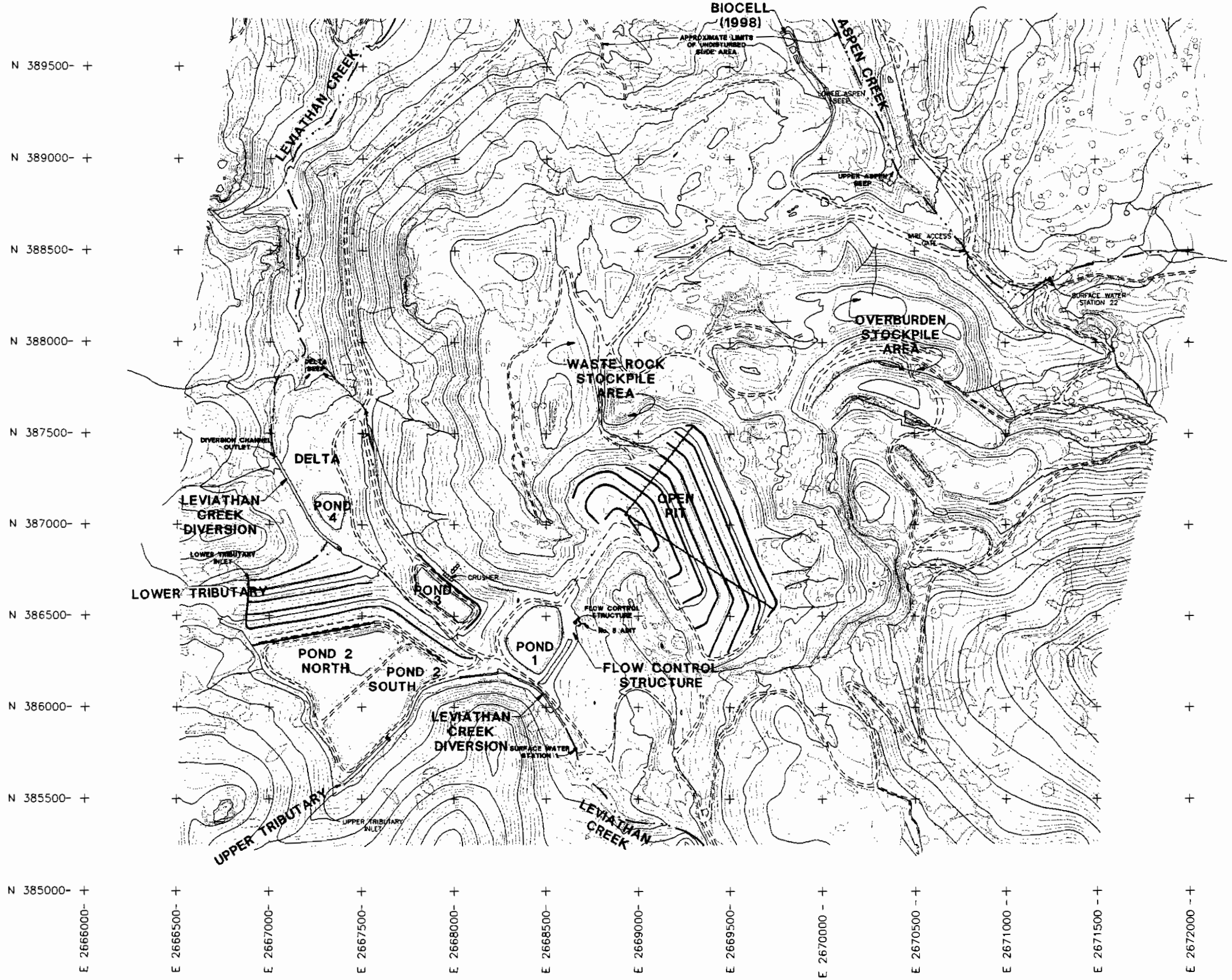


SRK Consulting
Engineers and Scientists

PROJECT NO.	DATE	REVISION
19333.0401	07/98	A

FIGURE 1.1

SITE LOCATION MAP
LEVIATHAN PROJECT



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REFERENCE		
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APPROVED		
APPROVED		

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ARCO ENVIRONMENTAL REMEDIATION, LLC.

TITLE:
SITE LAYOUT

PREPARED BY:
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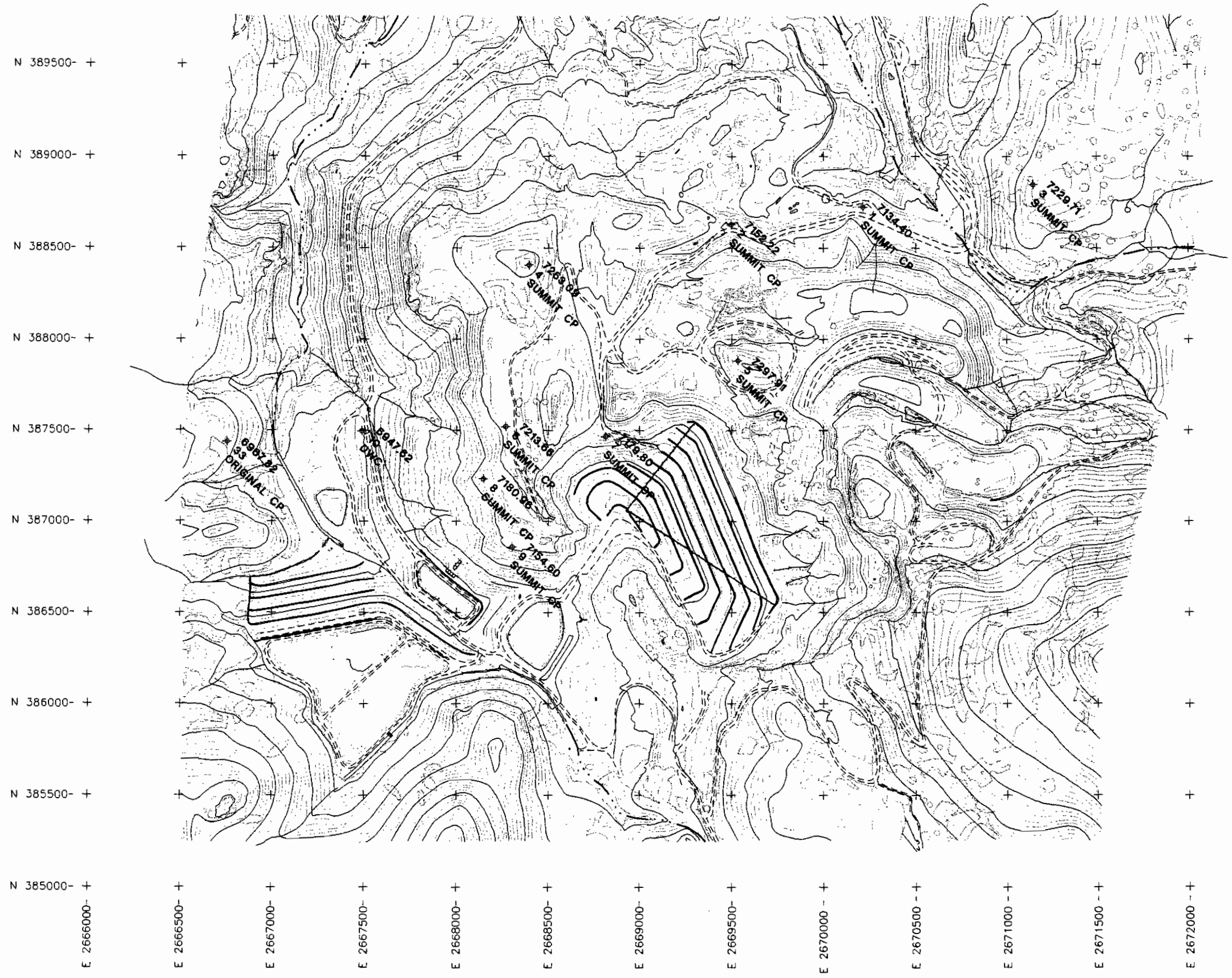
Engineers and Scientists

DRAWING No.: FIGURE 1.2
SHEET No. OF
SCALE: 1"=600'
PROJECT No.: 19333-1601
DRAWING NAME: 19333-1601_FIG12.DWG
REVISION: A



REVISIONS No.	DESCRIPTION	BY	DATE

REFERENCE				
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		DRAWN	TAD	11/98
		CHECKED		
		APPROVED		
		APPROVED		

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TITLE

SURVEY CONTROL POINTS

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SHEET No. OF

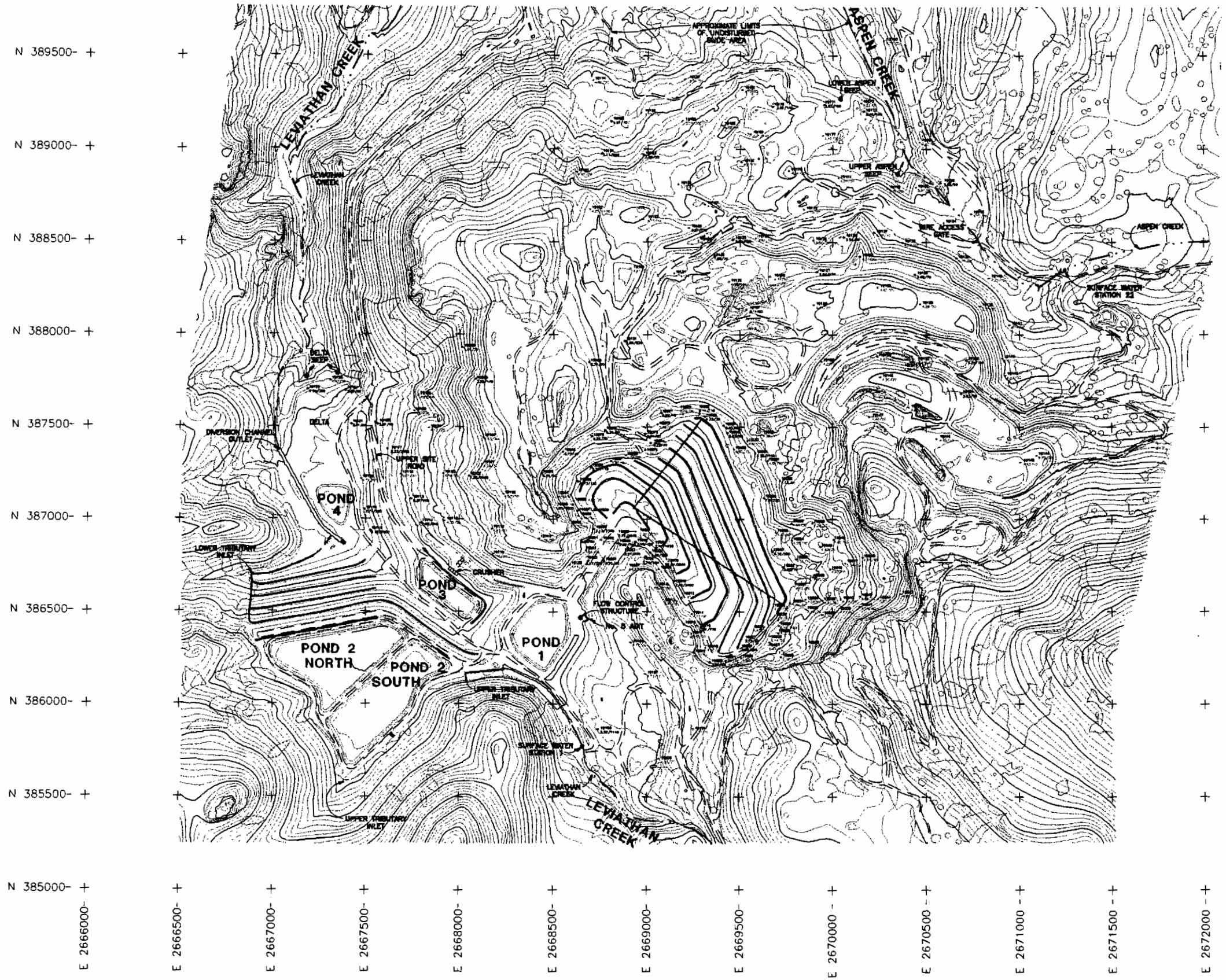
SCALE: 1"=600'

PROJECT No. 19333-1601

DRAWING NAME 19333-1601-FIG13.DWG

A

REVISION



600 300 0 600 1200

SCALE 1" = 600'

LEGEND

SOIL PASTE pH/TDS SAMPLE SITE

SAMPLE No. 19053

4.52/10

pH (S.U.) TDS (PPM)

SAMPLES WITH pH LESS THAN 4 SHOWN IN RED
SAMPLES WITH pH BETWEEN 4 AND 6 SHOWN IN GREEN
SAMPLES WITH pH GREATER THAN 6 SHOWN IN BLUE

REVISIONS No.	DESCRIPTION	BY	DATE

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1	TOPOGRAPHIC AND SURVEY CONTROL PROVIDED BY SUMMIT ENGINEERING (11/98)	DESIGNED	TB 11/98
		DRAWN	TAD 11/98
		CHECKED	
		APPROVED	
		APPROVED	

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TITLE:

SURFACE GEOCHEMICAL SURVEY RESULTS

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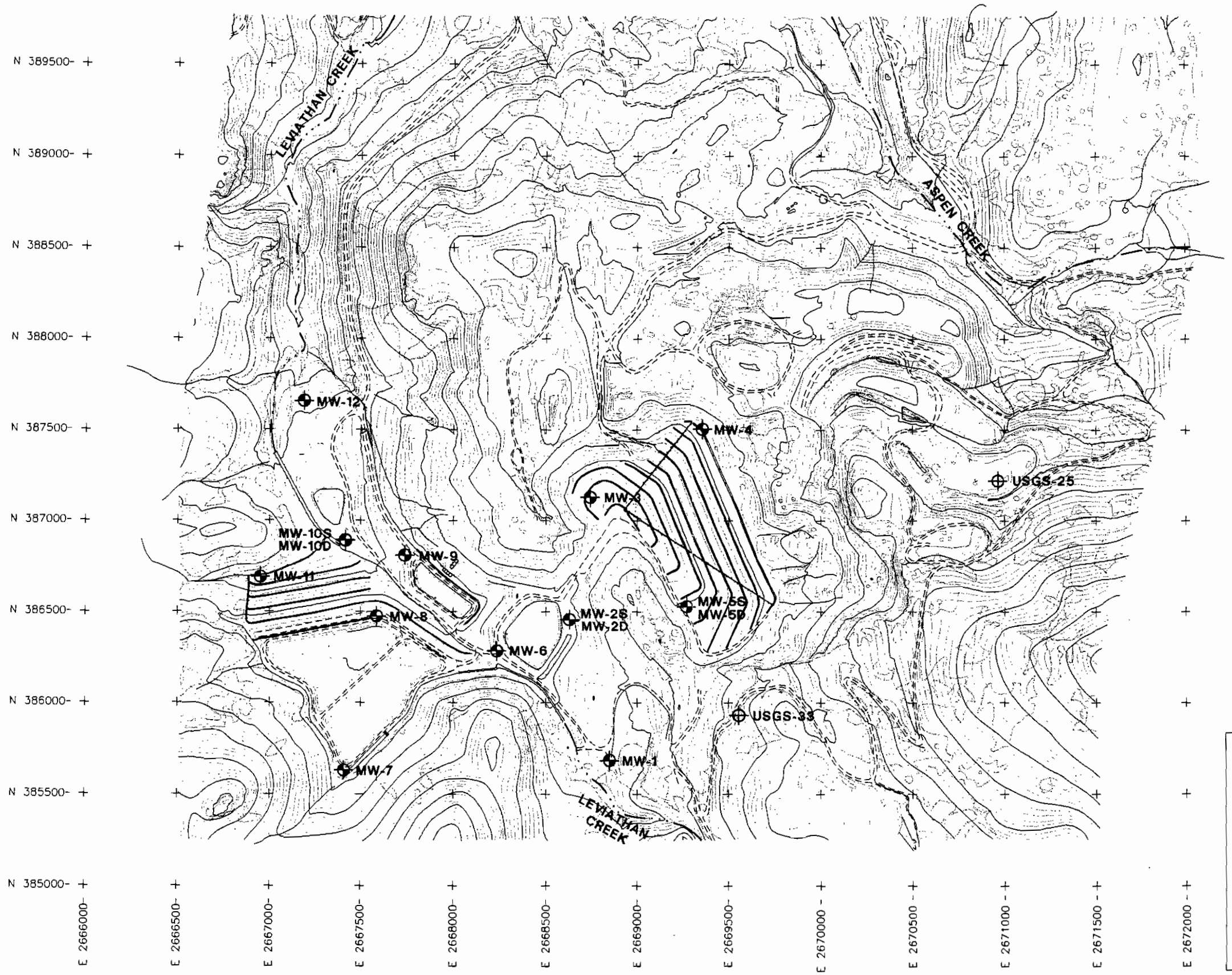
SCALE 1"=600'

PROJECT No. 19333-1601

DRAWING NAME 19333-1601-FIG2.1.DWG

REVISION A



LEGEND:

- MONITOR WELL LOCATION AND DESIGNATION
- USGS PIEZOMETER LOCATION

NOTES:

- S SHALLOW WELL
- D DEEP WELL

600 300 0 600 1200

SCALE 1" = 600'

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TITLE:
GROUND WATER MONITORING WELL LOCATIONS

PREPARED BY:
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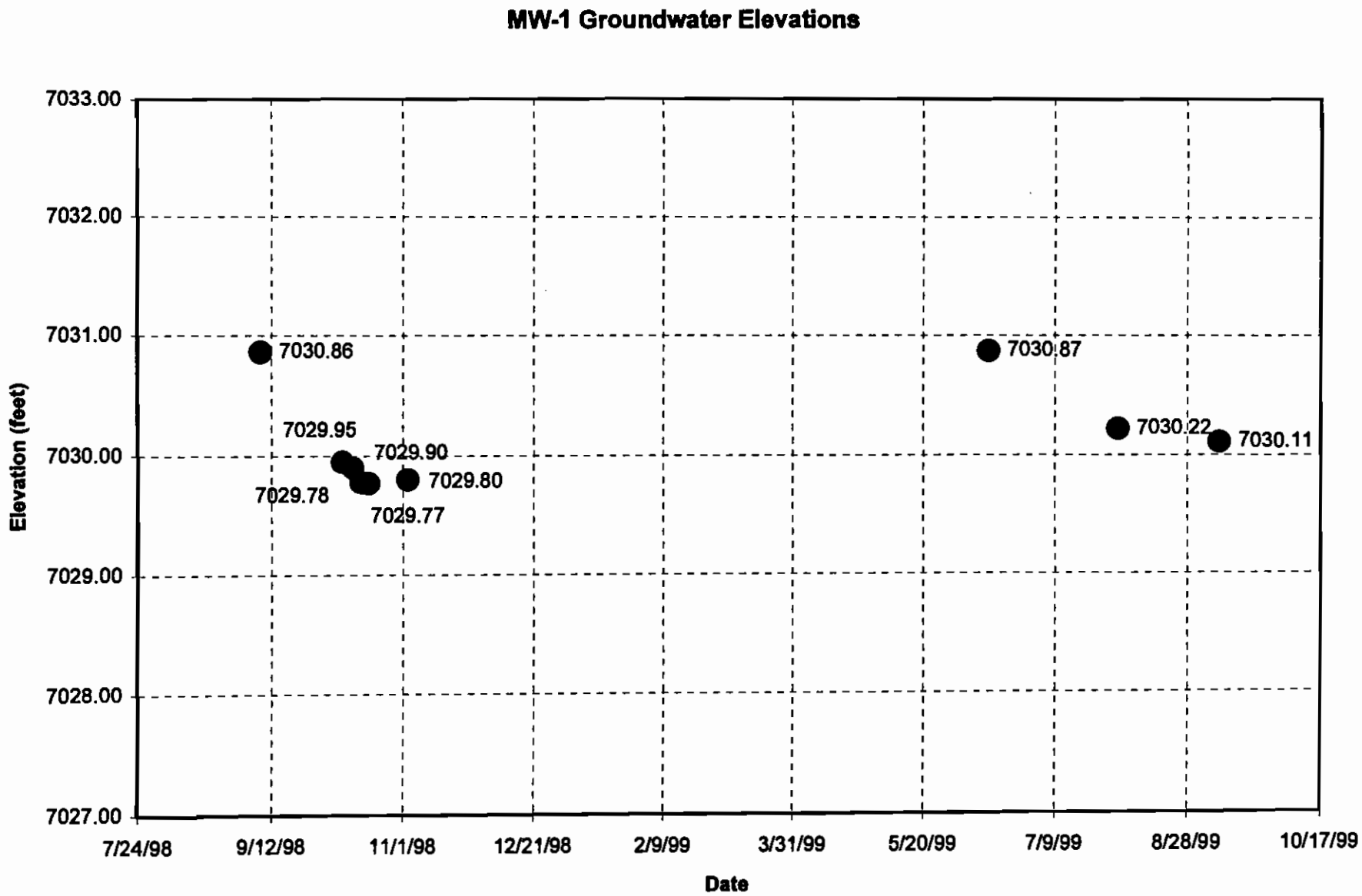
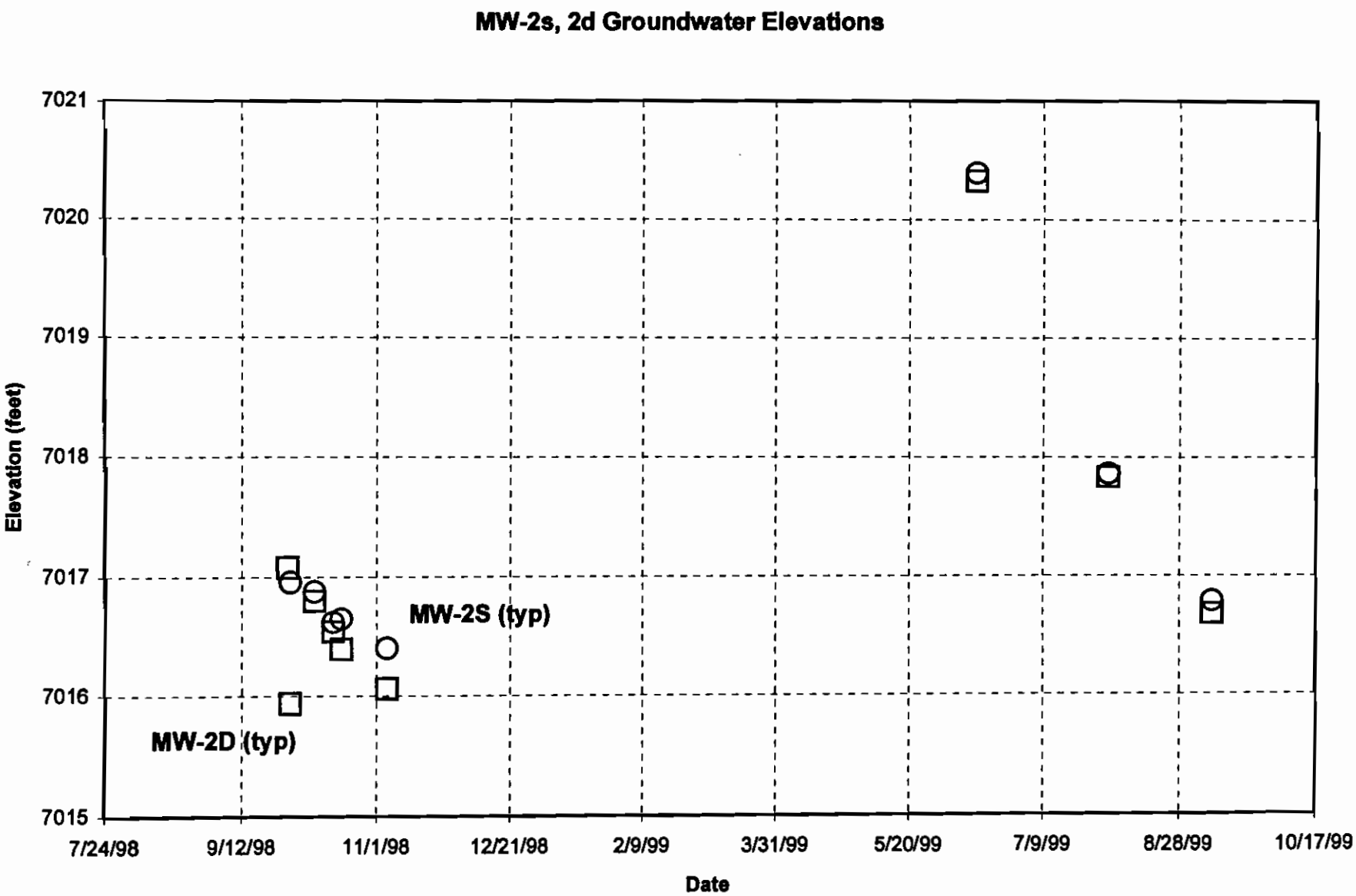
DRAWING No. FIGURE 3.1
SHEET No OF
SCALE 1"=600'
PROJECT No 19333-1601
DRAWING NAME 19333-1601-FIG3.1.DWG
REVISION A



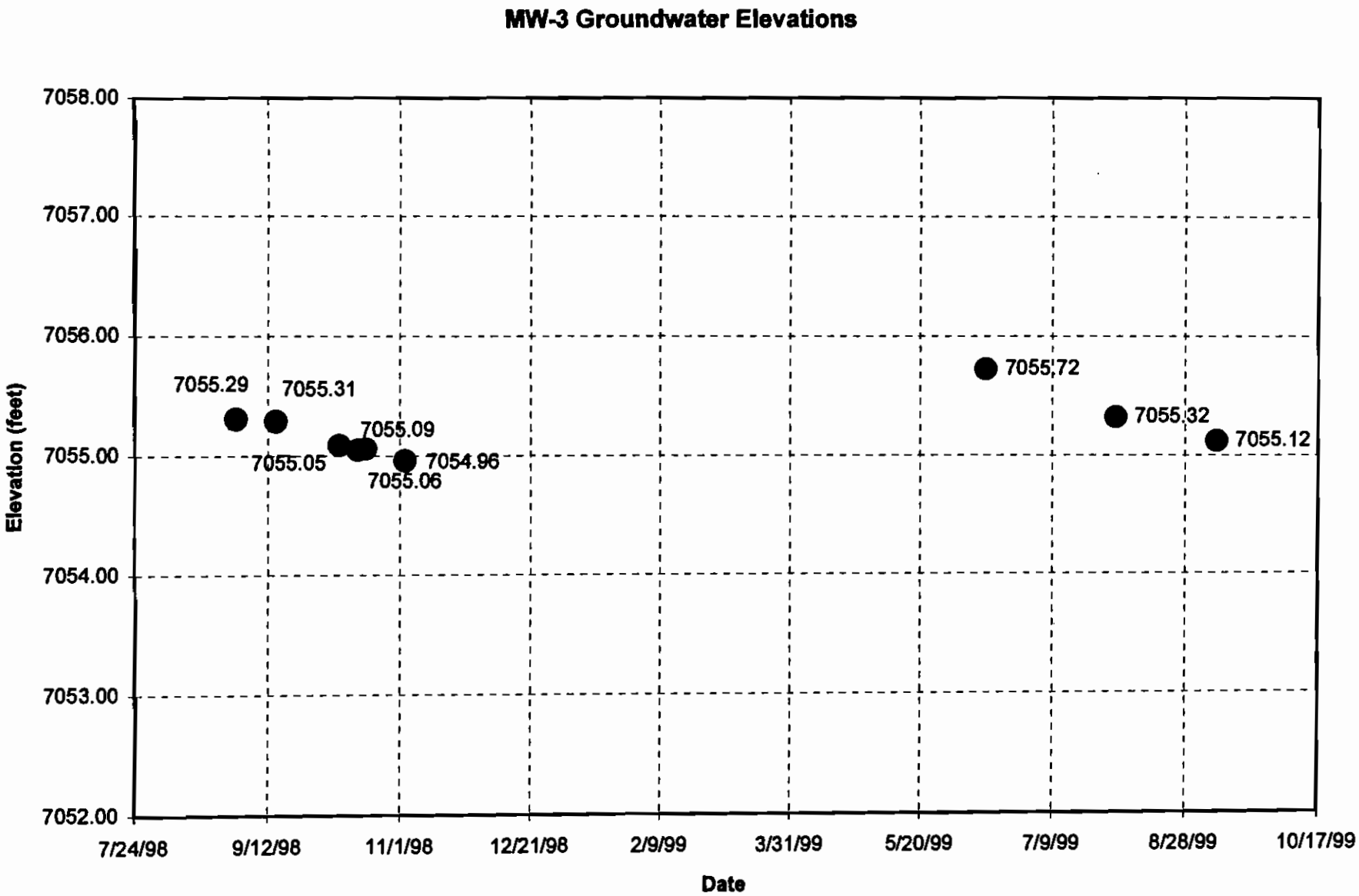
MW-1
98-99 GW Levels

MW-1 Groundwater Elevations
Figure 3.2



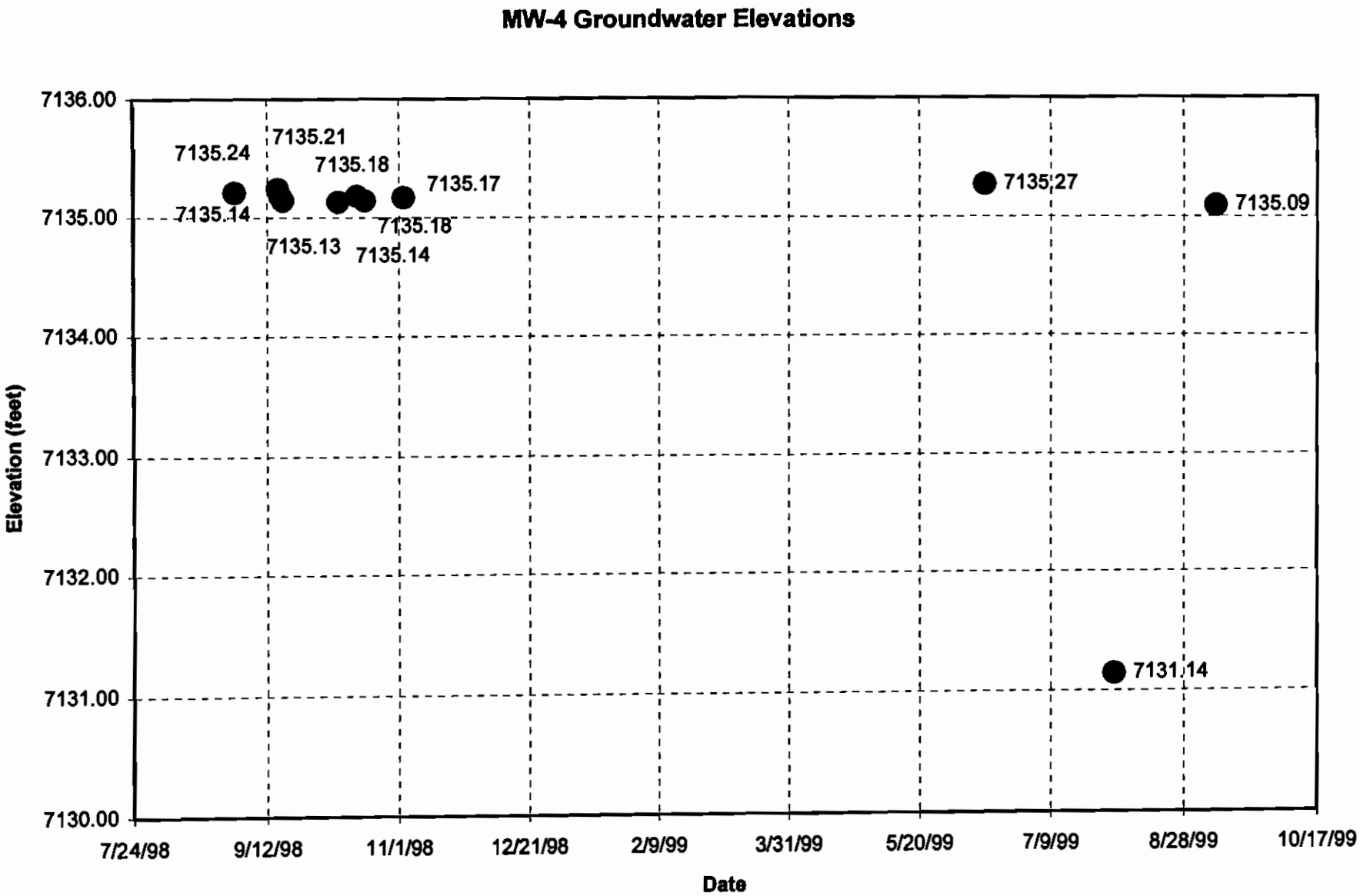
MW-2s, 2d
98-99 GW Levels

MW-2 Groundwater Elevations
Figure 3.3



MW-3
98-99 GW Levels

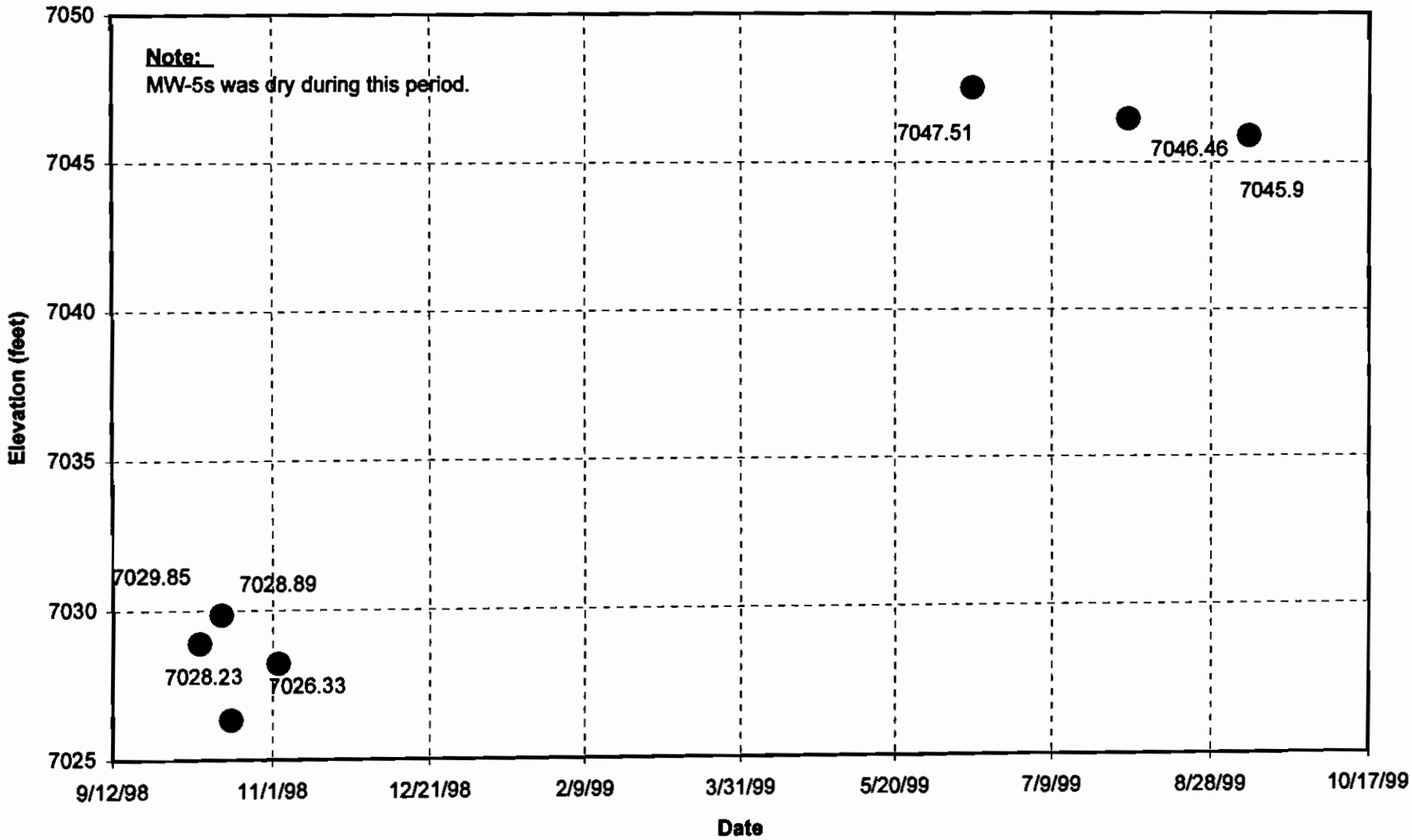
MW-3 Groundwater Elevations
Figure 3.4



MW-4
98-99 GW Levels

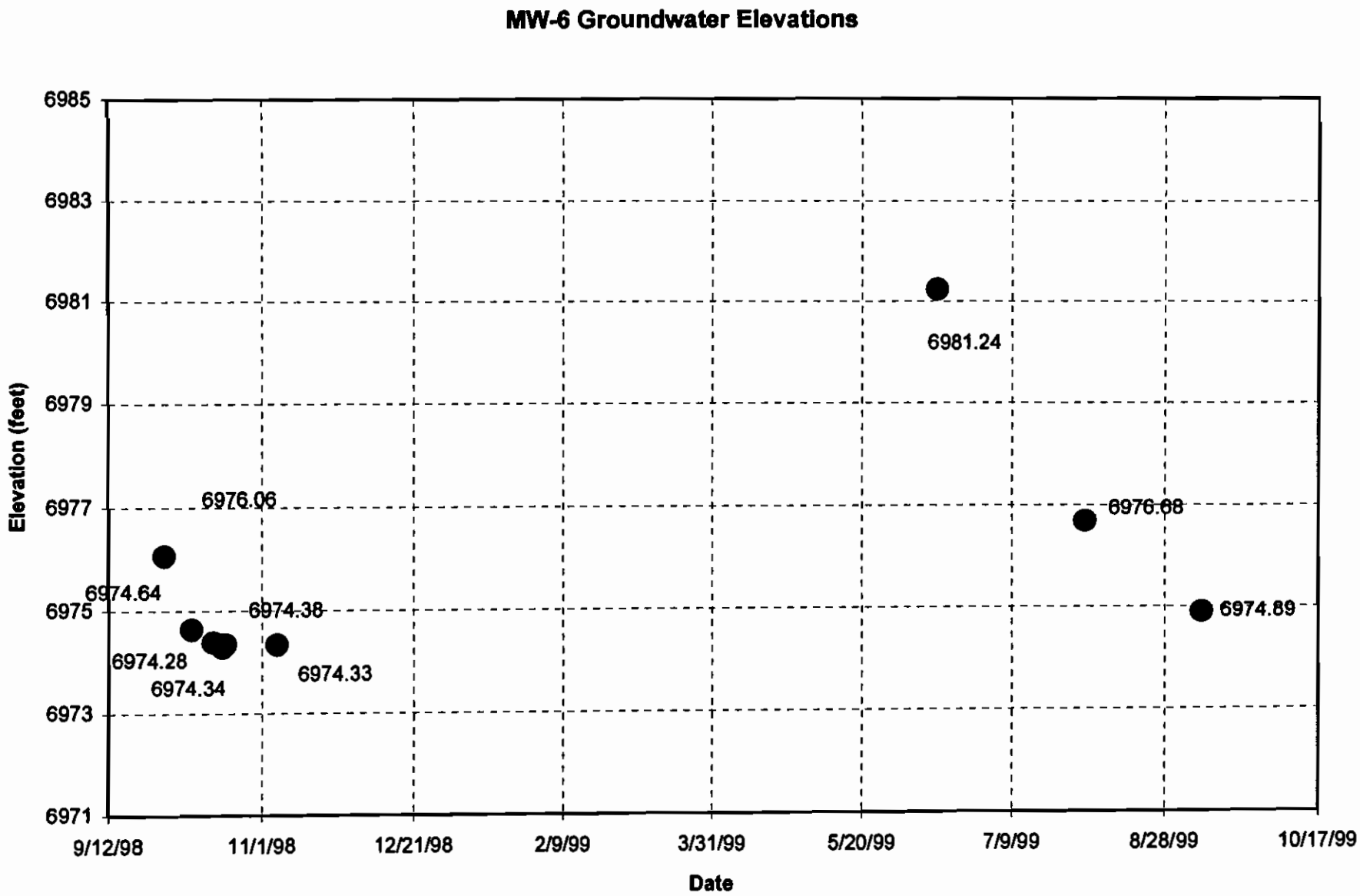
MW-4 Groundwater Elevations
Figure 3.5

MW-5d Groundwater Elevations



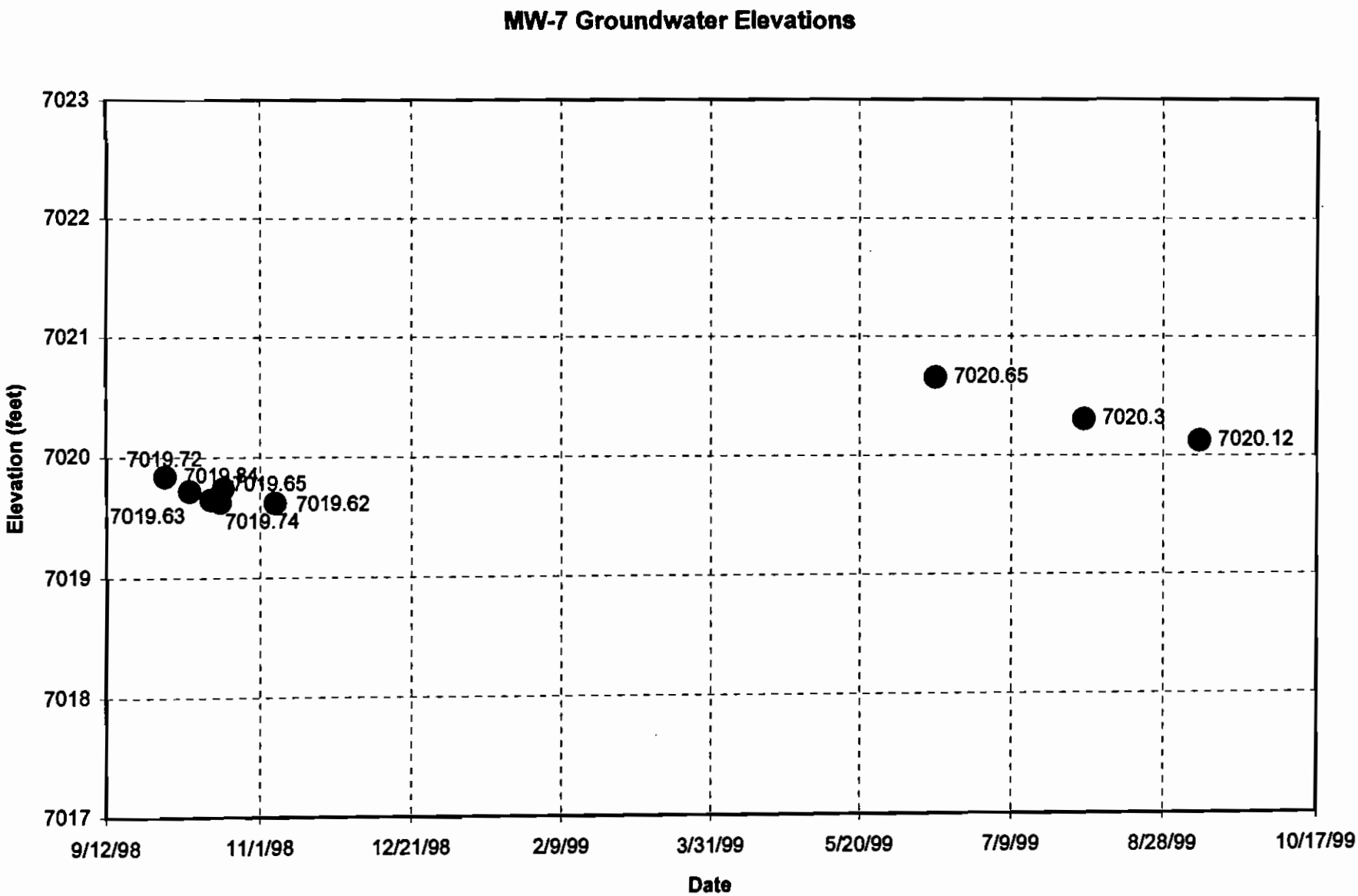
MW-5d
98-99 GW Levels

MW-5d Groundwater Elevations
Figure 3.6



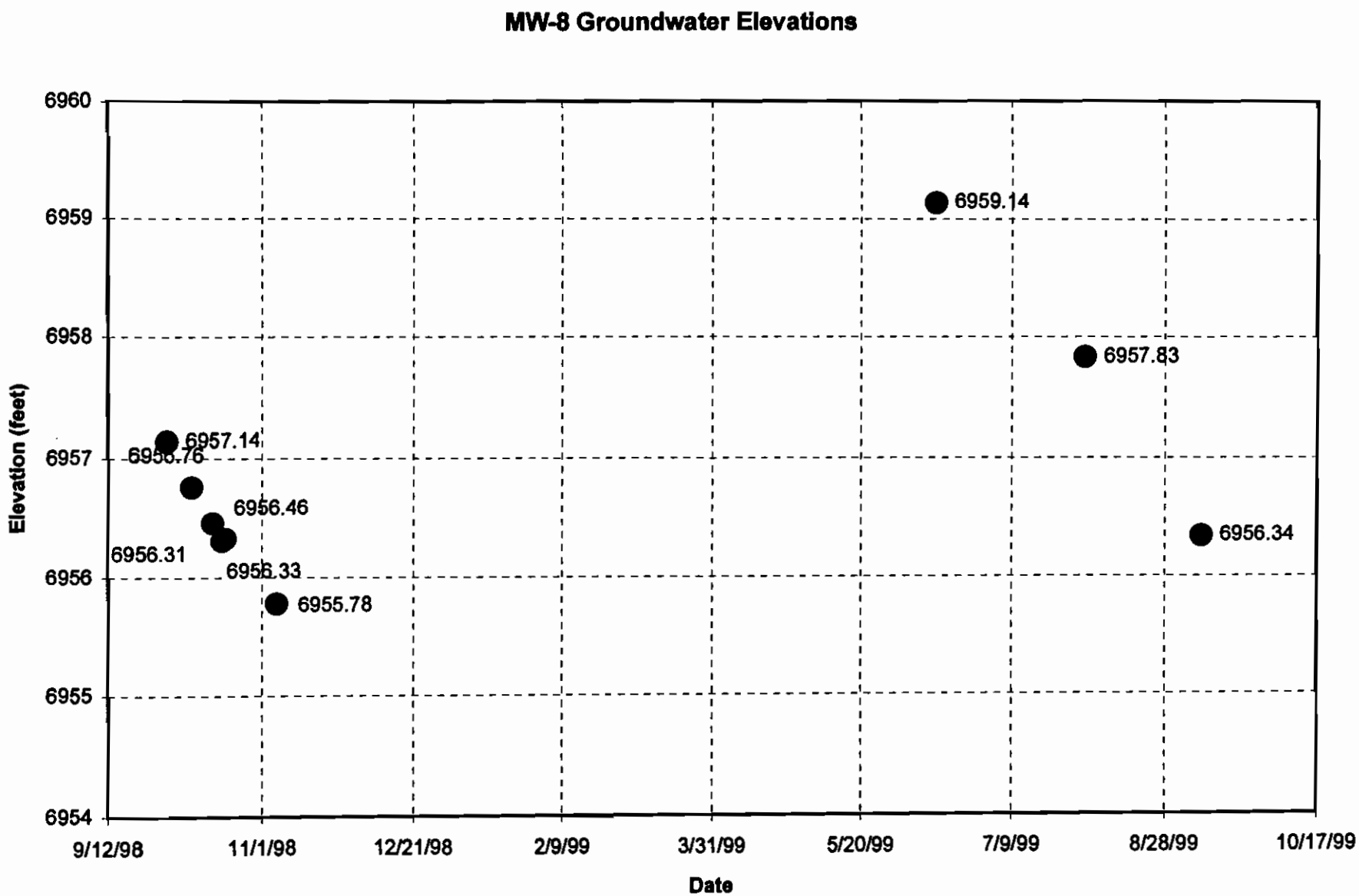
MW-6
98-99 GW Levels

MW-6 Groundwater Elevations
Figure 3.7



MW-7
98-99 GW Levels

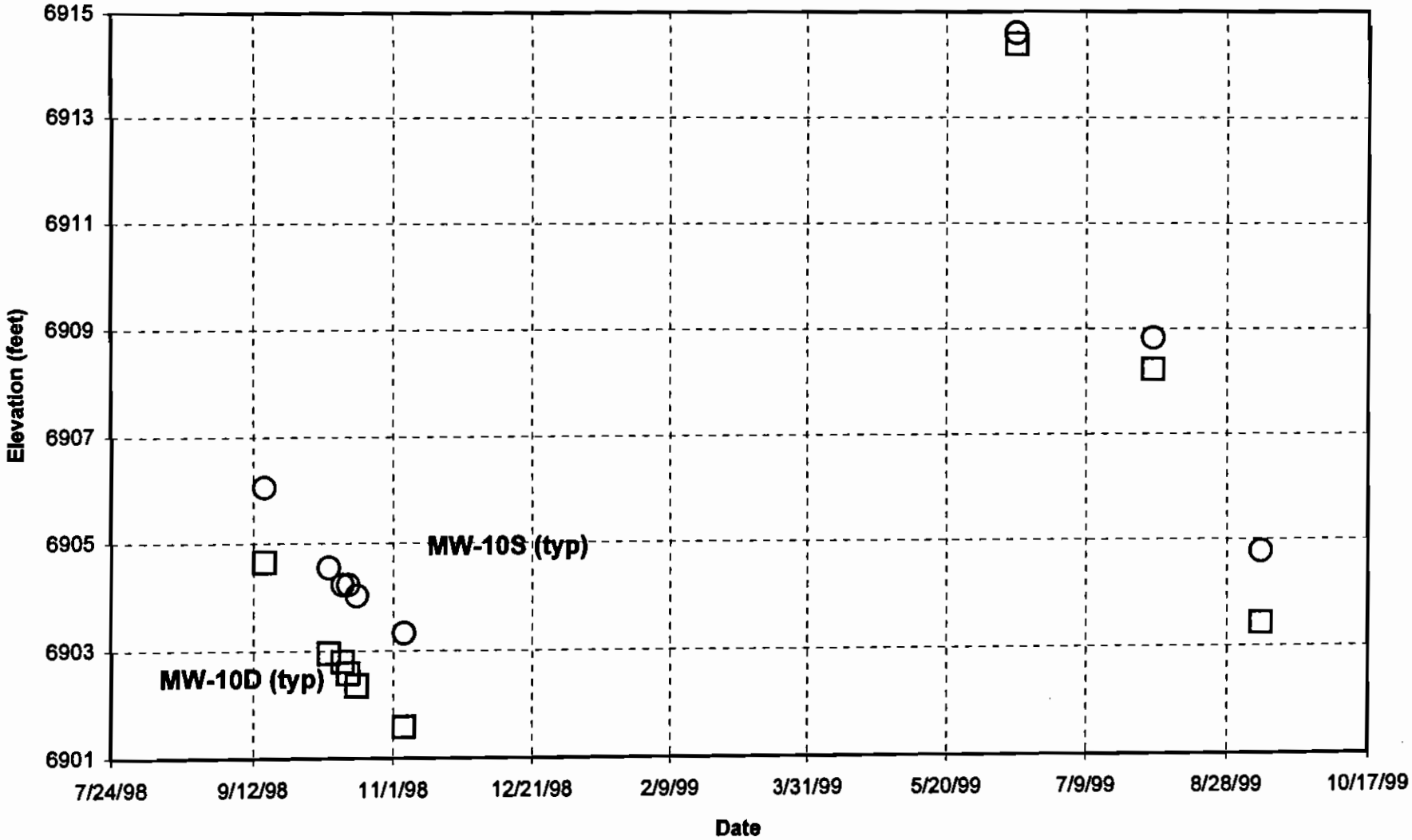
MW-7 Groundwater Elevations
Figure 3.8



MW-8
98-99 GW Levels

MW-8 Groundwater Elevations
Figure 3.9

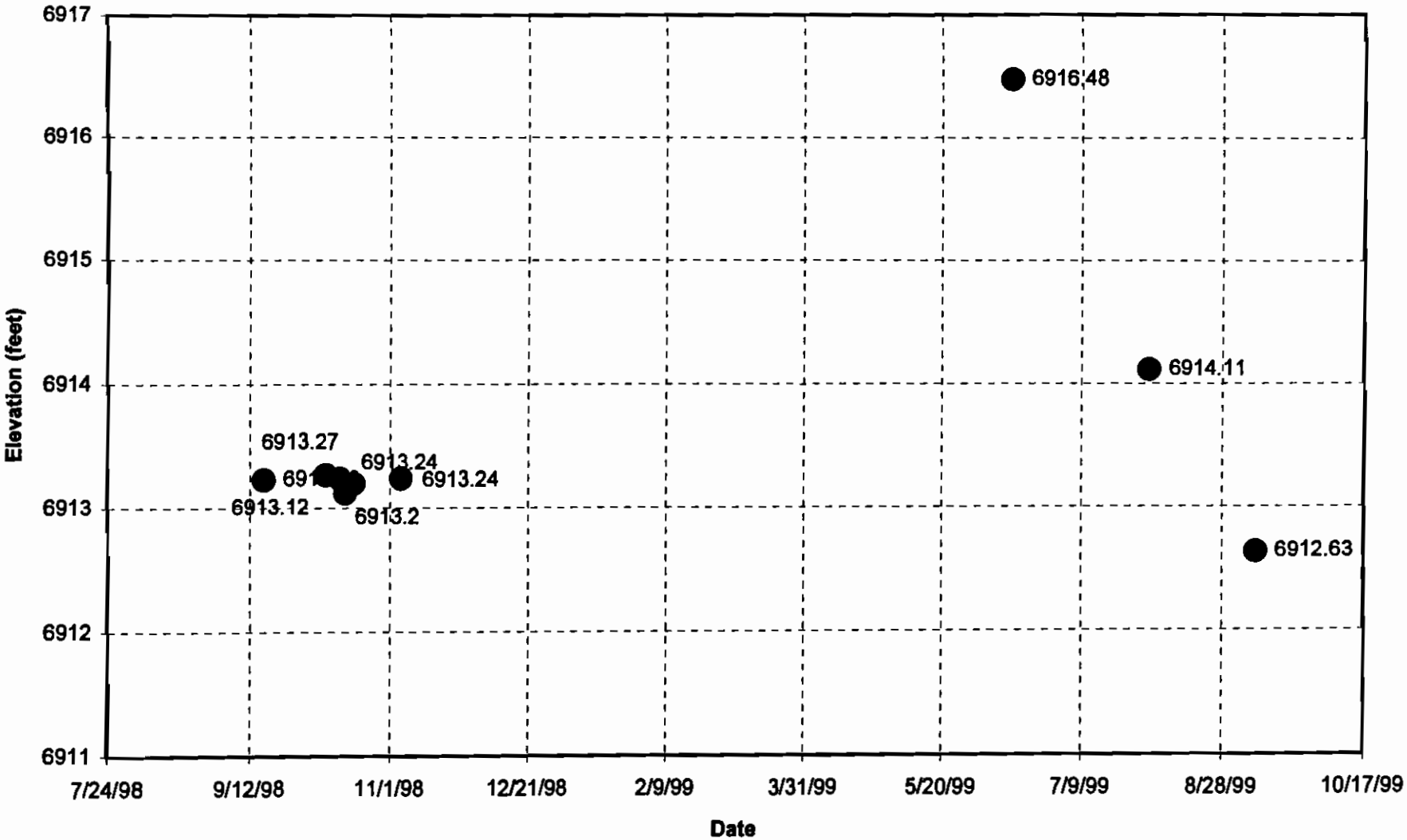
MW-10s, 10d Groundwater Elevations



MW-10s, 10d
98-99 GW Levels

MW-10s, 10d Groundwater Elevations
Figure 3.10

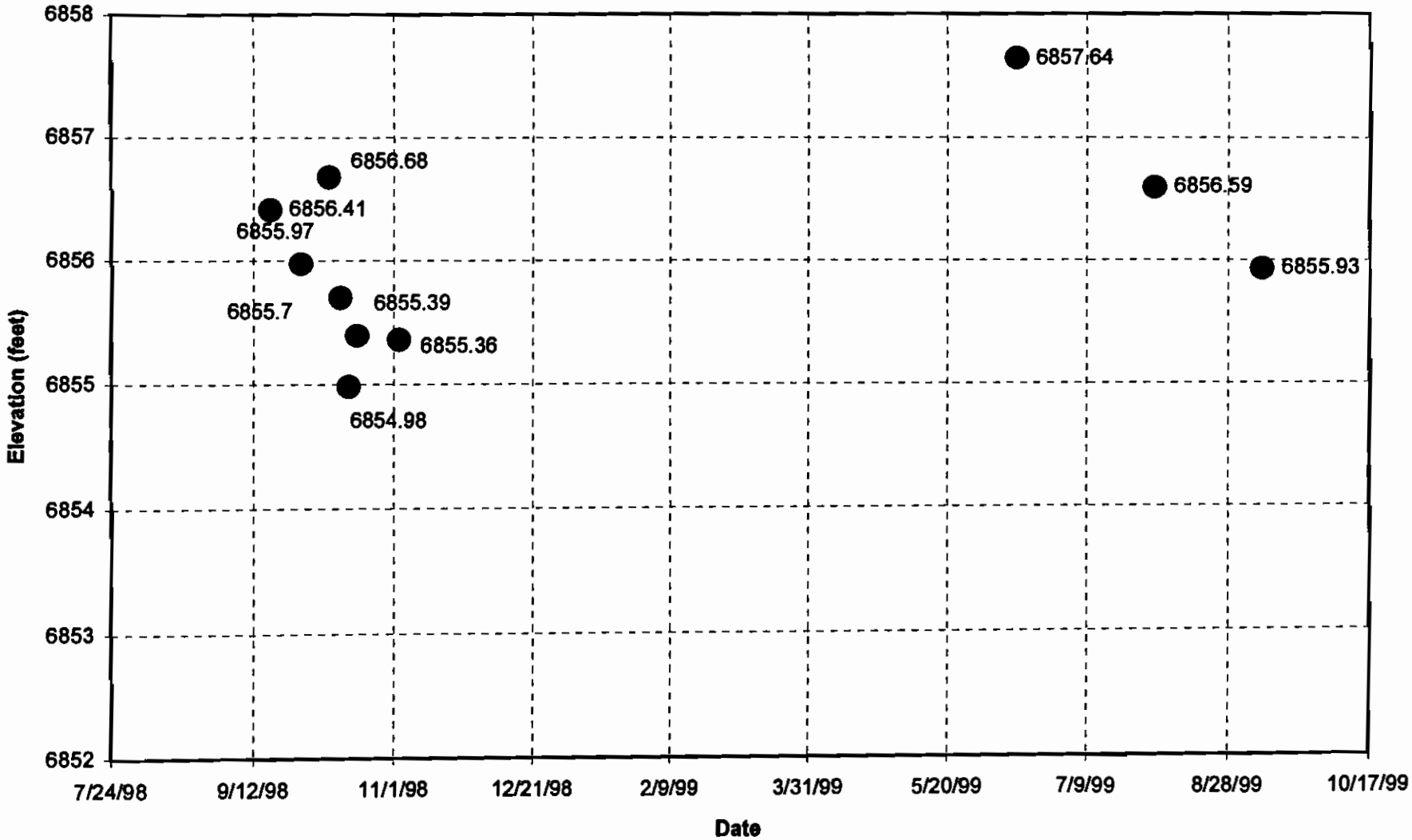
MW-11 Groundwater Elevations



MW-11
98-99 GW Levels

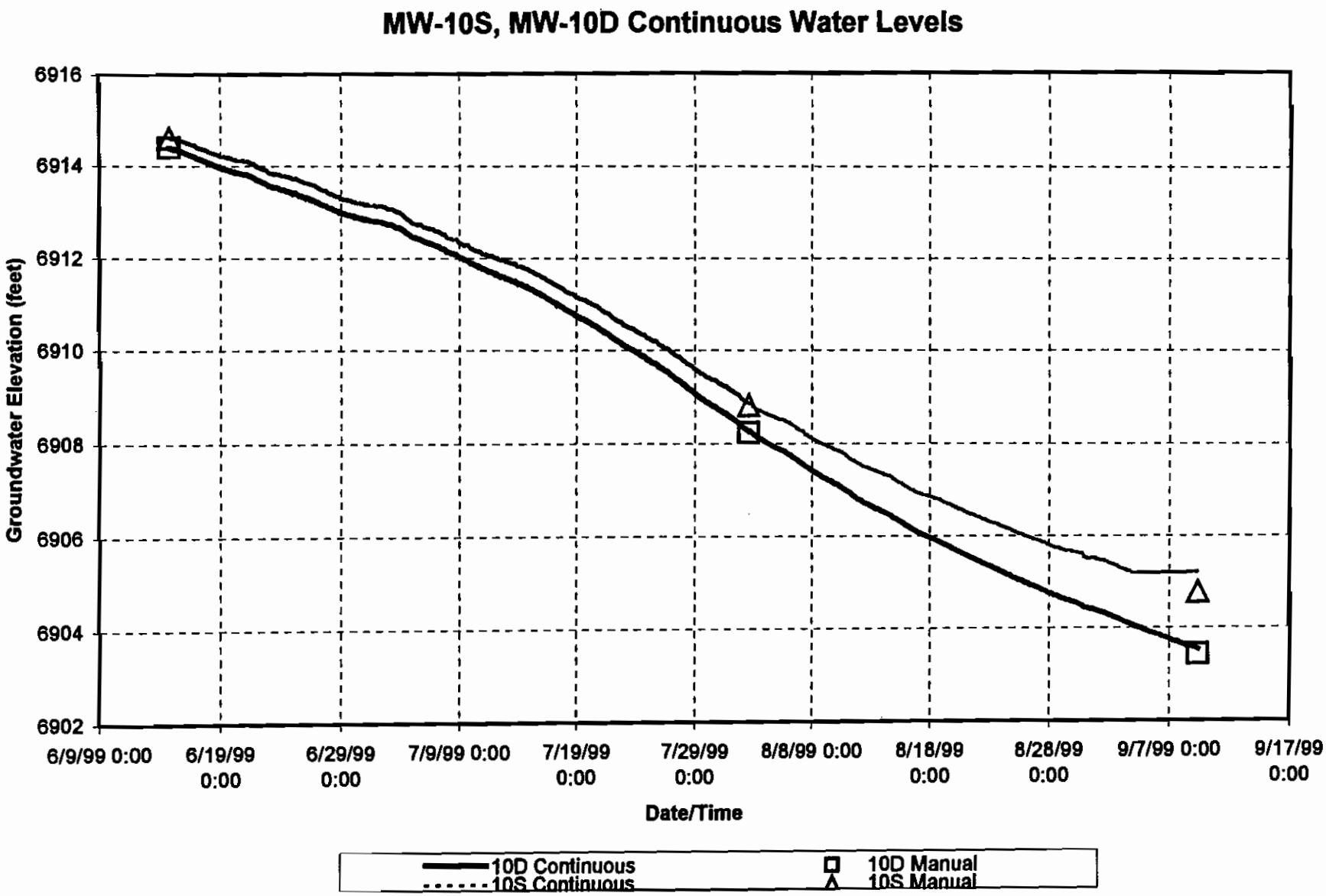
MW-11 Groundwater Elevations
Figure 3.11

MW-12 Groundwater Elevations



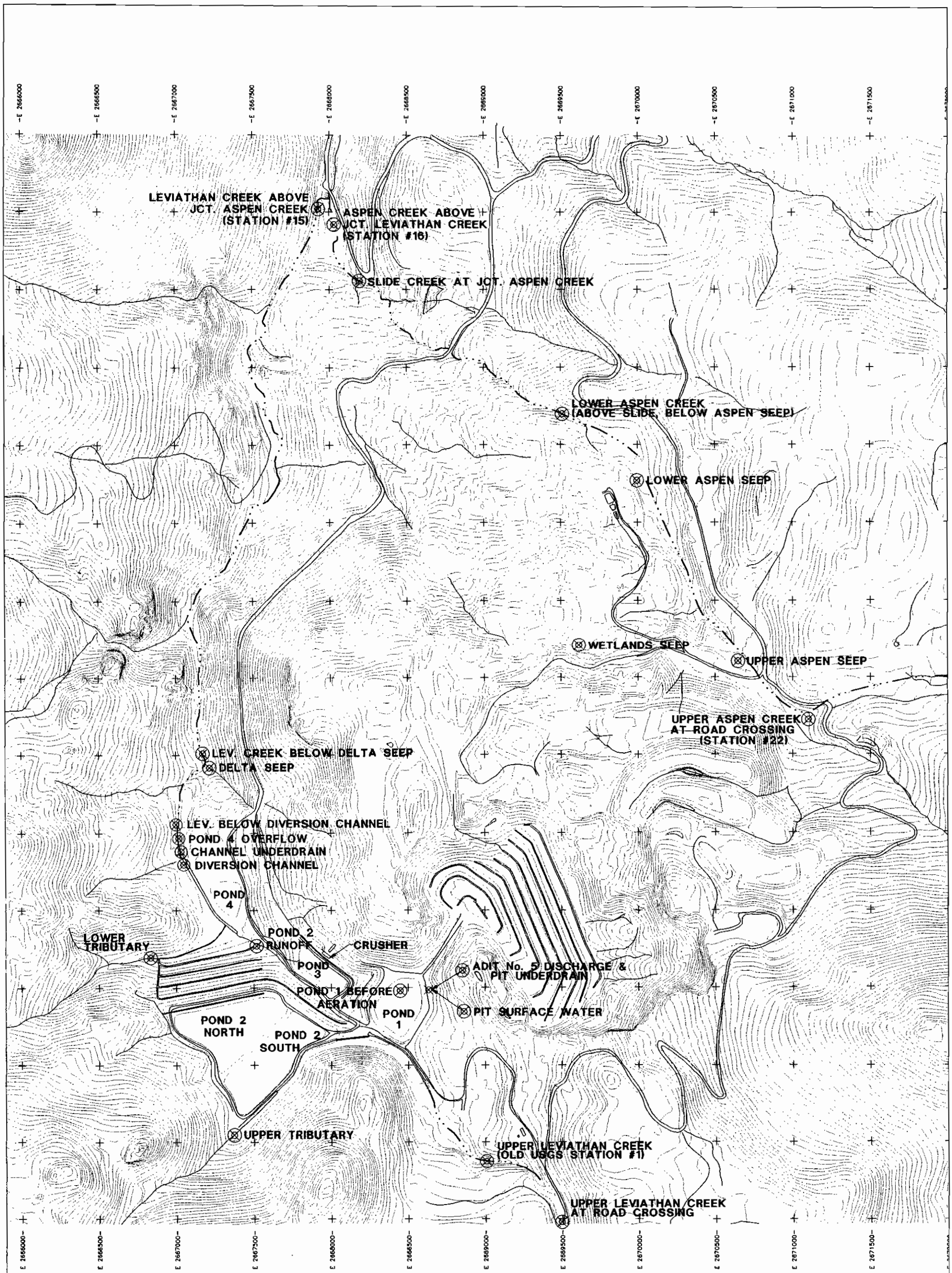
MW-12
98-99 GW Levels

MW-12 Groundwater Elevations
Figure 3.12



Plot
Continuous Water Level Data

MW-10S, MW-10D Continuous Water Levels
Figure 3.13



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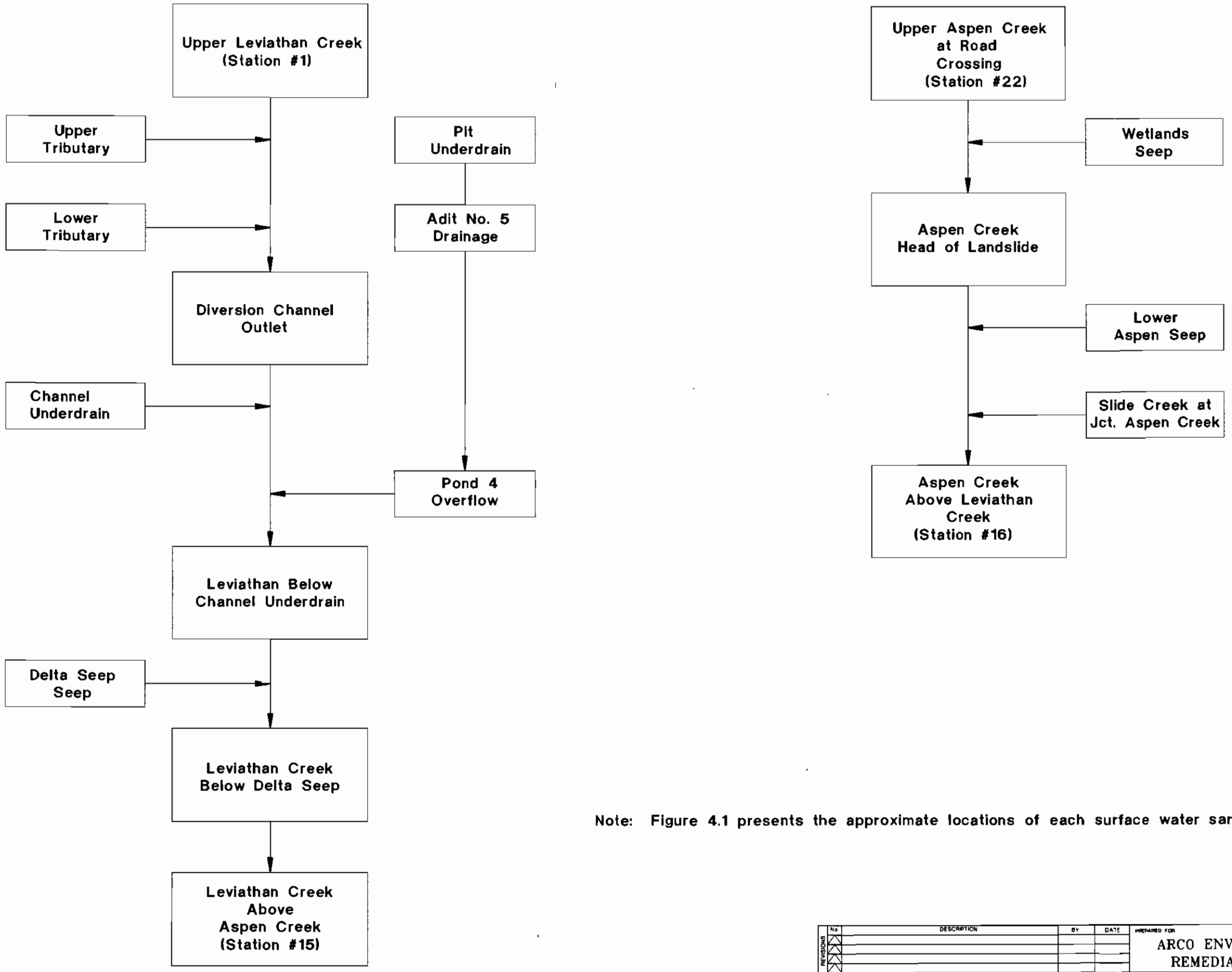
PREPARED FOR:
ARCO ENVIRONMENTAL REMEDIATION, LLC.

TITLE:
SURFACE WATER MONITORING STATIONS

PREPARED BY:
SRK Consulting
Engineers and Scientists

DRAWING No: FIGURE 4.1
SHEET No OF
SCALE: 1"=600'
PROJECT No.: 19333-1601
DRAWING NAME: 19333-1601_FIG4.2.DWG
A
REVISION



Note: Figure 4.1 presents the approximate locations of each surface water sampling station.

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REVISIONS			
REFERENCE	DESIGNED	TB	12/99
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TITLE: SURFACE WATER FLOW SCHEMATIC

PREPARED BY: SRK Consulting Engineers and Scientists

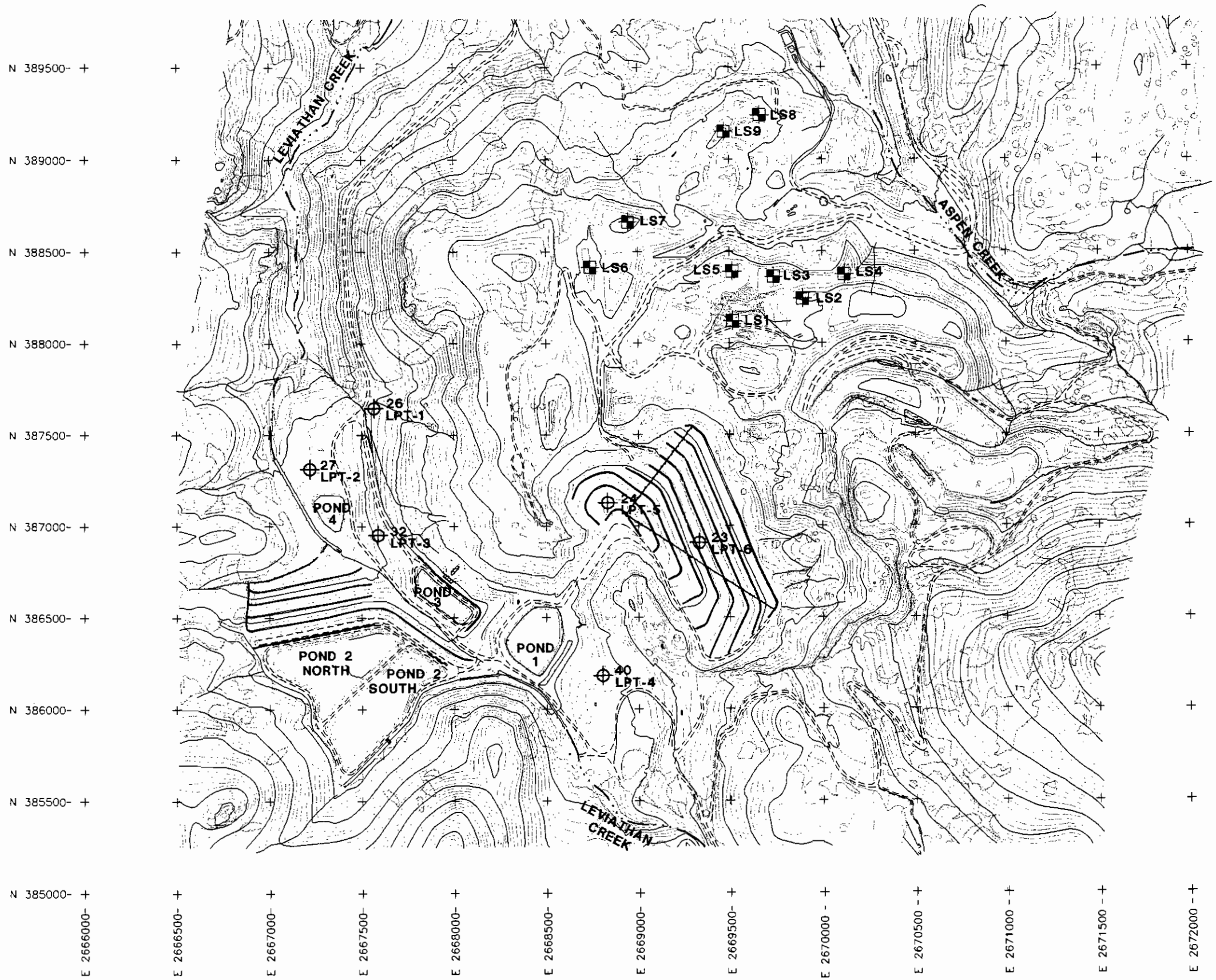
DRAWING No. FIGURE 4.2 | SHEET No OF

SCALE NTS

PROJECT No. 18333-1601

DRAWING NAME 18333-1601_FIG4.2.DWG

REVISION A



LEGEND:

40 LPT-4 TEST PIT LOCATION AND DESIGNATION

LS1 LANDSLIDE MONUMENT LOCATION AND DESIGNATION

REVISIONS No	DESCRIPTION	BY	DATE

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		CHECKED	
		APPROVED	
		APPROVED	

PREPARED FOR:
ARCO ENVIRONMENTAL REMEDIATION, LLC.

TITLE
TEST PIT AND LANDSLIDE MONUMENT LOCATIONS

PREPARED BY
SRK Consulting
Engineers and Scientists

DRAWING No. FIGURE 5.1
SHEET No. OF
SCALE: 1"=600'
PROJECT No. 19333-1801
DRAWING NAME 19333-1801-FIG5.1DWG
REVISION A

Appendix A
1998 Control Survey Information

SUMMIT ENGINEERING CORPORATION

FAX TRANSMITTAL

Summit Engineering Corporation
5405 Mae Anne Avenue
Reno, Nevada 89523
(702) 747-8550

RENO FAX # (702) 747-8559 ELKO FAX # (702) 738-8567 LAS VEGAS FAX # (702)252-5247

DATE: 5-12-99

DESTINATION NUMBER: 828-6810

TO: JEFF PARSHLEY
SRK

FROM: RYAN COOK

SUBJECT: LEVIATHAN MINE CONTROL

JEFF,

THE FOLLOWING IS A BRIEF DESCRIPTION OF HOW SUMMIT ENGINEERING DETERMINED THE COORDINATE SYSTEM USED OF THE TOPOGRAPHIC SURVEY OF LEVIATHAN MINE DURING THE FALL 1998.

OUR GPS SURVEY INCLUDED MANY BOUNDARY CORNERS & ORIGINAL PHOTO CONTROL PANELS (mid 1980's Mapping). ONCE WE REDUCED THE GPS DATA, WE INPUT THE

TOTAL NO. OF PAGES INCLUDING THIS

EQUALS

The information contained in this facsimile message is privileged and confidential information intended only for the use of the individual or entity named above. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified

COORDINATES GIVEN TO US BY SRK OF THE EXISTING PANELS, THE FOLLOWING NOTE IS GIVEN ON THE ORIGINAL COORDINATE LISTING:

"Bearings, distances, & coordinates used to identify survey control points are based on the California state Coordinate System, Zone 2, using Monuments USC&GS "HIGH PEAK" AND CDH "LEVIATHAN." The bearing between said Monuments is S 30° 03' 36" E Elevations are based on the elevation 8520 at USC&GS "HIGH PEAK" as shown on USC&GS horizontal control data sheet for station 1032 of Quad 381194. This elevation is given as 8520 feet, Sea Level Datum, 1929."

ALL GPS'ed STATIONS WERE THEN MOVED (COORDINATE WISE) TO BEST MATCH THE

ORIGINAL PANEL COORIDINATES
AS WE TOLD PETER
KRAATZ (SRK), THE RESIDUALS
OF THIS "BEST FIT" WERE
NEARLY 2.0 FOOT IN NORTHING
& 1.0 FOOT IN EASTING.

The grid to ground
factor we used is:

1.0004084773

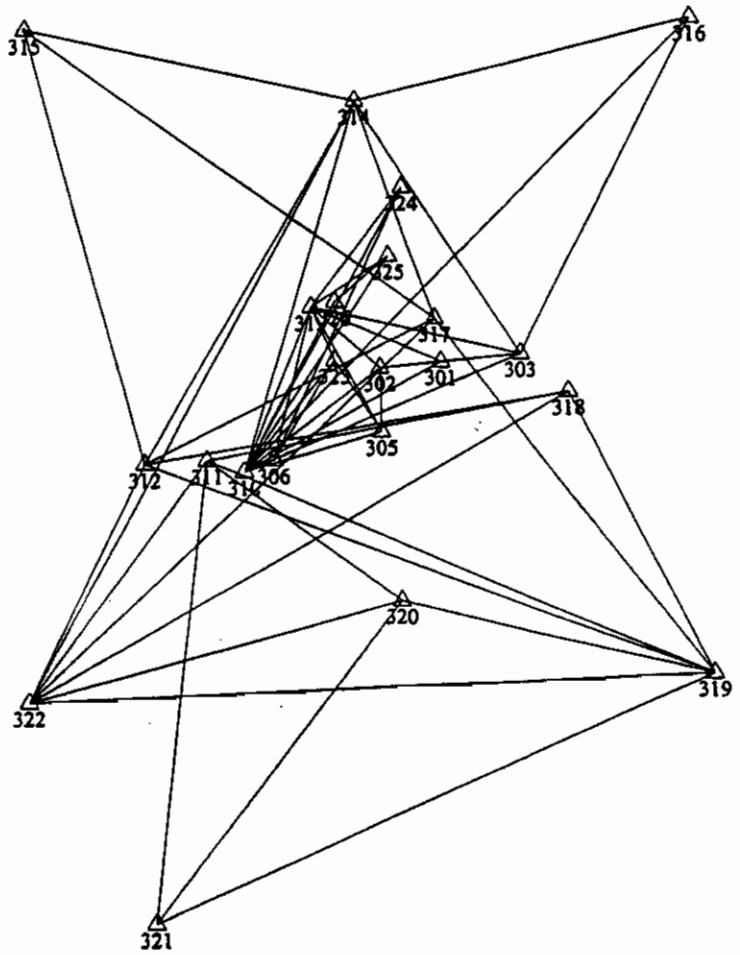
SUMMIT MANAGEMENT CORPORATION

Ryan Cook
Surveys
5405 Mae Anne Avenue • Reno, Nevada 89523
(702) 747-8550 FAX (702) 747-8559
LAS VEGAS (702) 252-3236 ELKO (702) 738-8058

Ryan Cook

5-12-99

Network Map: LEVIATHAN



500m

Elev AVG = 7200

MAP PROJECTION TRANSFORMATION

Scale AVG = 0.99993600714

ojection: 1927 State Plane Lambert
Zone = California Zone 2
Central Meridian = W 122°00'00.000000"
Latitude of Origin = N 37°40'00.000000"
Origin Northing = 0.0000 Easting = 2000000.0000
North Standard Parallel = N 39°50'00.000000"
South Standard Parallel = N 38°20'00.000000"
Scale along Standard Parallels = 1.000000000000

Linear units = US Survey Foot

POINT	NAME	GEODETIC	MAP	SCALE & CONVERGE
1 301		N 38°42'36.934788"	388713.6764	0.99993590
		W 119°39'07.235679"	2669927.3054	+ 1°28'49.2
2 302		N 38°42'36.171234"	388617.8667	[illegible]
		W 119°39'16.321329"	2669209.3717	+ [illegible]
3 303		N 38°42'37.909570"	388836.4461	[illegible]
		W 119°38'55.428608"	2670860.3199	+ 1°28'56.6
4 305		N 38°42'28.795277"	387872.4151	0.99993615
		W 119°39'16.102045"	2669246.0030	+ 1°28'43.6
5 306		N 38°42'25.535651"	387509.9135	0.99993626
		W 119°39'32.185210"	2667980.0600	+ 1°28'33.4
6 310		N 38°42'24.194608"	387365.4223	0.99993630
		W 119°39'36.534018"	2667638.9465	+ 1°28'30.7
7 311		N 38°42'25.502189"	387486.4813	0.99993626
		W 119°39'42.010139"	2667201.6051	+ [illegible]
8 312		N 38°42'25.078020"	387424.7732	0.99993627
		W 119°39'51.240400"	2666471.2876	+ 1°28'21.4
9 313		N 38°42'43.308971"	389318.5234	0.99993570
		W 119°39'26.669282"	2668370.8091	+ 1°28'36.9
10 314		N 38°43'07.415168"	391769.6636	0.99993495
		W 119°39'20.123358"	2668826.5797	+ 1°28'41.0
11 315		N 38°43'15.616606"	392498.5905	0.99993470
		W 119°40'09.405323"	2664900.7637	+ 1°28'10.0
12 316		N 38°43'16.869592"	392827.4960	0.99993466
		W 119°38'30.498293"	2672733.4731	+ 1°29'12.3
13 317		N 38°42'41.998100"	389223.8258	0.99993574
		W 119°39'08.154936"	2669841.2348	+ 1°28'48.6
14 318		N 38°42'33.484164"	388403.4059	0.99993601
		W 119°38'48.369097"	2671431.2880	+ 1°29'01.0
15 319		N 38°42'00.502102"	385111.0552	0.99993706

	W 119°38'27.454704"	2673175.1152	+	[illegible]
16 320	N 38°42'09.047818"	385881.4785		[illegible]
	W 119°39'13.149149"	2669531.5621	+	[illegible]
17 321	N 38°41'31.393114"	381999.3260		[illegible]
	W 119°39'49.523806"	2666746.9084	+	[illegible]
18 322	N 38°41'57.161518"	384567.0168		[illegible]
	W 119°40'08.274261"	2665193.9229	+	[illegible]
19 323	N 38°42'37.079065"	388695.7127		[illegible]
	W 119°39'23.148412"	2668666.0387	+	[illegible]
20 324	N 38°42'57.317610"	390763.0001		[illegible]
	W 119°39'13.052521"	2669413.1610	+	[illegible]
21 325	N 38°42'49.235860"	389941.5481		[illegible]
	W 119°39'15.094537"	2669272.4698	+	1928'44.2[illegible]
22 326	N 38°42'43.930492"	389388.5765		[illegible]
	W 119°39'23.145119"	2668648.4282	+	[illegible]

$$GRNG \rightarrow GRID = \frac{20906000}{7200 + 20906000} * \left(\text{Scale}_{AVG}\right) = 0.9995917490[illegible]$$

$$GRID \rightarrow GRND = 1.00040841773$$

1	301	388713.523640 2669927.022881	7134.3950 0.0000	
	302	388618.242655 2669209.877961	7152.2189 0.0000	
3	303	388836.296910 2670860.009478	7229.7149 0.0000	
4	305	387872.773220 2669246.515059	7297.9107 0.0000	
5	306	387510.270107 2667980.609299	7213.6631 0.0000	
6	310	387365.233351 2667638.711112	7081.2281 0.0000	
7	311	387486.240584 2667201.445290	6947.6200 0.0000	--H-
8	312	387424.602678 2666471.090015	6967.8198 0.0000	
9	313	389318.916388 2668371.346346	7014.2261 0.0000	----
10	314	391769.575566 2668826.317620	6764.1029 0.0000	----
11	315	392498.527529 2664900.601928	7396.1109 0.0000	----
12	316	392827.416299 2672733.107623	7538.1221 0.0000	----
13	317	389223.688792 2669840.954426	7083.3445 0.0000	----
14	318	388403.222746 2671430.990711	7191.0759 0.0000	----
15	319	385110.793223 2673174.784639	7773.1310 0.0000	----
16	320	385881.207668 2669531.352979	7321.9520 0.0000	----
17	321	381999.001400 2666746.754717	7610.9889 0.0000	----
18	322	384566.788041 2665193.767197	7570.4284 0.0000	----
19	323	388696.090143 2668666.569336	7178.8059 0.0000	----
20	324	390763.431987 2669413.670809	6982.1676 0.0000	----

21	325	389941.943274	7006.9913	---- YX
		2669272.989313	0.0000	
[illegible]	326	389388.427322	6990.0376	---- YX
		2668648.164862	0.0000	

SYSTEM PARAMETERS

Network status = reduced computed adjusted
Datum = NAD-27
Coordinate System = 1927 State Plane Lambert
Zone = California Zone 2
Linear units = US Survey Foot

COORDINATE ADJUSTMENT SUMMARY
NETWORK = LEVIATHAN
TIME = Mon Nov 2 10:58:54 1998

Datum = NAD-27
Coordinate System = 1927 State Plane Lambert
Zone = California Zone 2

Network Adjustment Constraints:
Inner constraints in y
Inner constraints in x
1 fixed coordinates in H

POINT	NAME		OLD COORDS	ADJUST	NEW COORDS	1.000
1	301					
		Y=	388713.5236	+0.0000	388713.5236	0.003888
		X=	2669927.0229	+0.0000	2669927.0229	0.003054
		ELL HT=	7134.3950	+0.0000	7134.3950	0.018177
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2	302					
		Y=	388618.2427	+0.0000	388618.2427	0.004214f
		X=	2669209.8780	+0.0000	2669209.8780	0.003252f
		ELL HT=	7152.2189	+0.0000	7152.2189	0.018399f
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3	303					
		Y=	388836.2969	+0.0000	388836.2969	0.003066f
		X=	2670860.0095	+0.0000	2670860.0095	0.002180f
		ELL HT=	7229.7149	+0.0000	7229.7149	0.016478f
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4	305					
		Y=	387872.7732	+0.0000	387872.7732	0.004765f
		X=	2669246.5151	+0.0000	2669246.5151	0.003404f
		ELL HT=	7297.9107	+0.0000	7297.9107	0.018416f
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5	306					
		Y=	387510.2701	+0.0000	387510.2701	0.003756f
		X=	2667980.6093	+0.0000	2667980.6093	0.002954f
		ELL HT=	7213.6631	+0.0000	7213.6631	0.018109f
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
6	310					
		Y=	387365.2334	+0.0000	387365.2334	0.002922f
		X=	2667638.7111	+0.0000	2667638.7111	0.002083f
		ELL HT=	7081.2281	+0.0000	7081.2281	0.016898f
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
7	311					
		Y=	387486.2406	+0.0000	387486.2406	0.006295f
		X=	2667201.4453	+0.0000	2667201.4453	0.004264f
		ELL HT=	6947.6200	+0.0000	6947.6200	FIXED
		ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

8 312				
Y=	387424.6027	+0.0000	387424.6027	[illegible]
X=	2666471.0900	+0.0000	2666471.0900	[illegible]
ELL HT=	6967.8198	+0.0000	6967.8198	[illegible]
ORTHO HT=	0.0000	+0.0000	0.0000	NOT [illegible]
9 313				
Y=	389318.9164	+0.0000	389318.9164	[illegible]
X=	2668371.3463	+0.0000	2668371.3463	[illegible]
ELL HT=	7014.2261	+0.0000	7014.2261	[illegible]
ORTHO HT=	0.0000	+0.0000	0.0000	[illegible]
10 314				
Y=	391769.5756	+0.0000	391769.5756	[illegible]
X=	2668826.3176	+0.0000	2668826.3176	[illegible]
ELL HT=	6764.1029	+0.0000	6764.1029	[illegible]
ORTHO HT=	0.0000	+0.0000	0.0000	[illegible]
11 315				
Y=	392498.5275	+0.0000	392498.5275	[illegible]
X=	2664900.6019	+0.0000	2664900.6019	[illegible]
ELL HT=	7396.1109	+0.0000	7396.1109	[illegible]
ORTHO HT=	0.0000	+0.0000	0.0000	[illegible]
12 316				
Y=	392827.4163	+0.0000	392827.4163	0.003923f
X=	2672733.1076	+0.0000	2672733.1076	0.002867f
ELL HT=	7538.1221	+0.0000	7538.1221	0.017194f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT [illegible]
13 317				
Y=	389223.6888	+0.0000	389223.6888	0.003664f
X=	2669840.9544	+0.0000	2669840.9544	0.002633f
ELL HT=	7083.3445	+0.0000	7083.3445	0.014602f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
14 318				
Y=	388403.2227	+0.0000	388403.2227	0.009699f
X=	2671430.9907	+0.0000	2671430.9907	0.006383f
ELL HT=	7191.0759	+0.0000	7191.0759	0.019155f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
15 319				
Y=	385110.7932	+0.0000	385110.7932	0.005595f
X=	2673174.7846	+0.0000	2673174.7846	0.004091f
ELL HT=	7773.1310	+0.0000	7773.1310	0.008780f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
16 320				
Y=	385881.2077	+0.0000	385881.2077	0.008397f
X=	2669531.3530	+0.0000	2669531.3530	0.005954f
ELL HT=	7321.9520	+0.0000	7321.9520	0.013372f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
17 321				
Y=	381999.0014	+0.0000	381999.0014	0.008519
X=	2666746.7547	+0.0000	2666746.7547	0.006543f
ELL HT=	7610.9889	+0.0000	7610.9889	0.013393f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

18 322

Y=	384566.7880	+0.0000	384566.7880	0.004745f
X=	2665193.7672	+0.0000	2665193.7672	0.005171f
ELL HT=	7570.4284	+0.0000	7570.4284	0.011034f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

19 323

Y=	388696.0901	+0.0000	388696.0901	0.003427f
X=	2668666.5693	+0.0000	2668666.5693	0.002465f
ELL HT=	7178.8059	+0.0000	7178.8059	0.014283f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

20 324

Y=	390763.4320	+0.0000	390763.4320	0.004745f
X=	2669413.6708	+0.0000	2669413.6708	0.003348f
ELL HT=	6982.1676	+0.0000	6982.1676	0.016003f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

21 325

Y=	389941.9433	+0.0000	389941.9433	0.016535f
X=	2669272.9893	+0.0000	2669272.9893	0.034[illegible]
ELL HT=	7006.9913	+0.0000	7006.9913	0.037[illegible]
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

22 326

Y=	389388.4273	+0.0000	389388.4273	0.006347f
X=	2668648.1649	+0.0000	2668648.1649	0.004512f
ELL HT=	6990.0376	+0.0000	6990.0376	0.021293f
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
301	2	1.544 5.065	☐ METERS ☒ FEET	☐ SLOPE ☒ TRUE VERT.	☒ MICRO ST ☐ MINI DOME	4644-302

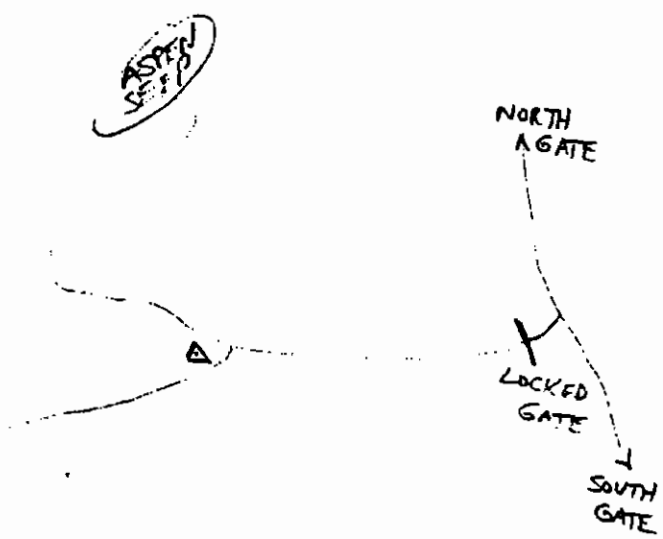
LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

START TIME	END TIME	PDOP	# SV'S
10:58	12:25	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap
HM = FLUSH



MONUMENT LOCATION

Conventional CP# 1

Set T-post
4' South

STATIC GPS OBSERVATION FORM

PAGE _____ OF _____

8:51 AM • 10-MAR-1995

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
302	5	2.2	☒ METERS O FEET	O SLOPE ☒ TRUE VERT	O MICRO ST ☒ MINI DOME	0302

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 42' 35.97"	119° 39' 16.03"	

START TIME	END TIME	PDOP	# SV'S
11:54	1:18	2.5	6

☒ QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

SUMMit rebar
& cap
set T-post
4' North
HM= FLUSH

MONUMENT LOCATION

Conventional CP #2
North side of dirt
road overlooking
Aspen Seep area
See Photo

STATIC GPS OBSERVATION FORM

PAGE _____ OF _____

8:51 AM • 10-MAR-1995

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
3406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	R.G.

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
303	5	2.2	☒ METERS O FEET	O SLOPE ☒ TRUE VERT.	O MICRO ST ☒ MINI DOME	0303

LATITUDE	LONGITUDE	PROCESS WITH
38° 42' 38.46"	119° 38' 57.28"	

START TIME	END TIME	PDOP	# SV'S
8:13	11:43	2.6	8

☒ QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM = FLUSH

set T-post 5' South

MONUMENT LOCATION

Conventional CP 3

Panelled as East

Center Panel

on West slope of

Knoll North of old

water tank, site

~6' lower than top

of Knoll

STATIC GPS OBSERVATION FORM

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8:51 AM • 10-MAR-1995

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SUMMIT ENGINEERING CORPORATION

CONSULTING ENGINEERS AND SURVEYORS

5405 MAE ANNE AVENUE

RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
305	2	1.572 5.160	☐ METERS ☒ FEET	☐ SLOPE ☒ TRUE VERT.	☒ MICRO ST ☐ MINI DOME	4644-3[illegible]

LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

START TIME	END TIME	PDOP	# SV'S
12:25	1:50	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap HM FLUSH

MONUMENT LOCATION

Conventional CP #5

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGO

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
306	2	1.615 5.295	☒METERS ☒FEET	○SLOPE ☒TRUE VERT.	☒MICRO ST ○MINI DOME	4644-3063

LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

START TIME	END TIME	PDOP	# SV'S
2:02	3:27	—	—

○ QUICK START SURVEY ○ CHANGE FILE NAME ○ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM = FLUSH

MONUMENT LOCATION

Convention CP #6

Panelled

Top of West facing slope overlooking ponds

STATIC GPS OBSERVATION FORM

PAGE ____ OF ____

8:51 AM • 10-MAR-1995

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SUMMIT ENGINEERING CORPORATION

CONSULTING ENGINEERS AND SURVEYORS

5405 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
310	3	1.531 5.025	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4642

LATITUDE	LONGITUDE	PROCESS WITH
—	—	

START TIME	END TIME	PDOP	# SV'S
7:28	5:16	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

7/8" rebar rough
weld cut top w/
no center punch
HM = 0.10'

MONUMENT LOCATION

ESE of Trailer
~750'
on West facing slope

~200' S from drainage

~400' W from Top of slope

STATIC GPS OBSERVATION FORM

PAGE _____ OF _____

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CONSULTING ENGINEERS AND SURVEYORS
5405 MAE ANNE AVENUE
RENO, NEVADA (702) 747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
Leviathan	23565	10-27-98	RG

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
311	4	2.2	☒ METERS ○ FEET	○ SLOPE ☒ TRUE VERT.	○ MICRO ST ☒ MINI DOME	031[illegible]

LATITUDE	LONGITUDE	PROCESS WITH
38°42'25.61"	119°39'42.75"	

START TIME	END TIME	PDOP	# SV'S
7:59	11:24	2.7	7

☒ QUICK START SURVEY ○ CHANGE FILE NAME ○ CHANGE ANTENNA HEIGHT

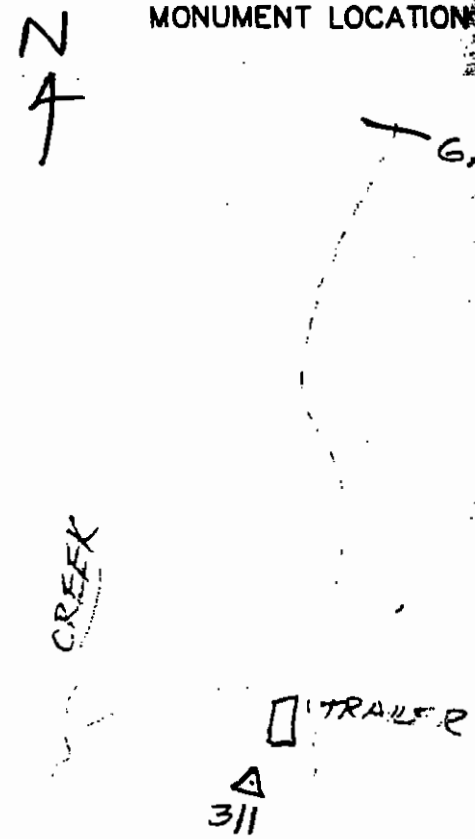
MONUMENT DESCRIPTION & SKETCH

3/4" I.P. w/ plastic plug

HM= FLUSH

FD "SURVEY RESTARTED AFTER POWER FAIL"

MONUMENT LOCATION



TBM ELEV = 6947.62

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702) 942-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
312	4	2.2	☒ METERS ○ FEET	○ SLOPE ☒ TRUE VERT	○ MICRO ST ☒ MINI DOME	0312 [illegible]

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 42' 25.45"	119° 39' 52.35"	

START TIME	END TIME	PDOP	# SVS
11:37	5:39	4.5	5

☒ QUICK START SURVEY ○ CHANGE FILE NAME ○ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

1" dia concrete stake
w/ center punch
HM = 0.10'
leaning Northerly

MONUMENT LOCATION

OLD PANEL POINT
RE-PANELED AS West
Center Panel

STATIC GPS OBSERVATION FORM

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8:51 AM • 10-MAR-1995

P:\DWGS\MISC\DON\GPSTATIC.DWG

SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
313	4	2.2	☒ METERS ☐ FEET	☐ SLOPE ☒ TRUE VERT.	☐ MICRO ST ☒ MINI DOME	0313-302

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 42' 42.08"	119° 39' 25.69"	

START TIME	END TIME	PDOP	# SV'S
11:25	4:40	3.3	6

☒ QUICK START SURVEY ☐ CHANGE FILE NAME ☐ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

7/8" concrete stake w/ center punch

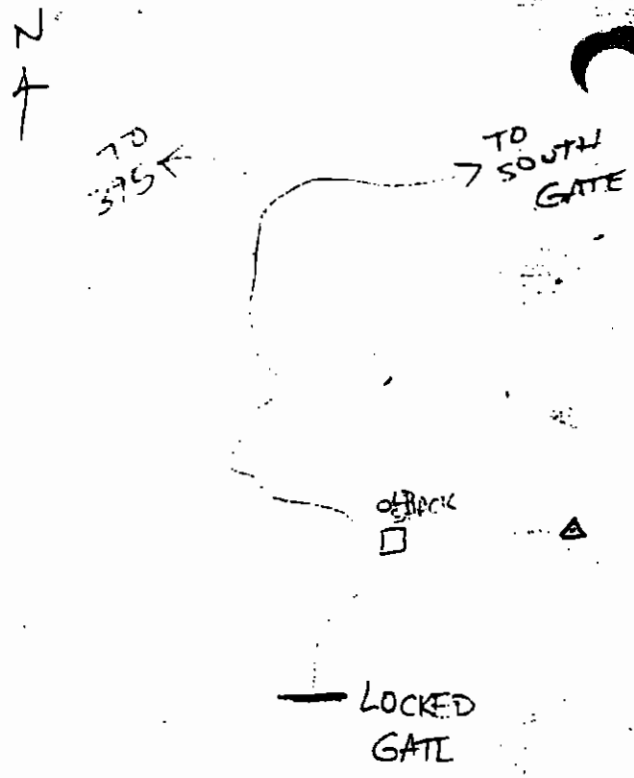
HM = 0.05'

~ 600' E of old shack → up drainage

~ 50' E of top of slope

MONUMENT LOCATION

OLD PANEL POINT



STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
314	5	2.2	☒ METERS ○ FEET	○ SLOPE ☒ TRUE VERT	○ MICRO ST ☒ MINI DOME	0314

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 43' 08.31"	119° 39' 18.13"	

START TIME	END TIME	PDOP	# SV'S
1:41	5:18	2.9	6

☒ QUICK START SURVEY ○ CHANGE FILE NAME ○ CHANGE ANTENNA HEIGHT

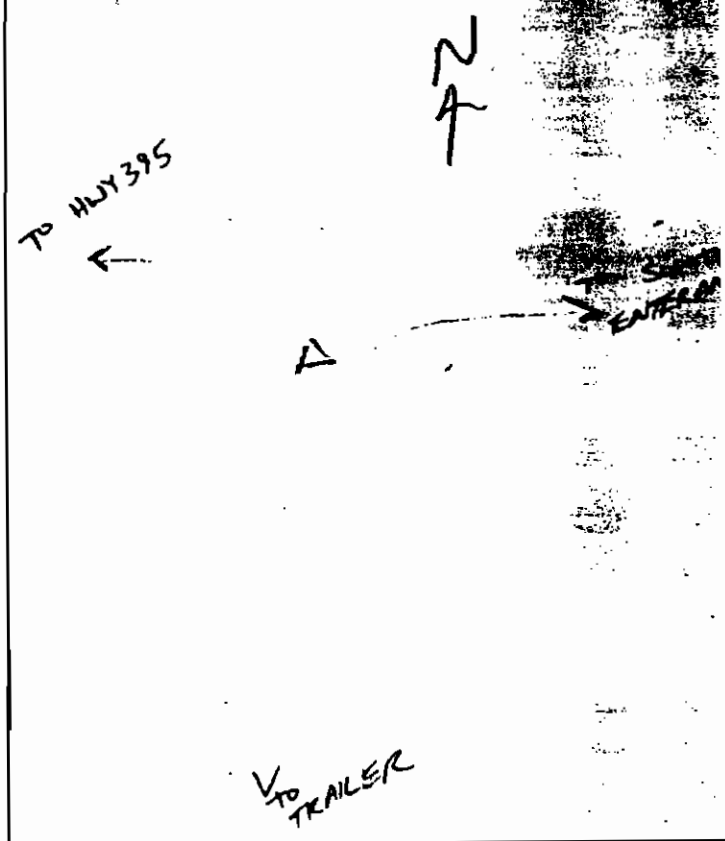
MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM = FLUSH

MONUMENT LOCATION

North Center Panel



STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702) 747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23.565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
314	4	2.2	☒ METERS O FEET	O SLOPE ☒ TRUE VERT.	O MICRO ST ☒ MINI DOME	034

LATITUDE	LONGITUDE	PROCESS WITH
38° 43' 08.70"	119° 39' 21.35"	

START TIME	END TIME	PDOP	# SV'S
7:49	11:13	3.7	8

☒ QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM = FLUSH

MONUMENT LOCATION

North Center Panel

See 10/27 GPS sheet

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5405 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-[illegible]-3	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
315	3	[illegible] 4.84	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	[illegible]

LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

START TIME	END TIME	PDOP	# SV'S
2:59	3:59	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HT = 0.20

Animal destroyed most of [illegible]

→ N

← 3.4' → 3.4'

MONUMENT LOCATION

NW [illegible]

BUILT [illegible]

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
316	2	1.343 4.405	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4644-302-0

LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

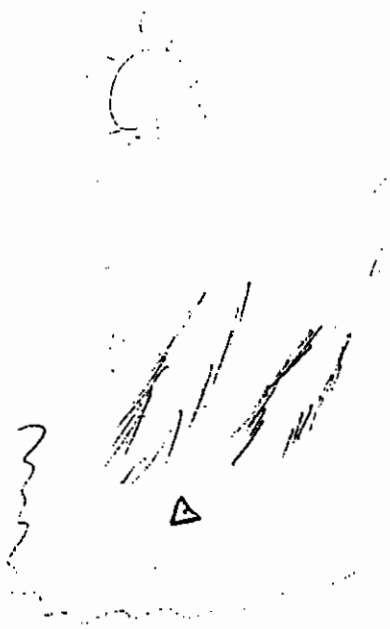
START TIME	END TIME	PDOP	# SV'S
9:19	10:20	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

SUMMIT REBAR

& CAP HM=0.25



MONUMENT LOCATION

NE Panel

on Ridge - See Phot

MADE 3' dia MUS

1 6' North

1 6' South

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5405 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVERS
LEVIATHAN	23565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
317	2	1.563 5.125	☒ METERS ☐ FEET	☐ SLOPE ☒ TRUE VERT.	☒ MICRO ST ☐ MINI DOME	4641

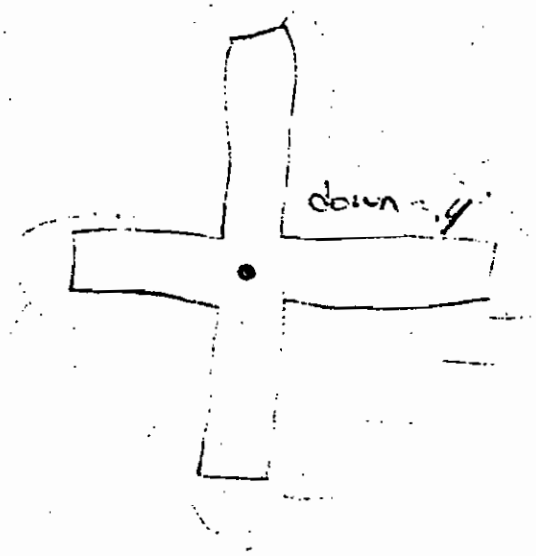
LATITUDE	LONGITUDE	PROCESS WITH
—	—	

START TIME	END TIME	PDOP	# SV'S
12:18	4:58	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

7/8" rebar rough weld cut top w/ No center punch



MONUMENT LOCATION

OLD PANEL
RE-PANELED
ON KNOLL
ABOVE EASTERLY
PONDS

STATIC GPS OBSERVATION FORM

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CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

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PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	Z3565	10-27-98	RGG

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
318	Z	1.245 4.085	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4644

LATITUDE	LONGITUDE	PROCESS WITH
—	—	

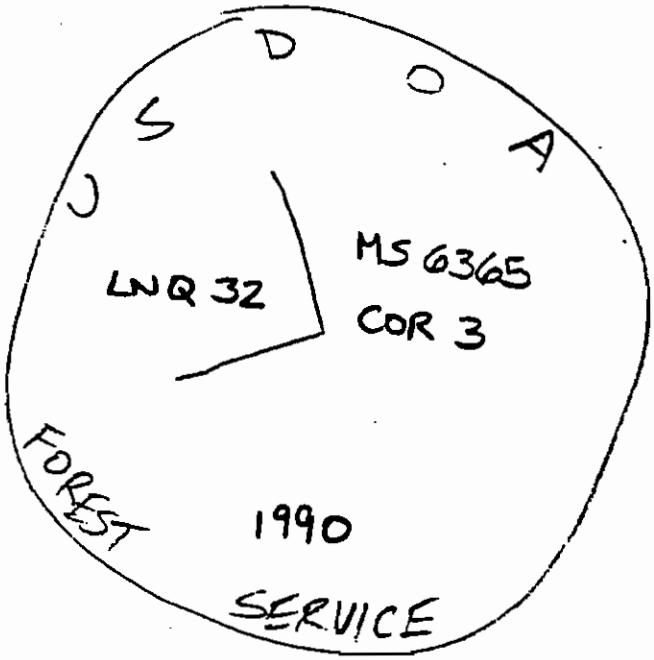
START TIME	END TIME	PDOP	# SV'S
11:04	12:07	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

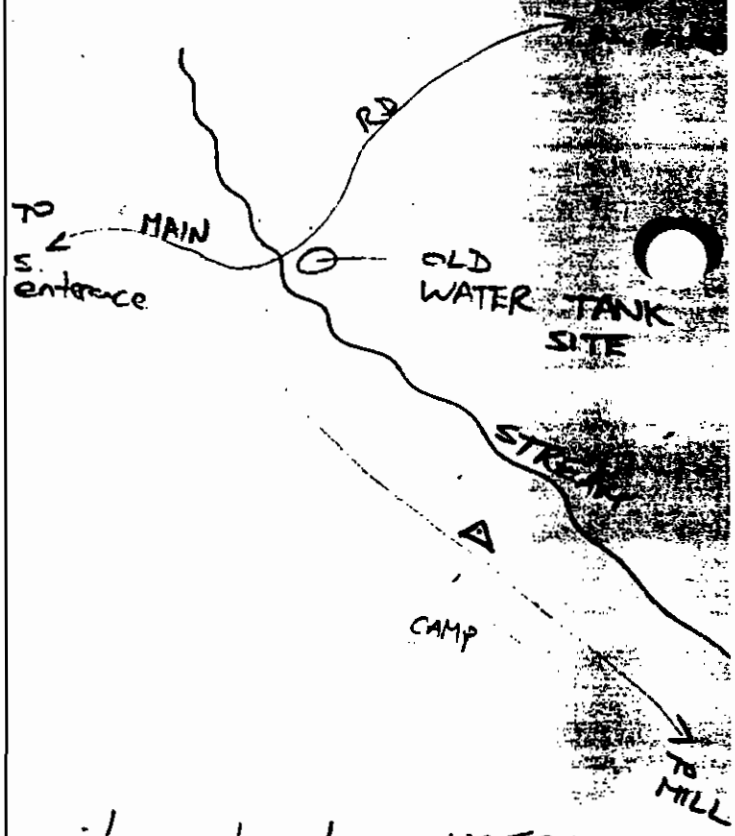
MONUMENT DESCRIPTION & SKETCH

3" USFS ALUM CAP
in 3' dia MOS

HM = 0.60'



MONUMENT LOCATION



witnessed by USFS
Mon sign 2' North

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	Z3565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
319	5	2.2	X METERS O FEET	O SLOPE X TRUE VERT	O MICRO ST X MINI DOME	0319

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 42' 00.90"	119° 38' 27.22"	

START TIME	END TIME	PDOP	# SV'S
9:16	1:01	2.2	7

2.47

X QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM= FLUSH

MONUMENT LOCATION

SE Most Panel

center ~300' dia clearing

~150' W of Jeep trail

346 (USFS)

STATIC GPS OBSERVATION FORM

PAGE _____ OF _____

8:51 AM • 10-MAR-1995

SUMMIT ENGINEERING CORPORATION

CONSULTING ENGINEERS

5405 MAE ANNE AVENUE
RENO, NEVADA (702) 747-8550

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PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
320	Z	1.571 5.155	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4644-300-[illegible]

LATITUDE	LONGITUDE	PROCESS WITH FILE
—	—	

START TIME	END TIME	PDOP	# SV'S
8:30	10:49	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

7/8" rebar w/center punch

HM= FLUSH

MONUMENT LOCATION

South Center Panel

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-27-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
321	3	0.957 3.14	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4672

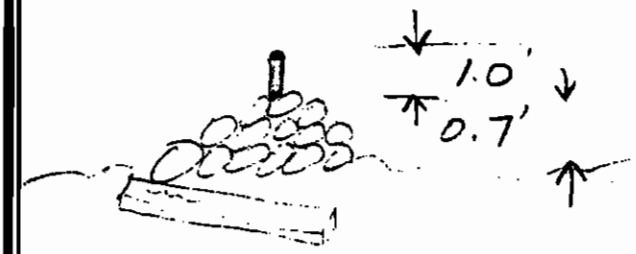
LATITUDE	LONGITUDE	PROCESS WITH
—	—	

START TIME	END TIME	PDOP	# SV'S
8:47	9:47	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

3/4" I.P. w/plastic plug "CALIF D.W.R." scribed Post laying south of 3' dia MOS



MONUMENT LOCATION

South of USFS Jeep Trail ~ 6

in Clearing

stream ~ 200' SW

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
3406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8590

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PROJECT NAME	JOB#	DATE	OBS
LEVIATHAN	23565	10-27-98	RGG

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE
322	3	1.353 4.44	☒ METERS ☒ FEET	○ SLOPE ☒ TRUE VERT.	☒ MICRO ST ○ MINI DOME	4[illegible]

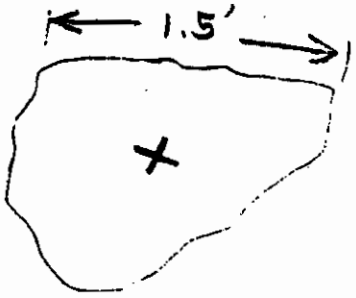
LATITUDE	LONGITUDE	PROCESS WITH
—	—	

START TIME	END TIME	PDOP	# SV'S
10:17	2:08 ?	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA

MONUMENT DESCRIPTION & SKETCH

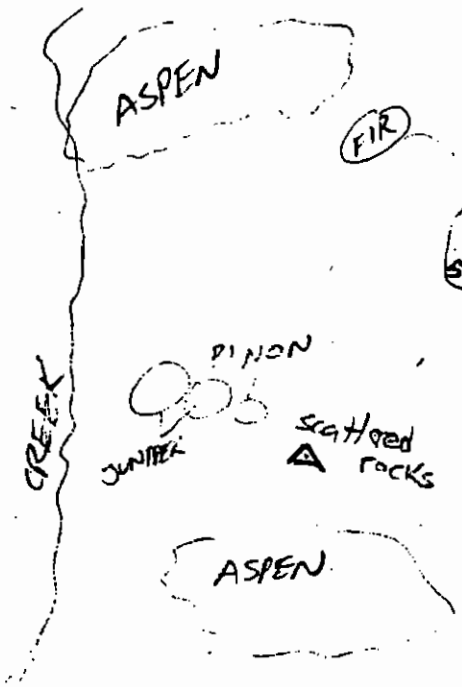
ROCK PAINTED ORANGE W/ CHISLED "X"



HM = 0.4'

MONUMENT LOCATION

SW Panel



STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5405 MAE ANNE AVENUE
RENO, NEVADA (702) 747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
323	5	2.2	☒ METERS ○ FEET	○ SLOPE ○ TRUE VERT.	○ MICRO ST ○ MINI DOME	0323

LATITUDE	LONGITUDE	PROCESS WITH FILE
38° 42' 36.05"	119° 39' 25.29"	

START TIME	END TIME	PDOP	# SV'S
1:29	2:45	2.8	6

○ QUICK START SURVEY ○ CHANGE FILE NAME ○ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

USFS 3" ALUM

cap - drive in style

HM = 0.40'

USDOA

USFS

COT 3 | COT 1

LN 24 | LN 8

MS 6365A

1990

FOREST SERVICE

MONUMENT LOCATION

NW of LS-1

~100'

down the slope

STATIC GPS OBSERVATION FORM

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SUMMIT CONSULTING ENGINEERS

5406 MAE AN

RENO, NEVADA

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PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	235-5	10-29-98	RG

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
324	5	2.2	X METERS O FEET	O SLOPE X TRUE VERT.	O MICRO ST X MINI DOME	0324-30

LATITUDE	LONGITUDE	PROCESS WITH FILE
38°42'57.33"	119°39'12.33"	

START TIME	END TIME	PDOP	# SV'S
3:06	4:09	2.0	7

O QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Set Summit rebar & cap in center of MOS w/ scribed post laying here nearby

Witnessed by a USFS Mon sign

MONUMENT LOCATION

~40' E of Main dirt Rd.

STATIC GPS OBSERVATION FORM

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

PROJECT NAME	JOB#	DATE	OBSERVER
			RGC

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
325	2	1.476 4.84	☒ METERS ☐ FEET	☐ SLOPE ☒ TRUE VERT.	☐ MICRO ST ☒ MINI DOME	46[illegible]

LATITUDE	LONGITUDE	PROCESS WITH [illegible]
—	—	

START TIME	END TIME	PDOP	# SV'S
4:01	4:59	—	—

☒ QUICK START SURVEY ☒ CHANGE FILE NAME ☒ CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

SUMMIT rebar
& cap
HM = FLUSH

MONUMENT LOCATION

~ 900' NW
of ASPEN SEEP

STATIC GPS OBSERVATION FORM

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8:51 AM • 10-MAR-1995

SUMMIT ENGINEER CORPORAT
CONSULTING ENGINEERS AND SURVEYORS
5406 MAE ANNE AVENUE
RENO, NEVADA (702)-74X-8550

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PROJECT NAME	JOB#	DATE	OBSERVER
LEVIATHAN	23565	10-29-98	RG[illegible]

STATION INFORMATION

STATION #	UNIT #	HI	UNITS	TYPE OF HI	ANTENNA TYPE	FILE NAME
326	5	2.2	X METERS O FEET	O SLOPE X TRUE VERT	X MICRO ST O MINI DOME	032[illegible]

LATITUDE	LONGITUDE	PROCESS WITH [illegible]
38°42'44.50"	119°39'22.15"	

START TIME	END TIME	PDOP	# SVS
4:34	5:28	2.1	8

X QUICK START SURVEY O CHANGE FILE NAME O CHANGE ANTENNA HEIGHT

MONUMENT DESCRIPTION & SKETCH

Summit rebar & cap

HM= FLUSH

MONUMENT LOCATION

westerly lower slide point ~700' NE of GPS 313

STATIC GPS OBSERVATION FORM

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8:51 AM • 10-MAR-1995

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SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS
5406 MAE ANNE AVENUE
RENO, NEVADA (702) 747-8550

**********/ 13:53:49 11-03-1998 /**********

. | "C:\\R14\\/Drawing.dwg"\

SUMMIT ENG CREW SHOTS BESTFIT TO SUMMIT ENG GPS CONTROL

HE TRANSFORMATION PARAMETERS ARE ~

A= 0.9999158584

B= 0.0129721286

C= -4793.1568280027

D= 34657.3186055711

S= 1.0000000000

ANGLE = -0.743269066

THE ADJUSTED VALUES AND RESIDUALS ARE ~

#	WANTED N.	ADJ. N.	v	WANTED E.	ADJ. E.	v
-1	387435.226	387435.467	0.241	2666757.021	2666757.12[illegible]	0.[illegible]
2	387496.655	387496.692	0.037	2667487.694	2667487.723	0.[illegible]
3	387520.446	387520.433	-0.012	2668267.184	2668267.22[illegible]	0.[illegible]
4	387882.692	387882.689	-0.003	2669533.723	2669533.724	0.[illegible]
5	388628.478	388628.481	0.004	2669497.309	2669497.28[illegible]	[illegible]
6	388723.568	388723.558	-0.010	2670214.777	2670214.7[illegible]	[illegible]
7	388846.093	388846.077	-0.016	2671148.184	2671148.1[illegible]	[illegible]

0.019 0.[illegible]

RMS ERROR = 0.0375

/ *******/ 13:41:53 11-03-1998 /**********

| "C:\\R14\\/Drawing.dwg"\

SUMMIT ENG FALL 98 GPS BESTFIT TO ORIGINAL CONTROL

THE TRANSFORMATION PARAMETERS ARE ~

A= 0.9999999489
B= 0.0003196553
C= -106.2759217801
D= 814.1168386672
S= 1.0000000000
ANGLE = -0.018314897

THE ADJUSTED VALUES AND RESIDUALS ARE ~

#	WANTED N.	ADJ. N.	v	WANTED E.	ADJ. E.	v
-1	387437.096	387435.226	-1.870	2666752.991	2666757.021	4.
-2	387496.040	387496.655	0.615	2667493.630	2667487.694	-5.
3	387376.063	387375.459	-0.604	2667925.660	2667925.100	-0.
-4	389322.675	389329.706	7.030	2668661.453	2668658.659	-2.
5	389232.018	389233.969	1.952	2670128.065	2670128.837	0.
6	385891.570	385890.222	-1.348	2669818.252	2669818.040	-0.

1.731 0.

RMS ERROR = 1.8635

**********/ 14:14:22 11-03-1998 /**********

| "N:\\DWGS\\J23565\\/CONTROL.dwg"\

BLM GCDB BOUNDARY BESTFIT TO SUMMIT ENG GPS

THE TRANSFORMATION PARAMETERS ARE ~

A= 0.9999969264
B= 0.0024793699
C= -943.9094096347
D= 6646.4741674298
S= 1.0000000000
ANGLE = -0.142057578

THE ADJUSTED VALUES AND RESIDUALS ARE ~

#	WANTED N.	ADJ. N.	v	WANTED E.	ADJ. E.
1	382007.321	382035.358	28.037	2667031.063	2667037.463
-2	388706.530	388770.665	64.135	2668953.803	2668948.156
3	388412.659	388402.286	-10.373	2671719.260	2671736.070
4	390774.478	390756.813	-17.664	2669701.871	2669678.66[illegible]

24.553

RMS ERROR = 32.1555

GPS. YXZ

301	388723.57	2670214.78	7134.40
302	388628.48	2669497.31	7152.22
303	388846.09	2671148.18	7229.71
[illegible]	387882.69	2669533.72	7297.91
[illegible]06	387520.45	2668267.18	7213.66
310	387375.46	2667925.10	7081.23
311	387496.66	2667487.69	6947.62 → BASIS OF ELEVATION
312	387435.23	2666757.02	6967.82
313	389329.71	2668658.66	7014.23
314	391781.22	2669114.60	6764.10
315	392511.72	2665187.51	7396.11
316	392838.24	2673023.32	7538.12
317	389233.97	2670128.84	7083.34
318	388412.66	2671719.26	7191.08
319	385118.33	2673462.71	7773.13
320	385890.22	2669818.04	7321.95
321	382007.32	2667031.06	7610.99
322	384576.65	2665478.26	7570.43
323	388706.53	2668953.80	7178.81
324	390774.48	2669701.87	6982.17
325	389952.70	2669560.87	7006.99
326	389399.16	2668935.61	6990.04

PIN ELEVATIONS

J23565 LEVIATHAN MINE

PANEL.YXZ

301	388723.57	2670214.78	7134.40	
302	388628.48	2669497.31	7152.22	
303	388846.09	2671148.18	7229.71	
305	387882.69	2669533.72	7297.91	
306	387520.45	2668267.18	7213.66	
310	387375.46	2667925.10	7081.13	
311	387496.66	2667487.69	6947.62	→ BASIS OF ELEVATION
312	387435.23	2666757.02	6967.72	
313	389329.71	2668658.66	7014.18	
314	391781.22	2669114.60	6764.10	
315	392511.72	2665187.51	7395.91	
316	392838.24	2673023.32	7537.87	
317	389233.97	2670128.84	7083.34	
319	385118.33	2673462.71	7773.13	
320	385890.22	2669818.04	7321.95	
322	384576.65	2665478.26	7570.43	(TOP OF ROCK; GROUND DOWN 0.4')

→ GROUND ELEVATIONS

11/3/98
RGC

1	388723.558	2670214.772	7134.40	SUMMIT CP
2	388628.481	2669497.285	7152.22	SUMMIT CP
3	388846.077	2671148.140	7229.71	SUMMIT CP
	388405.905	2668392.717	7263.09	SUMMIT CP
5	387882.689	2669533.724	7297.91	SUMMIT CP
6	387520.433	2668267.227	7213.66	SUMMIT CP
7	387464.950	2668811.137	7179.80	SUMMIT CP
8	387233.320	2668147.439	7180.96	SUMMIT CP
9	386858.416	2668303.354	7154.60	SUMMIT CP
10	387496.692	2667487.723	6947.62	DWC
11	389152.470	2669471.504	7148.08	LS9
12	389240.707	2669664.677	7114.49	LS8
13	388661.902	2668945.745	7193.06	LS7
14	388415.439	2668740.230	7217.23	LS6
15	388363.141	2669738.428	7228.89	LS3
16	388244.063	2669895.666	7251.39	LS2
17	388374.848	2670122.229	7246.87	LS4
18	388391.489	2669517.003	7228.36	LS5
19	388121.418	2669519.181	7217.48	LS1
20	387505.225	2669358.217	7160.02	WELL
21	386528.475	2669272.112	7105.14	DS WELL
22	386530.531	2669270.875	7104.02	DS #2 WELL
23	386908.165	2669333.945	7112.16	TEST PIT
24	387127.284	2668832.647	7072.36	TEST PIT
25	387129.332	2668741.993	7076.39	WELL
26	387646.262	2667569.753	6951.25	TEST PIT
27	387313.634	2667219.749	6910.97	TEST PIT
28	387656.426	2667189.258	6898.74	WELL
29	386752.575	2666923.574	6924.43	WELL
30	386889.175	2667419.168	6921.38	WELL
31	386890.624	2667417.734	6919.23	#2 WELL
32	386951.720	2667590.598	6960.31	TEST PIT
33	387435.467	2666757.122	6967.82	ORIGINAL CP
34	386474.242	2667588.109	7043.38	WELL
35	385629.949	2667410.495	7044.97	WELL
36	386285.423	2668236.238	7041.82	WELL
37	386459.405	2668627.719	7043.84	WELL
38	386456.261	2668628.319	7043.92	WELL
39	385684.277	2668848.497	7087.27	WELL
40	386182.323	2668803.080	7081.32	TEST PIT
41	386808.441	2667741.760	6990.64	WELL
301	388723.568	2670214.777	7134.40	
302	388628.478	2669497.309	7152.22	
303	388846.093	2671148.184	7229.71	
305	387882.692	2669533.723	7297.91	
306	387520.446	2668267.184	7213.66	
310	387375.459	2667925.100	7081.23	
311	387496.655	2667487.694	6947.62	
312	387435.226	2666757.021	6967.82	
313	389329.706	2668658.659	7014.23	
314	391781.220	2669114.600	6764.10	
315	392511.725	2665187.514	7396.11	
316	392838.243	2673023.324	7538.12	
317	389233.969	2670128.837	7083.34	
318	388412.659	2671719.260	7191.08	
319	385118.328	2673462.713	7773.13	
320	385890.222	2669818.040	7321.95	
321	382007.321	2667031.063	7610.99	
322	384576.653	2665478.263	7570.43	
323	388706.530	2668953.803	7178.81	

324	390774.478	2669701.871	6982.17
325	389952.699	2669560.869	7006.99
326	389399.156	2668935.613	6990.04

J23565 LEVIATHAN MINE PRIMARY VERTICAL CONTROL - 11/4/98
1
GPS311 1
7.62 .001
GPS311 -1 TBMB 1
43.235 .010
TBMB -1 TBMA 1
50.315 .011
TBMA -1 TBMC 1
0.620 .007
TBMA -1 TBMC 1
0.615 .005
TBMC -1 TBMA 1
-0.610 .007
TBMC -1 TBMA 1
-0.615 .005
TBMA -1 TBMB 1
-50.310 .011
TBMB -1 GPS311 1
-43.235 .010
GPS311 -1 TBMF 1
-29.760 .009
TBMF -1 GPS311 1
29.785 .009

SUMMIT PHOTOGRAMMETRY
OBSEQ - OBSERVATION EQUATION SOLUTION PROGRAM
J23565 LEVIATHAN MINE PRIMARY VERTICAL CONTROL - 11/4/98

9: 5:19 AM NOV. 5, 1998

SUMMARY OF OBSERVATION EQUATIONS, RESIDUALS, AND A PRIORI STANDARD DEV

COEFFICIENT	OBSERVED RESPONSE	RESIDUAL	STD DEV
1.0000000000 * GPS311	6947.6200000000	.00000	.00
-1.0000000000 * GPS311 1.0000000000 * TBMB	43.2350000000	.00000	.010
-1.0000000000 * TBMB 1.0000000000 * TBMA	50.3150000000	-.00236	.00
-1.0000000000 * TBMA 1.0000000000 * TBMC	.6200000000	-.00486	.007
-1.0000000000 * TBMA 1.0000000000 * TBMC	.6150000000	.00014	.005
-1.0000000000 * TBMC 1.0000000000 * TBMA	-.6100000000	-.00514	.007
-1.0000000000 * TBMC 1.0000000000 * TBMA	-.6150000000	-.00014	.005
-1.0000000000 * TBMA 1.0000000000 * TBMB	-50.3100000000	-.00264	.011
-1.0000000000 * TBMB 1.0000000000 * GPS311	-43.2350000000	.00000	.010
-1.0000000000 * GPS311 1.0000000000 * TBMF	-29.7600000000	-.01250	.009
-1.0000000000 * TBMF 1.0000000000 * GPS311	29.7850000000	-.01250	.009

GPS11	6947.620
TBMB	6990.855
TBMA	7041.168
IC	7041.783
TBMF	6917.848

SUMMIT PHOTOGRAMMETRY
OBSEQ - OBSERVATION EQUATION SOLUTION PROGRAM
J23565 LEVIATHAN MINE PRIMARY VERTICAL CONTROL - 11/4/98

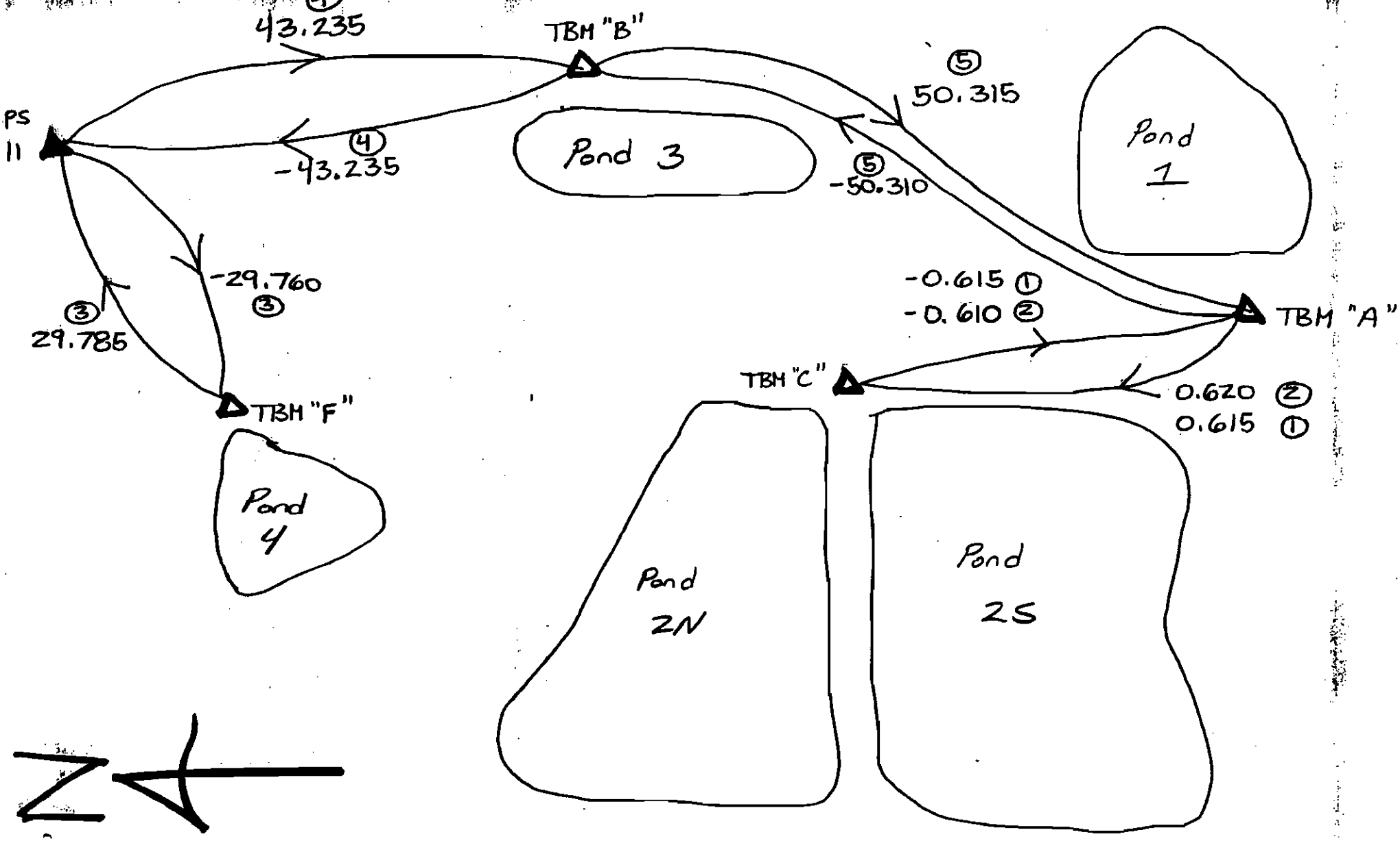
9: 5:19 AM NOV. 5, 1998

SUMMARY OF UNKNOWN PARAMETERS AND A POSTERIORI STANDARD DEVI

STANDARD DEVIATION OF UNIT WEIGHT = .91142 AT 6 DEGREES OF

UNKNOWN	VALUE	STD DEV
GPS311	6947.6201171875	.00091
TBMB	6990.8551177979	.00651
TBMA	7041.1676177979	.00962
TBMC	7041.7826178074	.00997
TBMF	6917.8476171494	.00587

PROJECT VERTICAL CONTROL



T-Post Locations

PROJECT NAME	JOB#	DATE/DAY #	OBSERVER

BASE STATION # 1

STA#	UNIT #	HI	UNITS	TYPE HI	ANTENNA TYPE	START	STOP	FILE NAME
			O m O Ft	O SLOPE O TRUE	O RECIEVER O MINI DOME			

BASE STATION # 2

STA#	UNIT #	HI	UNITS	TYPE HI	ANTENNA TYPE	START	STOP	FILE NAME
			O m O Ft	O SLOPE O TRUE	O RECIEVER O MINI DOME			

ROVER

STA#	UNIT #	HI	UNITS	TYPE HI	ANTENNA TYPE	START	STOP	FILE NAME
			O m O Ft	O SLOPE O TRUE	O RECIEVER O MINI DOME			

SET#	STA #	TIME	# SV'S	PDOP	EPOCS	HI	HM	DESCRIPTION
	LS6							T-Post 2' South
	303							T-Post 4' South
	302							T-Post 4' NORTH
	301							T-Post 4' SOUTH
	LS7							T-Post 2' SOUTH
	LS8							T-Post 2' SOUTH
	LS9							T-Post 2' SOUTH
	305							T-Post 4' SOUTH
	306							T-Post 4' SOUTH
	308							T-Post 4' NORTH
	309							T-Post 4' SOUTH
	304							T-Post 4' SOUTH
	325							T-Post 4' SOUTH
	326							T-Post 4 SOUTH
	LS1							T-Post 2' SOUTH
	LS5							T-Post 2' SOUTH
	LS2							T-Post 2' SOUTH
	LS4							T-Post 2' SOUTH
	LS3							T-Post 2' SOUTH

KINEMATIC GPS OBSERVATION FORM

PAGE _____ OF _____

7:34 AM • 11-FEB-1997

SUMMIT ENGINEERING CORPORATION
CONSULTING ENGINEERS AND SURVEYORS
5405 MAE ANNE AVENUE
RENO, NEVADA (702)-747-8550

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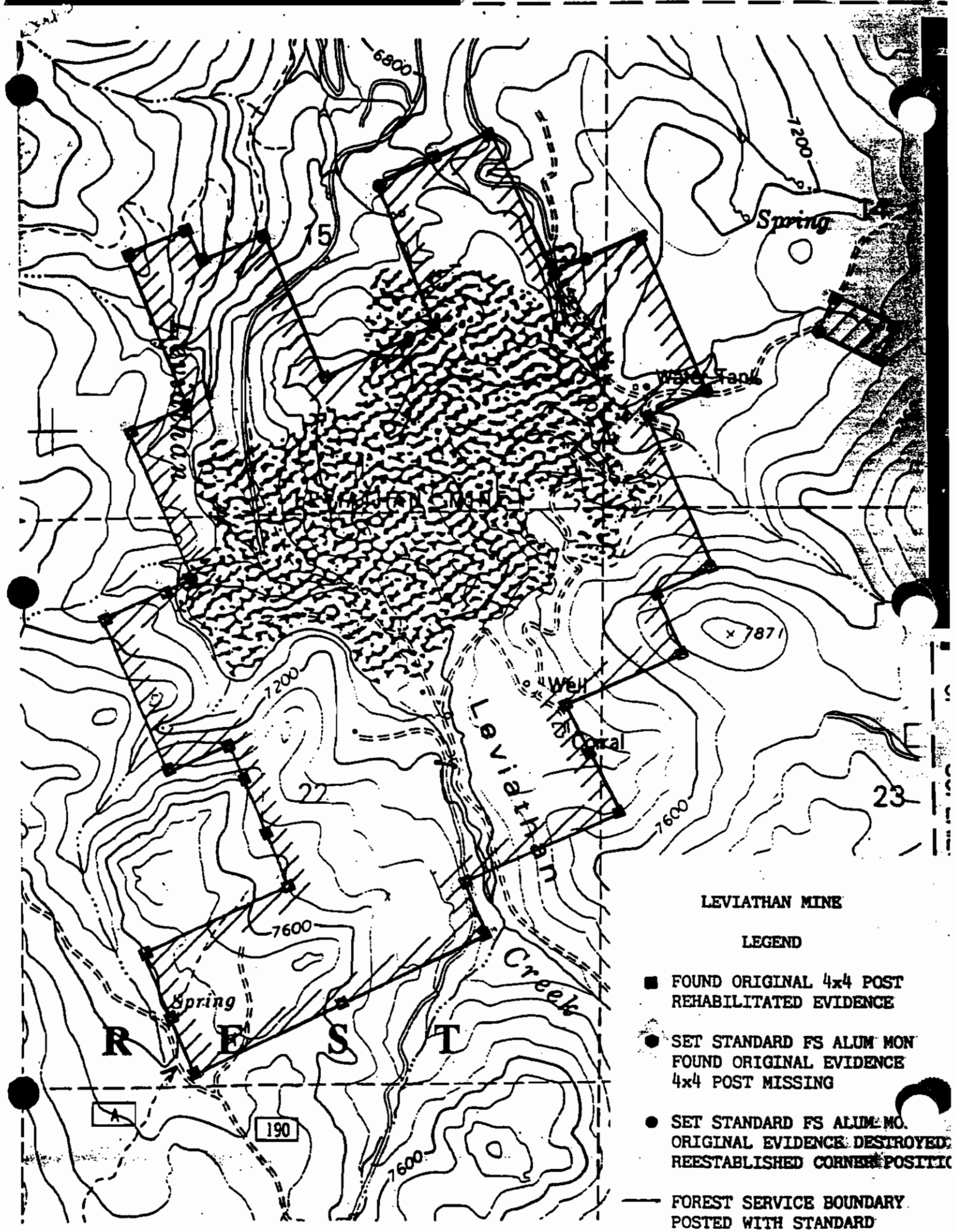
UP SUPERIEURE OBEN



Appendix B
1998 Drilling Program

Appendix B.1
1998 Drilling Program
Soil Boring Logs/Well Completion Details

Boring Log
(MW-1)

te name: Leviathan Mine	Project number:
ent name:	Depth to water at drilling time: 57
ocation: Upgradient on	Screen size/unit: 0.02,inches
ate drilled: 8/25/98	Screen Type: PVC Slotted
Date finished: 8/26/98	Drill method:
Surface elevation: 7080 feet	Notes: Spatial info to be entered at later date.
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 71.1 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			MW-1		100			CL	Mixed waste rock. Mottled. Slightly cohesive. Sulphur and iron present. Sandy gravelly clay.
5.0					100			CL	Highly weathered. Greenish andesitic and black. Mottled orange and green. Dark yellowish brown when mixed and wetted.
10.0					80			CL	Predominately gray and green. Mottled with orange. Mixed waste rock material.
15.0					50				
20.0					100			CL	Some oxidization. Iron oxide staining. Sandy material in clay matrix. Fine to coarse sandy clay. Trace gravel. Mottled
					100			CL	Dark yellowish gray clay with sand.
25.0					100			CL	Dark yellowish brown clay. Redish brown, brown, yellowish, and gray mottled. Sand and cobble in clay matrix.
					100				
30.0					100			GC	Cobbles and gravel in

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Boring Log
(MW-1)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			MW-1		100			GC	clay matrix predominately yellowish brown. Gravel is angular to subrounded.
					100				
35.3					100				
					100			CL	Yellowish brown clay with some iron oxide stains. Some sand and gravel w/coarse grained sandstone material. Loosely consolidated.
40.3					100				
					100				
45.3					83			GC	Brownish gray clayey gravel and subrounded cobbles up to 4 inches. Clay is plastic.
					100			CL	Sandy, angular gravelly clay dark yellowish brown with iron staining stringers. Dark yellowish brown mottles.
50.3									
					100				
55.3									
					100				
60.3									
					100				
					100			CL	Angular gravel in yellowish brown very fine to coarse sandy clay matrix.
65.3									
					100				
67.9								GC	Some clayey coarse sand and

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Boring Log
(MW-1)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
67.9 71.1			MW-1		100			GC	gravel with dark brown angular to subrounded cobles. Iron staining on gravels and cobbles.

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Boring Log
(MW-2S)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 26.4
Location: Adit Outlet	Screen size/unit: 0.02,inches
Date drilled: 9/1/98	Screen Type: PVC Slotted
Date finished: 9/1/98	Drill method:
Surface elevation: 7040 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 49 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
0.0									
5.0									
10.0									
15.0									
20.0									
25.0									
30.0									

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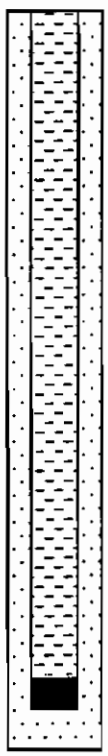
Boring Log
(MW-2S)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
30.3									
35.3									
40.3									
45.3									
49.0									

Boring Log
(MW-2D)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 26.5
Location: Adit Outlet-East	Screen size/unit: 0.02,inches
Date drilled: 8/30/98	Screen Type: PVC Slotted
Date finished: 8/31/98	Drill method:
Surface elevation: 7040 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 85 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core						
					100				Predominantly dark yellowish brown (with green gray, orangish brown) stiff sandy gravelly clay. Mixed waste rock. Low grade andesite ore mineralizateion observed at 14.5 feet.
5.0					80			CL	
10.0					100				
15.0								CL	Predominately gray clay with sand and gravel. Moderate brown soft clay with ore, free sulphur and sulphur mineralization.
					100			GC	Cobbles up to 5 inches
								CL	Increase in clay and
20.0					100				Soft moderate brown clay with white tuff coarse sand (native?). Predominately silica cap. Iron staining orangish brown (some grays) mostly gravels and sands. Agglomerate.
					100			CL	
25.0					100				
					100			CL	Predominately brown clay. Some white acid leach
30.0									

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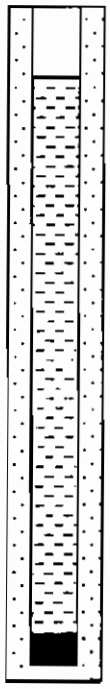
Boring Log
(MW-2D)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core						
					100			CL	sand/gravel. Cobbles at 29 feet consisting of andesite. Moderate brown, yellowish brown, orangish brown iron staining.
35.3									
					100			GC	Dark gray andesite
40.3					100			CL	Mixed agglomerate material predominately moderate brown clay with sand and gravel.
45.3					95			CL	Weathered acid leach tuff. Iron staining orangish brown with buff and white color. Increase in clay and decrease in gravels. Predominately dark brown.
50.3					100			GC	Increase in sandy gravels. Predominatly dark brown.
					0			CL	Dark brown hard clay with some sand and angular gravel. Lake deposit
55.3								ML	Gray brown silt.
					100			CL	Slightly dark brown agglomerate clay with orange buff and purplish gravels and cobbles. Orangish brown iron staining.
60.3					0				
					100				
65.3					100				
67.9					100				

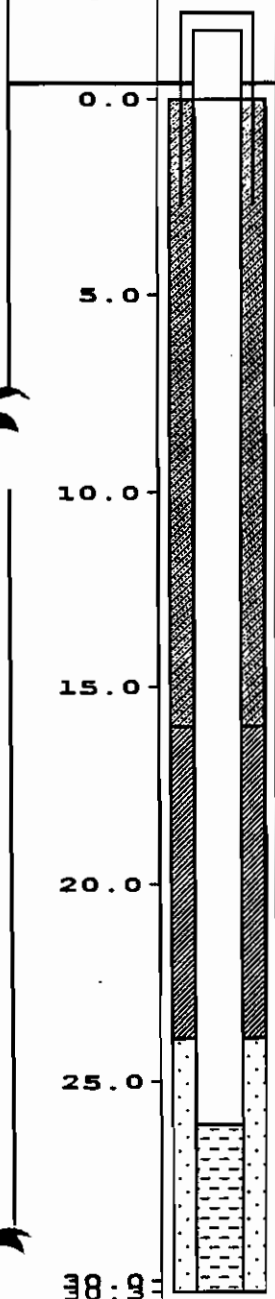
Boring Log
(MW-2D)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100			CL	
					100			GC	Grading towards gray, hard andesite with iron and quartz. Wet along gravels.
72.9					100			CL	Agglomerate material with mixed iron staining. Brown and gray clay with sand and gravel.
					100				
77.9					100				
					100			CL	Dark gray, slightly moist andesite with calcite. Stringers of very hard angular to subrounded gravels and cobbles up to 4.5 inches in clay matrix.
82.9					100				
85.0					100				



Boring Log
(MW-3)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 21
Location: Lower pit	Screen size/unit: 0.02,inches
Date drilled: 8/26/98	Screen Type: PVC Slotted
Date finished: 8/26/98	Drill method:
Surface elevation: 7080 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 42 feet	



Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core		100			CL	Pink to yellowish brown sandy clay mixed with waste rock. Mottled with orangish brown and gray green. Highly weathered acid leach chunk cobble appears at 5 feet. Some layers appear more compacted than others.
5.0					100			CL	Fairly plastic clay with predominately brown gravels and sands. Weathered silica cap rock. Andesitic material. Acid leach.
10.0					100			CL	Coarse sandy clay that is softer, cohesive, and more malleable.
15.0					65			CL	Iron staining. Weathered
20.0					100			CL	Material returns to predominately moderate brown material that is mottled orangish brown
					100			GC	Moderately gray sandy
25.0					100			GC	Mineralization (pyrite). Glassy, brittle, highly fractured, weathered bedrock contact with joint spacing present. Dark gray gravel/cobble weathered ore zone with trace of clay.
38.0					100			GC	Same as above. At 33

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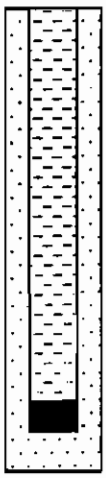
Boring Log
(MW-3)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100				feet, silty zone with cobbles present.
					100			GC	
35.3					100				
					100			GC	At 37 feet, fractured, broken laminated tuff. Greenish gray crumbly predominately fine grained tuff with some subrounded coarse grained sand.
40.3					0				
42.0									

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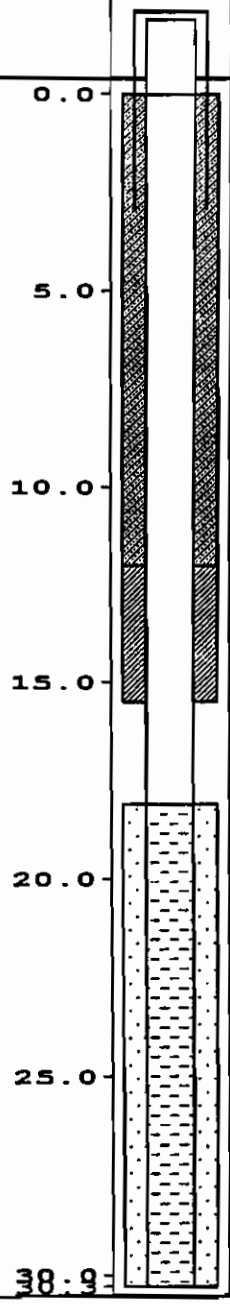
Boring Log
(MW-4)

te name: Leviathan Mine	Project number:
ent name:	Depth to water at drilling time: 24.5
ocation: Upper Pit -	Screen size/unit: 0.02,inches
ate drilled: 8/27/98	Screen Type: PVC Slotted
Date finished: 8/27/98	Drill method:
Surface elevation: 7155 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 39 feet	



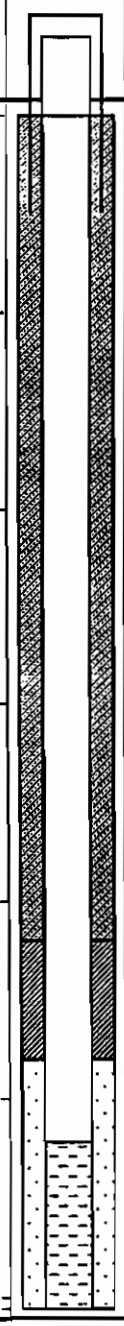
Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core					CL	Orangish brown clay. Waste rock acid leached andisite. Mix of sand and gravels in clay matrix.
					100			CL	Green color acid leach
								CL	~~Yellowish green color.~~
5.0								CL	Predominately reddish brown silica cap rock. Some
					100			CL	Cobbley zone of acid leach.
					100			CL	Sandy gravelly green gray clay. Mixed orangish to redish brown mottles. Acid leach silica cap green tuff sediments.
10.0									
					50				
15.0									
					100				
20.0					100			GC	Iron red sandy gravel with trace of clay. Angular silica caps. Layer grades towards orangish yellosish brown. Acid leach tuff present. Mottles are bright to dark yellowish brown and white.
25.0					100				
								CH	Cohesive plastic fat
30.0					100			CL	Gray to green andesite
35.0									

Boring Log
(MW-4)

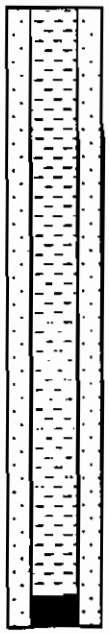
Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100			CL	sediments. Fine to coarse sand and fine gravel in fine grained tuff.
					100				
35.3					100			CL	Andesite greenish gray and occassionaly purple. Compentent. Little fracturing observed.
39.0									

Boring Log
(MW-5S)

te name: Leviathan Mine	Project number:
ient name:	Depth to water at drilling time: 24.5
ocation: Pit-south end	Screen size/unit: 0.02,inches
Date drilled: 9/11/98	Screen Type: PVC Slotted
Date finished: 9/11/98	Drill method:
Surface elevation: 7100 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 46 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0									
5.0									
10.0									
15.0									
20.0									
25.0									
30.0									
38.5									

Boring Log
(MW-5S)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
30.3									
35.3									
40.3									
45.3									
46.0									

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Boring Log
(MW-5D)

te name: Leviathan Mine	Project number:
ient name:	Depth to water at drilling time: 24.5
Location: Pit-South end	Screen size/unit: 0.02,inches
Date drilled: 8/27/98	Screen Type: PVC Slotted
Date finished: 8/28/98	Drill method:
Surface elevation: 7100 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 79 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core		100			CL	Waste rock mix. Sandy gravelly multicolored clay.
5.0								CL	6 inches of gray
					100				Waste rock mix. Sandy gravelly clay. Yellowish sulphur at 10 feet. Gray green andesite at 12 feet.
10.0								CL	
15.0					60				
20.0					100				Weathered orange, red, and brown silica cap rock at 18.5 feet. Andesite gray green material with sands and gravels. Crystaline sulphur observed.
					0				
					100			CL	
25.0					100				
30.0					100			GC	Fine to coarse sand with some quartz. Coarse gravel.

Boring Log
(MW-5D)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100			GC	Cobbles up to 5 inches. Sulphur mineralized andesite.
35.3					83				
					100				
40.3					100				
					100			GC	Free crystalized sulphur. Light greenish to gray clay. Gravel and cobbles in clay.
45.3					100				
					100			GC	Dark gray material. Sandy gravelly particles angular to subrounded. Wet from 50 to 52.5 feet.
50.3					100				
					100			GC	Increase in clay. Pyrite
55.3					100			GC	Return to green gray ore. Pulverized with cobbles. Sand is fine grained consisting of tuff and quartz. Pyrite is observed.
60.3					100			GC	Good solid hard core that is light green to dark gray andesite. Pyrite is observed at 61 feet with quartz.
					100			CL	Reddish brow with orange, purple, and green. Porphyritic agglomerate. Varying shapes and sizes. Soft tuff. Fine to coarse
65.3					100			GC / CL	Orange brown staining in Stratified deposit with gravels and sand in clay. Greenish gray andesite. Quartz, silica rich dark
67.9									

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Boring Log
(MW-5D)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100			CL	gray to black tuff.
72.9					100			CL	Reddish buff, purplish green andesite. Tuff with mixed sizes. Agglomerate.
					100				
77.9									
79.0									

Boring Log
(MW-6)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 65
Location: West of Pond 1	Screen size/unit: 0.02,inches
Date drilled: 8/30/98	Screen Type: PVC Slotted
Date finished: 8/30/98	Drill method:
Surface elevation: 7040 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 95 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
0.0			Core		100			CL	Yellowish brown, gray, orangish brown mixed clay and waste dump. Sand and gravels with andesite, quartz, and acid leach tuff. Mixed mottles. Iron staining.
5.0					100				
10.0									
					100			CL	~~Layer of dark gray gravelly~~ Mixed dump material. gravels of silica cap. Iron oxidation. Acid leach tuff in clay matrix. Multicolored. Wet in sandy gravels at 19 feet.
15.0									
					100				
20.0								CL	
					100				
25.0									
					100				
30.0					100				

Boring Log
(MW-6)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core					CL	
					100			CL	Gravelly cobbled dark
35.3					100				Decrease in clay. Increase in gravels. Mixed grays/reddish purple clay. Possible lake-deposited agglomerate.
40.3					100				
45.3					100			CL	
50.3					100				
55.3					100				
60.3					100			CL	Increase in greenish gray andesite. Sandy gravelly clay.
65.3					100				
67.9									

Boring Log
(MW-6)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100			CL	
72.9					100			CL	Dark gray increasing gravels and sand. Fair amount of clay.
								CL	Andesitic cobbles.
								CL	Moderately brown clay
77.9					100			CL	Mottles are a mix of greenish gray, buff, white, purple, and orange. Tuff.
								CL	Moderate brown sticky sandy gravelly clay (sluff?)
82.9					100			CL	Buff, brown, and purple mottled gravelly clay. Increase in gray andesite. Tuff acid leach. Gray and dark yellowish clay.
87.9					100				
92.9					100			CL	Hard mixed darker colors.
95.0									

Boring Log
(MW-7)

te name: Leviathan Mine	Project number:
ient name:	Depth to water at drilling time: 25
ocation: Upper	Screen size/unit: 0.02,inches
ate drilled: 8/29/98	Screen Type: PVC Slotted
Date finished: 8/29/98	Drill method:
Surface elevation: 7040 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 34 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core						Soft clayey mixed waste rock. Green colored tuff. Roots decomposed. Wood organic material observed.
					100				
5.0								CL	
					100				
10.0									Lake stratified tuff agglomerate. Multicolor - dark orangeish, brown, green gray, purple sized material. Organic material (roots) observed.
					100				
15.0								CL	
					80				
20.0								OH	~~Tree branch Wet, black~~
					100			GC	Dark gray materail. Increase in subrounded gravels. Decrease in clay. Cobbley, sandy. Lots of organics.
					100				
25.0					100			CL	Moderate brown clay with
					100			GC	Large dense cobbles. Acid leach stratified moist yellowish orangish brown tuff.
30.0					100				

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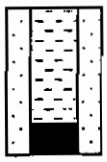
Boring Log
(MW-7)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
30.3			Core		100			GC	
34.0									

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Boring Log
(MW-8)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		66				
					100				
35.3									
					80				
40.3								CL	
45.3					70				
50.3					80				Waste rock mix with green and gray andesite. Sandy gravelly clay and acid leach tuff. Colors include moderate brown, white, buff and reddish brown. Some cobbles.
55.3									
								CL	
60.3					50				
65.3					40				
67.9									

Boring Log
(MW-8)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
67.9			Core						
					40				
72.9								CL	
77.9					40				
								GC	Light orangish brown fine
82.9								CL	Hard clay darker in color. Increase in andesite. Decrease in acid leach. Increase in iron.
					100				
87.9					100				
					100			CL	Orangish brown silica cap rock. Increase in cobbles. Decrease in clay. Gray green andesite. Clay is dark in color.
92.9					100				
					100				
97.9					100				
102.9					100			CL	3 inchess of wet sandy clay zone. Moist and sandy gravelly clay. Predominately greenish gray and purplish clay with sand and gravel. Acid leach and mix.
105.5					100				

Boring Log
(MW-8)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
105.5			Core						
					100				
110.5									
					100				
								CL	
115.5					100				
					100				
120.5									
					100				
					100				Greenish gray 'fresh' hard andesite. Material is wet, sandy gravel. with yelowish tinge and saturated zones within the sand and gravels.
125.5					100				
								CL	
130.5					80				
135.5									
					100				
140.5									
								CL	Dark brown clay with trace of sand and gravel.
143.2									

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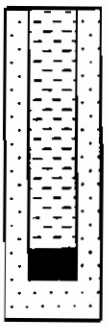
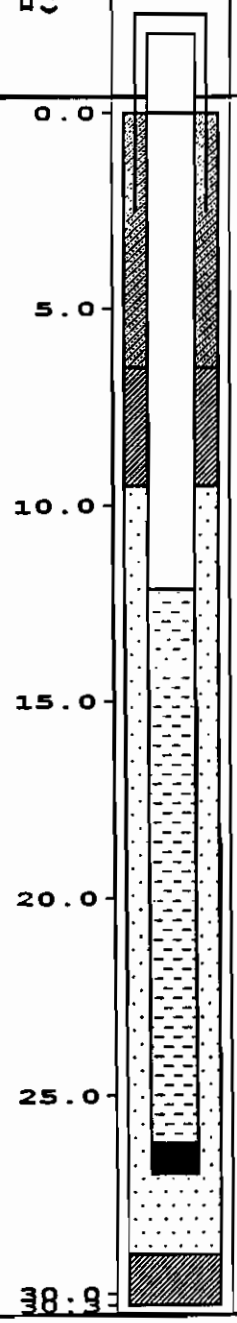
Boring Log
(MW-8)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
143.2			Core		100			CL	Some quartz. Gravels are angular to subrounded.
					100				
148.2					100				
151.0									

Boring Log
(MW-9)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 85.4
Location: Pond 3 North end	Screen size/unit: 0.02,inches
Date drilled: 8/29/98	Screen Type: PVC Slotted
Date finished: 8/29/98	Drill method:
Surface elevation: 6990 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 40 feet	



Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core					CL	Dark yellowish brown
					100			CL	Very dark gray, almost black andesit ore. Sandy gravelly clay with evident sulphur. Wet at 4.5 feet along gravels.
5.0					50			CL	Back into mixed waste rock which is predominantly
10.0					100			CL	Return to dary gray ore materaial containing abundant sulphur, and mineralized andesite.
15.0					100				
20.0					100			CL	8 inch cobbles at 18.5 feet. Orangish brown iron stained silica cap rock with cobbles. Adic leach tuff with iron staining.
					100				
					100				
25.0					100			GC	Iron stained gravels (cap or tuff) with some intermixed gray clay and gravels. Gray clay cobbles at 26 feet.
30.0					100			CL	Moderate brown, soft clay

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Boring Log
(MW-9)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100				with gravel and sand. Orangish to brown material with some gray color.
					100			CL	
35.3									
					100				
40.0									

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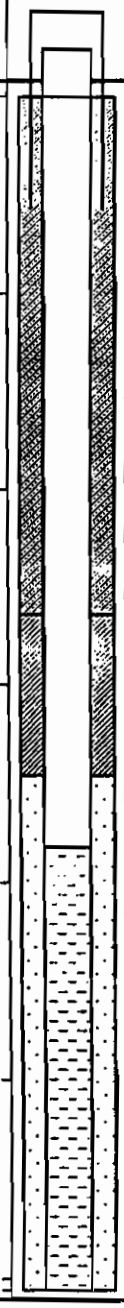
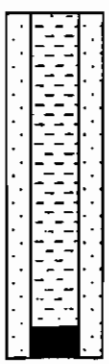
Boring Log
(MW-10S)

te name: Leviathan Mine	Project number:
ent name:	Depth to water at drilling time: 13
ocation: South of Pond 4	Screen size/unit: 0.02,inches
ate drilled: 9/10/98	Screen Type: PVC Slotted
Date finished: 9/10/98	Drill method:
Surface elevation: 6915 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 39 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0									
5.0									
10.0									
15.0									
20.0									
25.0									
30.0									
38.9									

Boring Log
(MW-10S)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
30.3									
35.3									
39.0									

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Boring Log
(MW-10D)

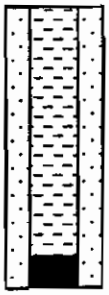
Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 16.5
Location: South of Pond 4,	Screen size/unit: 0.02,inches
Date drilled: 9/9/98	Screen Type: PVC Slotted
Date finished: 9/9/98	Drill method:
Surface elevation: 6915 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 75 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core		100			CL	Sandy gravelly clay waste rock. Multicolored-brown, yellow, orange, gray/green.
5.0					100				
10.0					100			CL	Increase in acid leach cobbles and gravels. Color generally lighter. Sand is coarse to fine and angular. Gravels are rounded to subrounded.
					100				
15.0					100			CL	Sandy gravelly clay. Predominately moderate brown. Decrease in clay. Increase in sand and graves. Agglomearate.
20.0					80				
25.0					100			CL	Sandy gravelly clay agglomerate predominately moderate brown. Gray antular to subrounded tuff.
30.0					100				

Boring Log
(MW-10D)

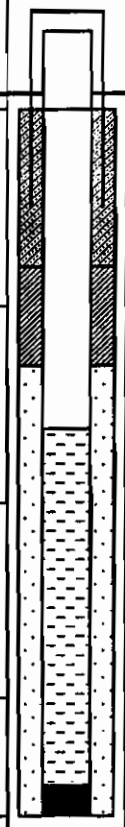
Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core						
					100			CL	
35.3									
					100				Agglomerate medium brown, sandy, gravelly clay. Some GC. Angular mineralized sulphur crystals. Mottles are yellow, orange, green, gray and brown.
40.3									
					100			CL	
45.3					100				
					0				
									Grayish brown grading towards gray clay with fine to coarse sand and gravel.
50.3					100			CL	
55.3					100				Very dark brown and medium to dark gray clay with organics including branches, and roots. Some cobbles sand and gravels. Agglomerate material. Not colormixed.
					100				
60.3								CL	
					100				
65.3									Laminated reddish to moderate brown lake deposit agglomerated sandy clay with some GC.
					100			CL	
67.9									

Boring Log
(MW-10D)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100 100 90			CL	
72.9									
75.0									

Boring Log
(MW-11)

te name: Leviathan Mine	Project number:
ient name:	Depth to water at drilling time: 11.1
ocation: Lower	Screen size/unit: 0.02,inches
ate drilled: 9/8/98	Screen Type: PVC Slotted
Date finished: 9/8/98	Drill method:
Surface elevation: 6925 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 18 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
0.0			Core		80			CL	Compacted dark yellowish brown mixed waste rock. Large amount of roots between 2 to 2.5 feet. Greenish tuff sediments present at 4.5 feet.
5.0					100			GC	Dark brown almost black clayey subrounded alluvial gravels. Large amount of organic materaial includidng roots and branches.
10.0					80			CL	Greenish and brown clay in lenses.
15.0					100 100			GC	Laminated clay an cobbles/gravels. Andesite.
18.0									

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Boring Log
(MW-12)

te name: Leviathan Mine	Project number:
ent name:	Depth to water at drilling time: 42
ocation: North end of	Screen size/unit: 0.02,inches
ate drilled: 9/10/98	Screen Type: PVC Slotted
ate finished: 9/11/98	Drill method:
Surface elevation: 6900 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 72 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core						Moderate brown mottled clay waste dump with fine to coarse sand and gravel in clay matrix.
					90				
5.0					80				
10.0					33			CL	
15.0					41				
20.0					100				
								GC	~~Predominately orange to~~ Iron stained sand and angular gravels.
25.0					100				Predominately moderate brown clay. Some tuffacious sediments.
					100			CL	
					100				
30.0					100				

Boring Log
(MW-12)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100				
					100			CL	
35.3					100				
					100				Iron staining. Moderately brown clay with gravels and sands. 'Fresh' greenish andesite. Fewer gravels and cobbles.
40.3					100				
					83			CL	
45.3					100				
					100				
50.3					100				
					100				Large amount of dark organic material. Some gravels and cobbles. Grading toward dark brown silty clay with greenish gray lenses.
					100				
55.3					100			CL	
60.3					100				
65.3					100			CH	Organic material. Fat, silty clay. Some sand.
67.9									

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Boring Log
(MW-12)

Depth (feet)	Well	(PID) PPM	Samples				Graphic Log	USCS Symbol	Description
			Number	Condition	Recovery	Blows			
67.9			Core		100				
					100			CH	
72.0									

Appendix B.2
1998 Drilling Program
Paste pH Values

LEVIATHAN PROJECT
1998 Drillhole Construction
well_mon_data

Object Name	Date/Time	pH	Depth (ft)
MW-2D	8/30/98	5.16	2
MW-2D	8/30/98	5.92	4
MW-2D	8/30/98	4.18	7
MW-2D	8/30/98	4.41	9
MW-2D	8/30/98	5.22	13
MW-2D	8/30/98	3.7	14.5
MW-2D	8/30/98	4.07	16
MW-5D	8/27/98	4.39	5
MW-5D	8/27/98	2.42	10
MW-5D	8/27/98	3.8	15
MW-5D	8/27/98	3.55	20
MW-5D	8/27/98	3.99	25
MW-5D	8/27/98	3.57	35
MW-5D	8/27/98	4.22	39
MW-5D	8/27/98	3.71	45
MW-5D	8/27/98	3.14	49
MW-5D	8/27/98	1.83	52
MW-5D	8/27/98	2.04	53
MW-5D	8/27/98	2.96	54
MW-5D	8/27/98	3.39	58
MW-5D	8/28/98	3.48	59
MW-5D	8/28/98	5.27	61
MW-5D	8/28/98	4.1	61.5
MW-5D	8/28/98	4.74	63
MW-5D	8/28/98	4.77	66
MW-5D	8/28/98	4.93	68
MW-5D	8/28/98	5.11	72
MW-5D	8/28/98	4.99	74.5
MW-5D	8/28/98	4.88	77.5
MW-5D	8/28/98	4.84	80
MW-6	8/30/98	4.09	2
MW-6	8/30/98	5.48	5
MW-6	8/30/98	4.5	9
MW-6	8/30/98	4.61	12
MW-2D	8/30/98	3.8	22
MW-2D	8/30/98	3.85	23.5
MW-2D	8/30/98	4.01	25
MW-2D	8/30/98	4.04	27
MW-2D	8/30/98	4.2	29
MW-2D	8/30/98	4.04	32
MW-2D	8/30/98	3.99	35
MW-2D	8/30/98	3.8	39
MW-2D	8/30/98	4.16	44
MW-2D	8/30/98	4.19	48
MW-2D	8/30/98	4.17	51
MW-2D	8/30/98	4.3	53
MW-2D	8/30/98	4.32	57

LEVIATHAN PROJECT
1998 Drillhole Construction
well_mon_data

Object Name	Date/Time	pH	Depth (ft)
MW-6	8/30/98	4.41	15
MW-6	8/30/98	4.99	19
MW-6	8/30/98	4.35	24
MW-6	8/30/98	5.2	26.5
MW-6	8/30/98	4.91	29.5
MW-6	8/30/98	5.77	32.5
MW-6	8/30/98	5.88	35
MW-6	8/30/98	6.15	40
MW-6	8/30/98	6.07	44.5
MW-6	8/30/98	6.17	49.5
MW-6	8/30/98	6.31	55
MW-6	8/30/98	6.76	60
MW-6	8/30/98	6.47	65
MW-6	8/30/98	6.04	71
MW-6	8/30/98	4.42	78
MW-6	8/30/98	6.34	80
MW-6	8/30/98	6.25	86
MW-6	8/30/98	5.54	90
MW-1	8/25/98	3.82	2
MW-1	8/25/98	4.35	5
MW-1	8/25/98	4.75	10
MW-1	8/25/98	4.78	15
MW-1	8/25/98	5.68	22
MW-1	8/25/98	4.37	25
MW-1	8/25/98	6.88	27
MW-1	8/25/98	6.42	31
MW-2D	8/30/98	4.24	58.5
MW-3	8/26/98	3.83	2
MW-3	8/26/98	4.9	5
MW-3	8/26/98	4.47	7.5
MW-3	8/26/98	4.14	10
MW-3	8/26/98	4.45	12
MW-3	8/26/98	4.57	15
MW-3	8/26/98	4.44	20
MW-3	8/26/98	5.14	22
MW-3	8/26/98	5.74	23
MW-4	8/27/98	4.48	1
MW-6	8/30/98	6.3	95
MW-7	8/29/98	5.06	2
MW-7	8/29/98	5.71	4.5
MW-7	8/29/98	6	7.5
MW-7	8/29/98	6.43	10
MW-7	8/29/98	4.55	12.5
MW-7	8/29/98	4.16	15
MW-7	8/29/98	5.35	19
MW-7	8/29/98	6.55	22.5
MW-7	8/29/98	6.77	25

Object Name	Date/Time	pH	Depth (ft)
MW-7	8/29/98	7.16	27
MW-7	8/29/98	5.18	30
MW-7	8/29/98	5.1	32
MW-2D	8/30/98	4.2	63
MW-2D	8/31/98	4.18	66.5
MW-2D	8/31/98	4.2	70
MW-2D	8/31/98	4.56	72
MW-2D	8/31/98	4.1	75
MW-2D	8/31/98	4.2	78
MW-2D	8/31/98	5.55	79
MW-2D	8/31/98	6.17	80
MW-2D	8/31/98	6.28	82
MW-2D	8/31/98	7.22	83.5
MW-3	8/26/98	5.04	24
MW-3	8/26/98	4.6	25
MW-3	8/26/98	4.35	26
MW-3	8/26/98	3.94	27
MW-3	8/26/98	4.41	29
MW-3	8/26/98	4.5	30
MW-3	8/26/98	3.67	32
MW-3	8/26/98	3.04	33
MW-3	8/26/98	3.35	34
MW-3	8/26/98	3.64	37
MW-4	8/27/98	3.54	4.5
MW-4	8/27/98	4.86	5
MW-4	8/27/98	5	6.5
MW-4	8/27/98	4.82	10
MW-4	8/27/98	4.98	14
MW-4	8/27/98	4.85	17.5
MW-4	8/27/98	5.77	20
MW-4	8/27/98	5.37	23
MW-4	8/27/98	4.74	27
MW-4	8/27/98	4.88	29
MW-4	8/27/98	5.91	29.5
MW-4	8/27/98	4.72	32
MW-4	8/27/98	4.31	35
MW-4	8/27/98	4.11	38
MW-1	8/25/98	6.95	33
MW-1	8/25/98	7.38	37
MW-1	8/25/98	7.17	40
MW-1	8/25/98	7.35	44
MW-1	8/25/98	7.78	47
MW-1	8/25/98	7.75	50
MW-1	8/25/98	7.57	53
MW-1	8/25/98	7.76	60
MW-1	8/25/98	7.76	63
MW-1	8/25/98	7.86	65

LEVIATHAN PROJECT
1998 Drillhole Construction
well_mon_data

Object Name	Date/Time	pH	Depth (ft)
MW-1	8/25/98	7.41	68
MW-2D	8/31/98	8.77	85
MW-3	8/26/98	3.68	40
MW-7	8/29/98	5.94	34
MW-8	9/1/98	3.62	2
MW-8	9/1/98	5.54	5
MW-8	9/1/98	4.13	8.5
MW-8	9/1/98	5.61	11
MW-8	9/1/98	3.78	20
MW-8	9/1/98	3.92	25
MW-8	9/1/98	3.59	30
MW-8	9/1/98	3.75	35
MW-8	9/1/98	3.66	40
MW-8	9/1/98	4.12	45
MW-8	9/1/98	4.29	50
MW-8	9/1/98	4.2	55
MW-8	9/1/98	4.1	65
MW-8	9/1/98	3.85	75
MW-8	9/1/98	3.63	85
MW-8	9/1/98	3.52	87
MW-8	9/1/98	4.08	89
MW-8	9/1/98	4.5	91
MW-8	9/1/98	4.8	93
MW-8	9/1/98	6.3	95
MW-8	9/2/98	5.8	97
MW-8	9/2/98	4.34	100
MW-8	9/2/98	4.02	104
MW-8	9/3/98	4.49	110
MW-8	9/3/98	5.37	114
MW-8	9/3/98	6.02	117
MW-8	9/3/98	5.17	119
MW-8	9/3/98	5.7	121
MW-8	9/3/98	5.83	124
MW-8	9/13/98	5.09	125
MW-8	9/13/98	5.4	129
MW-8	9/13/98	5.01	132
MW-8	9/13/98	4.96	135
MW-8	9/13/98	5.36	137
MW-8	9/13/98	5.35	144
MW-8	9/13/98	5	146
MW-8	9/13/98	4.75	150
MW-9	8/29/98	2.56	1
MW-9	8/29/98	2.35	3
MW-9	8/29/98	2.2	5
MW-9	8/29/98	1.98	7.5
MW-9	8/29/98	1.94	11
MW-9	8/29/98	1.7	14

LEVIATHAN PROJECT
1998 Drillhole Construction
well_mon_data

Object Name	Date/Time	pH	Depth (ft)
MW-9	8/29/98	2.14	17
MW-9	8/29/98	3.52	21
MW-9	8/29/98	3.25	26
MW-9	8/29/98	3.42	30
MW-9	8/29/98	3.71	32
MW-9	8/29/98	3.54	36
MW-9	8/29/98	3.88	40
MW-11	9/8/98	7.09	2
MW-11	9/8/98	4.52	4
MW-11	9/8/98	6.25	7
MW-11	9/8/98	6.69	9.5
MW-11	9/8/98	8.16	15
MW-11	9/9/98	7.09	13.5
MW-11	9/9/98	8.75	17
MW-12	9/10/98	3.63	2
MW-12	9/10/98	3.57	6
MW-12	9/10/98	4.55	12
MW-12	9/10/98	4.81	17
MW-12	9/10/98	4.76	22
MW-12	9/10/98	4.37	25
MW-12	9/10/98	4.57	27.5
MW-12	9/10/98	4.63	30
MW-12	9/10/98	4.82	32
MW-12	9/10/98	4.64	34
MW-12	9/10/98	4.63	37
MW-12	9/10/98	4.3	39.5
MW-12	9/10/98	4.08	45
MW-12	9/10/98	4.31	47
MW-12	9/10/98	4.61	50
MW-12	9/10/98	5.44	52
MW-12	9/10/98	5.87	54
MW-12	9/10/98	6.43	59
MW-12	9/11/98	6.3	62
MW-12	9/11/98	6.43	65
MW-12	9/11/98	6.55	68
MW-12	9/11/98	6.6	70

Appendix B.3
1998 Drilling Program
Well Development Records

Groundwater Monitoring Well Development Log

Well: MW-1 (LI-1)

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Gallons Purged	Remarks
			4 in	Grundfos					
9/8/98									
Pump	13:36	56.28				1830	55	0	Pumping fine sand
	13:38					1940	57.3	5	Mod Brown, mod turbid
	13:40	66				1890	55	5	Brown, heavy turbid
	13:43	Dry				1870	52.3	5	Brown, very turbid
Recovery	13:44	65.25							
	13:47	63.87							
	13:49	62.57							
	13:51	61.58							
	13:52	61.13							
	13:53	60.85							
	13:54	60.47							
	13:55	60.26							
Pump	13:57							0	Pump set at 67
	14:00	64.37				1840	50.6	5	Mod Brown, Mod Turb
Recovery	14:03							4	Pump shut off
	14:34	60							
	14:44	59.15							
Pump	14:51								Pumping fine sand
Recovery	14:55	60.47							
	14:58	59.92							
	15:00	59.57							
Pump	15:10								
Recovery	15:12				6.59	1710	55	7.5	Mod brown, Mod turb
	15:15	62.72							
	15:20	60.72							
	15:25	60.09							
	15:31	59.57							
Pump	15:35							0	Pumping fine sand
	15:36.5							5	
	15:38.5				7.37	1820	59.5	11	Mod brown, Mod turb

Groundwater Monitoring Well Development Log

Well: MW-1 (LI-1)

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Gallons Purged	Remarks
			4 in	Grundfos					
Recovery	15:41	65.6							
	15:42	64.54							
	15:43	63.85							
	15:44	63.28							
	15:45	62.8							
	15:46	62.41							
	15:53	60.81							
Pump	16:03							0	
	16:05.5							5	
Recovery	16:06	67.1						13	
	17:00	65.65							
	17:01	64.94							
	17:02	64.32							
	17:03	63.85							
	17:04	63.44							
	17:05	63.15							
	17:10	62.05							Clearing up well
	17:35					1470	50.5	5	Pale brown, lt turb
	17:42	68.45				1470	50.3	7	No odor, much improv.

Total Purged: Approx. 85 gallons

Groundwater Monitoring Well Development Log

Well: MW-2D (P2-D)

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Turbidity/Color	Gallons Purged	Remarks
			4 in	Grundfos						
9/29/98										
	16:05	26.76							0	
Pump	16:16									
									5	13.67 sec
									5	15.54 sec
	16:18				4.16	3230	54.3	Very turb, lt. bro	40	Pumped dry
	16:31								50	1 min - dry
	16:45				4.2	3070	52.6	Very turb, mod. bro	60	1 min - dry
	17:01				4.2	3061	53.1	Very turb, mod. bro	65	30 sec - dry
	17:15				3.9	3100	51.6	Very turb, dark bro	70	25 sec - dry
	17:30				3.7	2690	54.4	Very turb, dark bro	75	25 sec - dry
9/30/98	9:40	27.9								
Pump	9:49				4.2	2560	50	Lt turb, lt bro	40	2 min - dry
Recovery	10:10	68.65								
	10:15	65.57								
	10:20	63.29								
	10:25	60.67								
	10:30	59.51								
	10:35	56.39								
	10:40	54.07								
	10:45	52.35								
	10:50	50.93								
	10:55	49.45								
	11:00	47.92								
	11:15	43.99								
	11:30	40.96								
	11:45	88.44								
	12:00	36.44								
	12:14	34.68							40	
Pump	12:30				4.1	3430	56.7	Mod - lt turb, lt bro	82	2 min - 5 sec pump
Pump	13:05				4	3630	57.3	Mod - lt turb, lt bro	104	1 min - 2 sec pump
Pump	16:35	29.04			4	3210	53.2	Mod - lt turb, lt bro		2 min - 16 sec pump

Groundwater Monitoring Well Development Log

Well: MW-2D (P2-D)

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Turbidity/Color	Gallons Purged	Remarks
			4 in	Grundfos						
10/1/98										
Pump					4	2670	52.1	Mod - lt turb, lt bro		2 min - 15 sec pump

Groundwater Monitoring Well Development Log

Well: MW-2S (P2-S)

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Turbidity/Color	Gallons Purged	Remarks
			4 in	Grundfos						

1 casing volume is approximately 13 gallons

9/30/98	10:00	26.96							0	
Pump	10:14				4.1	2390	52.2	Very turb, mod bro	20	Pumped 1 min
	10:30				4.1	2370	52.4	Very turb, mod bro	35	Pumped 45 sec
	10:45				4.1	2500	53.2	Mod turb, lt bro	50	Pumped 42 sec
	11:00				3.9	2680	55.7	Mod turb, lt bro	65	Pumped 45 sec
	11:15				3.8	2690	55.9	Mod turb, lt bro	80	Pumped 43 sec
	11:30				3.8	2840	56.1	Lt turb, lt bro	95	Pumped 42 sec
	11:45				3.8	2870	55	Lt turb, v lt bro	110	Pumped 41 sec
	12:00				3.9	2960	55.5	V lt turb, gray bro	125	Pumped 42 sec
Recovery	12:05	39.93								
	12:06	38.9								
	12:07	38.42								
	12:08	37.51								
	12:09	36.65								
	12:10	35.97								
	12:11	35.27								
	12:28	28.84								
	12:34	28.25								
	13:15	27.44								
	13:21	27.32								

Groundwater Monitoring Well Development Log

Well: MW-3

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							
9/15/98	15:19	21.1		Bail					0	Initial water level
	15:36			"	2.15	3430	56.3	Dk gray	1.5	Sulfur odor
	15:49	21.2		"	2.24	3300	54	Dk gray	6	
	15:54	21.2		"	2.81	2500	52.2		10	v dk fines
	16:00			Sub Pump						lower pump to 40 feet
	16:03	21.5		"					15	
	16:04	21.55		"	2.5	2220	53.8		20	
	16:10	21.6		"				Clearing slightly	25	1 min 40 sec for 5 gal
	16:16	21.6		"	2.21	3010	52.7	"	35	3 gpm
	16:22	21.6		"				Dk	45	
9/15/98	16:37	21.45		"	2.39	3830	53.4	Clearing	60	fine gray sand
	16:48	21.6		"	2.15	4320	53.2		100	less fines, 3.5 gpm
	16:56	21.65		"					125	Cont to clear, 3.5 gpm
	16:57	21.2		Swab					150	pump off
	17:13			Sub Pump				V dk gray		Bailer swab well, pump on
	17:18			"	3.03	3690	54.6	dk gray	160	Sulfur odor
	17:32			"	2.39	4690	54.1	lighter gray	180	clearing slightly
	17:37	21.56		"	2.22	4800	54.1		200	clearing slightly
	17:46	21.47			2.14	4870	53.9	Cloudy gray	225	Pump off
	17:57	21.5			2.11	5120	53.5	Slightly cloudy	250	Recovery
Recovery	17:58	21.21								
	18:12	21.19								

Groundwater Monitoring Well Development Log

Well: MW-4 (P-4)

Date	Time (minutes)	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							
9/16/98	0:00	24.78								
	0:01			Bail	3.74	1312	55.8	Orange/Brown	1.5	Few sands, mostly clay
	0:03	27.54		Bail					5	
		30.3		Bail	3.7	1595	53.7	Orange/Brown	15	
				Pump	3.8	1493	55.1	Orange/Brown	20	
									22	Dry
Recovery	0.00	33.8								
	2.00	33.4								
	4.00	33.13								
	6.00	32.89								
	8.00	32.61								
	10.00	32.31								
15:38	15.00	31.57								
	20.00	31.16								
	25.00	30.46								
	30.00	29.84								
	35.00	29.22								
	40.00	28.77								
	45.00	28.38								
	50.00	27.99								
	55.00	27.6								
	60.00									
9/17/99	11:40	24.84								
Pump	11:54			Pump	3.41	1590	54.6	Orange/Browon	0	
	12:00								10	
	12:03	33.68							13	Pump stopped
Recovery	12:05	33								
	12:07									
	15:41	24.88							0	

Groundwater Monitoring Well Development Log

Well: MW-4 (P-4)

Date	Time (minutes)	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
	15:58	33.45						Dk bro/orange	13	
9/18/98	9:30	24.88		Pump						
	9:47									Start pump
	9:49							Mod turb, oran/bro	58	
	9:50								61	Pump stopped
	9:53	33.65								Pump is in the well
	9:54	33.23								
	9:55	32.94								
	9:56	32.66								
	9:57									
	9:58	32.22								
	10:03	30.87								
	10:08	29.52								
	10:13	28.58								Removed pump
	10:18	28.05								
	10:23	27.35								
	10:28	26.71								
	10:33	26.16								
	10:38	25.82								
	10:43	25.51								
	10:48	25.32								
	10:53	25.2		Bail					61	
		31.98							74	

Groundwater Monitoring Well Development Log

Well: MW-6

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							

TD 91.5 feet as built
TD 92 feet tagged prior to development (difficult to feel)
(91.5-65.76) x 0.66 = 16.98 gal = 1 casing volume

9/30/98	13:51	65.76								
	14:05			Pump	4.8	2300	53.1	V, Very Turb, dk gray	15	
	14:20				5	2170	51.2	V, Very Turb, dk gray	30	
	14:35				5	2150	51.4	V, Very Turb, dk gray	45	
	14:50				5.1	2180	52	Very Turb, dk gray	60	
	15:25				5.1	2210	52.8	Mod Turb, mod gray	75	
	15:40				5.2	2100	50	Mod Turb, mod gray	90	
	15:50				5.2	2050	48.7	Mod Turb, mod gray	105	
	16:00				5.2	2060	48.8	Mod - lt turb, lt gray	120	
	16:10				5.2	2060	49	Lt Turb, lit gray	135	
	16:20		~ 10 c vol		5.2	2070	48.8	V Lt Turb, V lt gray	150	
	End Pumping									
	16:34	67.05								
	16:35	67								
	16:36	66.99								

Groundwater Monitoring Well Development Log

Well: MW-7

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							

TD 35.30 feet, bottom filled with sandy silts and clay (dark grayish black)
(34 - 25.13) x 0.66 = 5.85 gal = 1 casing volume

Pump/surge/Pump

10/1/98	10:30	25.13								
	10:35				4.1	3070	57	V Turb, black gray		First pumping
	10:45				5.1	1480	53.1			
	10:55				5.4	1140	55.7			25 sec
	11:10				6	1090	62.5	V Turb, black gray		27 sec
	11:25				6	880	57.5	V Turb, black gray		24 sec
	11:45				6.1	720	63.4	V Turb, black gray		25 sec
	12:05				6.4	610	63.7	V Turb, black gray		18 sec
	12:35				6.6	490	63.2	V Turb, black gray		48 sec = 6 gal
	13:00				6.7	440	58.4	V Turb, black gray		
	14:15				6.6	560	59.5	V Turb, black gray		35 sec = 6 gal
	14:35				6.7	480	56.9	V Turb, black gray		25 sec = 5 gal
	14:55				6.7	420	61.2	V Turb, black gray		35 sec = 5 gal
Note: surge action very effective, removing much sand, silt and clay										
	15:15				5.9	370	59.3	V Turb, black gray	5	
	15:30				6	350	54.4	V Turb, black gray	4	
	15:45				6.2	350	55.6	V Turb, black gray	4	
	16:00				6.4	340	56.1	V Turb, black gray	4	
	16:01	31.8								
	16:02	31.55								
	16:03	31.36								
	16:04	31.01								
	16:05	30.87								
	16:06	30.64								
	16:07	30.42								
	16:08	30.14								

Groundwater Monitoring Well Development Log

Well: MW-7

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
	16:09	29.8								
	16:10	29.58								
	16:15	28.6								
	16:20	27.37								
	One last pumping cycle									
	16:22				6.8	310	51.6	V Turb, black gray	73	

Groundwater Monitoring Well Development Log

Well: MW-8

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							

TD 150 feet, light brown mud on bottom

Too much hose and cable in hole to get water level probe down hole.

(150-86.24) x 0.66 = 42.1 gallons per casing volume

Pump/surge/Pump

10/1/98	16:41								0	
	17:24				4.2	1380	47.2	V Turb, med tan	50	Well recharge > 12 gpm
	17:34				4.2	1370	47.2	Lt - Mod Turb, med tan	120	
	17:44				4.2	1360	47.1	Lt turb, lt gray	240	
	17:49				4.2	1360	47	v lt turb, v. lt gray	300	
10/2/98	11:16				3.79	1930	53.4	Clear	5	
	11:18								15	
	11:26					1880	49.9	Clear		
	11:36				3.6	1880	52.4	Clear		
	11:46				3.6	1870	50	Clear	120	
		Pull Pump from Well								
Recovery:	12:02	86.44								
	16:06	30.64								
	16:07	30.42								
	16:08	30.14								
	16:09	29.8								
	16:10	29.58								
	16:15	28.6								
	16:20	27.37								
	One last pumping cycle									
	16:22				6.8	310	51.6	V Turb, black gray	73	

Groundwater Monitoring Well Development Log

Well: MW-10D

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
			4 in							
TD 75 feet										
(75 - 16.73 = 58.27 x 0.66 = 38.46 gal per casing volume										
				Bail/Pump						Initial DTW prior to purge of MW-10S
9/16/98		16.73								
	13:01	16.73								
	13:43	16.78								After 50 g purge from 10s
	13:50			Bail	5.24	1080	56.3		1.5	Thick muddy mod bro clay
	13:58	16.81		Bail	6.15	1048	52.3	Muddy, med brown	5	
	14:10	16.95		Bail	6.55	1062	54.2	Muddy, med brown	10	
	14:36			Pump						
		17.9								
	14:40				5.75	1050	55.2	Muddy, med brown	15	5 gal pumped in 3 min
	14:47	1840			6.23	984	57	Muddy, med brown	25	
	14:51				6.26	950	53.6	Muddy, med brown	30	
	14:59	18.35					53.2	Muddy, med brown	35	25 gal pumped in 15 min
		18.03								Pump on bott
	15:18								80	Increase purge rate
	15:33								105	
									110	Incr. Disch rate to 4.5 gpm
	15:50	19.9			5.78	891	13.3	Slightly cloudy gray	185	
	15:55				6.34	913	12.1	Slightly cloudy gray	205	
	16:05	19.9			6.43	950	12.3	Almost clear	250	
	16:15				6.53	561	12.3	Slightly cloudy gray	295	Q = 4.5
	16:25				6.58	784	12.4	Almost clear	340	Q = 4.5
	16:30	19.88			6.58	786	11.9	Almost clear	365	Q = 4.5, Air temp decr
	17:20	16.8								Pump off for 50 minutes

Groundwater Monitoring Well Development Log

Well: MW-10S

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
TD 39 bgs			4 in							
				Bail/Pump						Water Meter Ser 94481
										Clay-like gray mud
9/16/98	12:42	13.17		Bail				Muddy	1.5	
	12:44			Bail	4.15	1514	58	Muddy	5	
	12:48	17.42		Bail				Muddy	10	Fine sand in discharge
	12:56	19.74		Pump	4.19	1370	51.8	Muddy	15	3 min 40 sec for 5 gal
	13:07	22.6						Muddy	20	10 g after 6 min 45 sec
	13:09				4.17	1414	56.3	Muddy	25	15 g after 12 min, 1.2 gpm
	13:14	26.3						Clearing slightly	50	Fewer fine sands
	13:39	34.22			3.63	1483	59.3		67	
	13:41	35.53							85	Pump off
	13:54	34.4								
Recovery	13:55	33								
	13:56	32.4								
	13:57	31.48								
	13:58	31.15								
	13:59	30.44								
	14:00	29.76								
	14:01	29.15								
	14:02	28.56								
	14:03	27.89								
	14:04	27.38								
	14:05	26.82								
	14:06	26.62								Pump removed
	14:15	22.4								
	14:25	17.62								
	14:35	15.11								
	14:45	14.01								

Groundwater Monitoring Well Development Log

Well: MW-10S

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
	14:55	13.65								
	15:15	13.43								
	15:45	13.4								
Pump	16:30									Pump On - ~ 1 gpm
	16:40				4.64	1024	13.5	Low turb, gray	95	
	16:45				4.3	1131	12.4		100	
	16:50				4.27	1133	13.7		105	
	16:53								108	Incr discharge to 3 gpm
	16:58				4.29	1178	12		123	
	17:03				4.56	1160	12.5		138	
Recovery	17:05	36.9								
	17:06	35.9								
	17:07	34.98								
	17:08	34.2								
	17:09	33.44								
	17:10	32.71								
	17:15	29.05								
	17:22	25.13								
	17:25	23.75								
	17:30	21.74								
	17:35	19.68								
	17:47	15.95								
	17:55	14.9								
	18:10	13.97								
	18:20	13.72								
	18:30	13.59								

Groundwater Monitoring Well Development Log

Well: MW-11

Date	Time	Depth to Water from TOC	Casing Diameter 4 in	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
9/17/98		11.2		Bail					0	
		11.28							5	
	13:03			Pump					5	
	13:07				6.3		54.3	Mod turb, gray	10	
	13:12				6.32		53.4		20	
	13:14				6.23		52.5	lt turb	25	
	13:17				6.17		53		30	
	13:19	12.39			6.23		53.3		35	
	13:22	12.41			6.3		53.1	lt turb, incr. Purge rate	40	
	13:24				6.24		52.2		45	
	13:25				6.34		52.2		50	
	13:30				6.29		52.4	v lt turb	60	
	13:33				6.19		52.2		70	
	13:37	13.5			6.5		52.2		80	
	13:39				6.42		52		90	
	13:43	13.63			6.53		52.1	clear	100	
	13:49	13.72			6.67		52.1		120	
	14:00									
	14:18				6.74		52.1	Clear		
	14:23				6.97		52.2			
Recovery	14:25	12.67								
	14:26	12.28								
	14:27	12.15								
	14:28	12.08								
	14:29	12.05								
	14:30	11.99								
	14:35	11.88								

Groundwater Monitoring Well Development Log

Well: MW-11

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
	14:40	11.78								
	14:45	11.7								
	14:50	11.66								Rem pump after reading
	14:55	11.61								
	15:00	11.57								
	15:05	11.53								
	15:10	11.51								
	15:15	11.49								
	15:20	11.46								
	15:25	11.42								

Groundwater Monitoring Well Development Log

Well: MW-12

Date	Time	Depth to Water from TOC	Casing Diameter 4 in	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
9/18/98	11:45			Pump					0	
	11:49								0	Start pump
	11:54							v turb, dark grey	5	Pump stop
	12:12			Bail					17	
	12:52							v turb, dark grey	29	
Recovery	0:00	65.38								
	0:01	64.94								
	0:02	64.92								
	0:03	64.92								
	0:04									
	0:05	64.92								
	0:10	64.92								
	0:15	64.92								
	0:20	64.92								
	0:25									
	0:30									
9/29/98		42.77								
Pump	14:14									
	14:37				5.49	1630	50.4	Very turbid	40	
	14:45								45	Pumped dry
	15:23	71.42			5.5	1710	51		50	
Recovery	15:25	71.28								
	15:26	71.22								
	15:27	71.1								
	15:28									
	15:29	71.01								
	15:34	70.82								

Groundwater Monitoring Well Development Log

Well: MW-12

Date	Time	Depth to Water from TOC	Casing Diameter	Purge Method	pH (SU)	Cond. (umhos/cm)	Temp (F/C)	Clarity	Gallons Purged	Remarks
	15:39	70.67								
	15:44	70.35								
	15:49	70.13								

Appendix B.4
1998 Drilling Program
MW-10s and MW-10d Continuous Water Level Data for 1999

Water Level Data

MW-10D
In-Situ Well Sentinel
Serial #: L3K00526

Downloaded:	9/9/99	
Unit ID:	L3K00526	
Test Name:	1	
Linearity:	0.042	
Scale Factor:	9.999	
Offset:	0.025	
Specific Gravity:	1	
Data Type:	Level	
Units:	English	
Mode:	Top of Casing	
Ref. Level:	6914.4	
Ref. Taken:	6/14/99	17:36
Test Begun:	6/14/99	17:45

MW-10S
In-Situ Well Sentinel
Serial #: L3K00508

Downloaded:	9/9/99	
Unit ID:	L3K00508	
Test Name:	2	
Linearity:	0.027	
Scale Factor:	10.024	
Offset:	0.024	
Specific Gravity:	1	
Data Type:	Level	
Units:	English	
Mode:	Top of Casing	
Ref. Level:	6914.61	
Ref. Taken:	6/14/99	17:46
Test Begun:	6/14/99	17:50

Avg Time+Data	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
6/14/99 17:47	6/14/99	17:45	6914.4	6914.401	6/14/99	17:50	6914.61	6914.61
6/14/99 18:47	6/14/99	18:45	6914.398		6/14/99	18:50	6914.61	
6/14/99 19:47	6/14/99	19:45	6914.391		6/14/99	19:50	6914.604	
6/14/99 20:47	6/14/99	20:45	6914.39		6/14/99	20:50	6914.601	
6/14/99 21:47	6/14/99	21:45	6914.379		6/14/99	21:50	6914.589	
6/14/99 22:47	6/14/99	22:45	6914.373		6/14/99	22:50	6914.586	
6/14/99 23:47	6/14/99	23:45	6914.371		6/14/99	23:50	6914.585	
6/15/99 0:47	6/15/99	0:45	6914.371		6/15/99	0:50	6914.585	
6/15/99 1:47	6/15/99	1:45	6914.364		6/15/99	1:50	6914.584	
6/15/99 2:47	6/15/99	2:45	6914.37		6/15/99	2:50	6914.586	
6/15/99 3:47	6/15/99	3:45	6914.368		6/15/99	3:50	6914.585	
6/15/99 4:47	6/15/99	4:45	6914.371		6/15/99	4:50	6914.586	
6/15/99 5:47	6/15/99	5:45	6914.365		6/15/99	5:50	6914.586	
6/15/99 6:47	6/15/99	6:45	6914.364		6/15/99	6:50	6914.582	
6/15/99 7:47	6/15/99	7:45	6914.359		6/15/99	7:50	6914.579	
6/15/99 8:47	6/15/99	8:45	6914.355		6/15/99	8:50	6914.582	
6/15/99 9:47	6/15/99	9:45	6914.348		6/15/99	9:50	6914.578	
6/15/99 10:47	6/15/99	10:45	6914.34		6/15/99	10:50	6914.575	
6/15/99 11:47	6/15/99	11:45	6914.329		6/15/99	11:50	6914.562	
6/15/99 12:47	6/15/99	12:45	6914.323		6/15/99	12:50	6914.556	
6/15/99 13:47	6/15/99	13:45	6914.32		6/15/99	13:50	6914.55	
6/15/99 14:47	6/15/99	14:45	6914.316		6/15/99	14:50	6914.543	
6/15/99 15:47	6/15/99	15:45	6914.319		6/15/99	15:50	6914.544	
6/15/99 16:47	6/15/99	16:45	6914.32		6/15/99	16:50	6914.546	
6/15/99 17:47	6/15/99	17:45	6914.316		6/15/99	17:50	6914.544	
6/15/99 18:47	6/15/99	18:45	6914.316		6/15/99	18:50	6914.544	
6/15/99 19:47	6/15/99	19:45	6914.313		6/15/99	19:50	6914.539	
6/15/99 20:47	6/15/99	20:45	6914.303		6/15/99	20:50	6914.533	
6/15/99 21:47	6/15/99	21:45	6914.3		6/15/99	21:50	6914.529	
6/15/99 22:47	6/15/99	22:45	6914.29		6/15/99	22:50	6914.52	
6/15/99 23:47	6/15/99	23:45	6914.289		6/15/99	23:50	6914.519	
6/16/99 0:47	6/16/99	0:45	6914.286		6/16/99	0:50	6914.514	
6/16/99 1:47	6/16/99	1:45	6914.283		6/16/99	1:50	6914.511	
6/16/99 2:47	6/16/99	2:45	6914.28		6/16/99	2:50	6914.51	
6/16/99 3:47	6/16/99	3:45	6914.268		6/16/99	3:50	6914.5	
6/16/99 4:47	6/16/99	4:45	6914.268		6/16/99	4:50	6914.495	
6/16/99 5:47	6/16/99	5:45	6914.259		6/16/99	5:50	6914.488	
6/16/99 6:47	6/16/99	6:45	6914.256		6/16/99	6:50	6914.482	
6/16/99 7:47	6/16/99	7:45	6914.255		6/16/99	7:50	6914.485	
6/16/99 8:47	6/16/99	8:45	6914.248		6/16/99	8:50	6914.481	
6/16/99 9:47	6/16/99	9:45	6914.241		6/16/99	9:50	6914.477	
6/16/99 10:47	6/16/99	10:45	6914.236		6/16/99	10:50	6914.474	
6/16/99 11:47	6/16/99	11:45	6914.232		6/16/99	11:50	6914.468	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
6/16/99 12:47	6/16/99	12:45	6914.226		6/18/99	12:50	6914.463	
6/16/99 13:47	6/16/99	13:45	6914.22		6/16/99	13:50	6914.459	
6/16/99 14:47	6/16/99	14:45	6914.216		6/16/99	14:50	6914.456	
6/16/99 15:47	6/16/99	15:45	6914.211		6/16/99	15:50	6914.453	
6/16/99 16:47	6/16/99	16:45	6914.211		6/16/99	16:50	6914.453	
6/16/99 17:47	6/16/99	17:45	6914.209		6/16/99	17:50	6914.451	
6/16/99 16:47	6/16/99	16:45	6914.206		6/16/99	16:50	6914.445	
6/16/99 19:47	6/16/99	19:45	6914.199		6/16/99	19:50	6914.435	
6/16/99 20:47	6/18/99	20:45	6914.19		6/16/99	20:50	6914.426	
6/16/99 21:47	6/16/99	21:45	6914.16		6/18/99	21:50	6914.413	
6/16/99 22:47	6/16/99	22:45	6914.172		6/16/99	22:50	6914.404	
6/16/99 23:47	6/18/99	23:45	6914.169		6/18/99	23:50	6914.4	
6/17/99 0:47	6/17/99	0:45	6914.167		6/17/99	0:50	6914.396	
6/17/99 1:47	6/17/99	1:45	6914.161		6/17/99	1:50	6914.394	
6/17/99 2:47	6/17/99	2:45	6914.155		6/17/99	2:50	6914.387	
6/17/99 3:47	6/17/99	3:45	6914.151		6/17/99	3:50	6914.384	
6/17/99 4:47	6/17/99	4:45	6914.151		6/17/99	4:50	6914.384	
6/17/99 5:47	6/17/99	5:45	6914.146		6/17/99	5:50	6914.379	
6/17/99 6:47	6/17/99	6:45	6914.145		6/17/99	6:50	6914.376	
6/17/99 7:47	6/17/99	7:45	6914.139		6/17/99	7:50	6914.377	
6/17/99 6:47	6/17/99	6:45	6914.135		6/17/99	6:50	6914.371	
6/17/99 9:47	6/17/99	9:45	6914.129		6/17/99	9:50	6914.369	
6/17/99 10:47	6/17/99	10:45	6914.127		6/17/99	10:50	6914.365	
6/17/99 11:47	6/17/99	11:45	6914.119		6/17/99	11:50	6914.361	
6/17/99 12:47	6/17/99	12:45	6914.112		6/17/99	12:50	6914.356	
6/17/99 13:47	6/17/99	13:45	6914.109		6/17/99	13:50	6914.355	
6/17/99 14:47	6/17/99	14:45	6914.109		6/17/99	14:50	6914.352	
6/17/99 15:47	6/17/99	15:45	6914.099		6/17/99	15:50	6914.346	
6/17/99 16:47	6/17/99	16:45	6914.099		6/17/99	16:50	6914.346	
6/17/99 17:47	6/17/99	17:45	6914.099		6/17/99	17:50	6914.343	
6/17/99 16:47	6/17/99	18:45	6914.094		6/17/99	18:50	6914.339	
6/17/99 19:47	6/17/99	19:45	6914.09		6/17/99	19:50	6914.33	
6/17/99 20:47	6/17/99	20:45	6914.082		6/17/99	20:50	6914.322	
6/17/99 21:47	6/17/99	21:45	6914.077		6/17/99	21:50	6914.313	
6/17/99 22:47	6/17/99	22:45	6914.07		6/17/99	22:50	6914.306	
6/17/99 23:47	6/17/99	23:45	6914.065		6/17/99	23:50	6914.301	
6/18/99 0:47	6/18/99	0:45	6914.063		6/16/99	0:50	6914.298	
6/18/99 1:47	6/18/99	1:45	6914.061		6/18/99	1:50	6914.296	
6/18/99 2:47	6/18/99	2:45	6914.054		6/18/99	2:50	6914.293	
6/18/99 3:47	6/18/99	3:45	6914.051		6/18/99	3:50	6914.293	
6/18/99 4:47	6/18/99	4:45	6914.044		6/18/99	4:50	6914.284	
6/18/99 5:47	6/18/99	5:45	6914.045		6/18/99	5:50	6914.282	
6/18/99 6:47	6/18/99	6:45	6914.04		6/18/99	6:50	6914.277	
6/18/99 7:47	6/18/99	7:45	6914.034		6/16/99	7:50	6914.277	
6/18/99 8:47	6/18/99	8:45	6914.029		6/18/99	8:50	6914.272	
6/18/99 9:47	6/18/99	9:45	6914.025		6/18/99	9:50	6914.271	
6/18/99 10:47	6/18/99	10:45	6914.021		6/18/99	10:50	8914.27	
6/18/99 11:47	6/16/99	11:45	6914.012		6/18/99	11:50	8914.281	
6/18/99 12:47	6/18/99	12:45	6914.006		6/16/99	12:50	8914.258	
6/18/99 13:47	6/18/99	13:45	6914.003		6/18/99	13:50	6914.255	
6/18/99 14:47	6/18/99	14:45	6913.996		6/16/99	14:50	6914.251	
6/18/99 15:47	6/18/99	15:45	6913.995		6/16/99	15:50	6914.249	
6/18/99 16:47	6/18/99	16:45	6913.995		6/18/99	18:50	6914.249	
6/18/99 17:47	6/18/99	17:45	6913.99		6/18/99	17:50	6914.242	
6/16/99 18:47	6/18/99	18:45	6913.987		6/18/99	18:50	6914.24	
6/18/99 19:47	6/18/99	19:45	6913.98		6/18/99	19:50	6914.233	
6/18/99 20:47	6/18/99	20:45	6913.976		6/18/99	20:50	6914.226	
6/18/99 21:47	6/18/99	21:45	6913.967		6/18/99	21:50	6914.217	
6/16/99 22:47	6/18/99	22:45	6913.96		6/18/99	22:50	6914.209	
6/18/99 23:47	6/18/99	23:45	6913.96		6/18/99	23:50	6914.206	
6/19/99 0:47	6/19/99	0:45	6913.963		6/19/99	0:50	6914.21	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
6/19/99 1:47	6/19/99	1:45	6913.957		6/19/99	1:50	6914.204	
6/19/99 2:47	6/19/99	2:45	6913.959		6/19/99	2:50	6914.207	
6/19/99 3:47	6/19/99	3:45	6913.959		6/19/99	3:50	6914.209	
6/19/99 4:47	6/19/99	4:45	6913.953		6/19/99	4:50	8914.206	
6/19/99 5:47	6/19/99	5:45	6913.951		8/19/99	5:50	6914.201	
6/19/99 6:47	6/19/99	6:45	6913.944		6/19/99	6:50	6914.198	
6/19/99 7:47	6/19/99	7:45	6913.941		6/19/99	7:50	6914.197	
6/19/99 8:47	6/19/99	8:45	6913.932		6/19/99	8:50	6914.191	
6/19/99 9:47	6/19/99	9:45	6913.929		6/19/99	9:50	6914.19	
6/19/99 10:47	6/19/99	10:45	8913.925		6/19/99	10:50	8914.183	
6/19/99 11:47	6/19/99	11:45	8913.918		6/19/99	11:50	6914.18	
6/19/99 12:47	6/19/99	12:45	6913.917		6/19/99	12:50	6914.178	
6/19/99 13:47	6/19/99	13:45	6913.915		6/19/99	13:50	6914.181	
6/19/99 14:47	6/19/99	14:45	6913.914		6/19/99	14:50	8914.18	
8/19/99 15:47	6/19/99	15:45	6913.911		6/19/99	15:50	6914.178	
6/19/99 16:47	6/19/99	16:45	6913.908		6/19/99	16:50	8914.18	
6/19/99 17:47	6/19/99	17:45	6913.906		6/19/99	17:50	6914.178	
6/19/99 16:47	6/19/99	18:45	6913.902		6/19/99	16:50	6914.172	
6/19/99 19:47	6/19/99	19:45	6913.9		6/19/99	19:50	6914.168	
6/19/99 20:47	6/19/99	20:45	8913.895		6/19/99	20:50	6914.164	
6/19/99 21:47	6/19/99	21:45	6913.883		6/19/99	21:50	6914.152	
6/19/99 22:47	6/19/99	22:45	6913.882		6/19/99	22:50	6914.147	
6/19/99 23:47	6/19/99	23:45	6913.877		6/19/99	23:50	8914.142	
6/20/99 0:47	6/20/99	0:45	6913.877		6/20/99	0:50	6914.139	
6/20/99 1:47	6/20/99	1:45	6913.877		6/20/99	1:50	6914.142	
6/20/99 2:47	6/20/99	2:45	8913.872		6/20/99	2:50	6914.141	
6/20/99 3:47	6/20/99	3:45	6913.873		6/20/99	3:50	6914.139	
6/20/99 4:47	6/20/99	4:45	6913.869		6/20/99	4:50	6914.135	
6/20/99 5:47	8/20/99	5:45	6913.861		6/20/99	5:50	6914.127	
6/20/99 6:47	6/20/99	8:45	6913.861		6/20/99	6:50	6914.125	
6/20/99 7:47	6/20/99	7:45	6913.854		6/20/99	7:50	6914.123	
6/20/99 8:47	6/20/99	8:45	6913.648		6/20/99	8:50	6914.122	
6/20/99 9:47	6/20/99	9:45	8913.851		6/20/99	9:50	6914.122	
6/20/99 10:47	6/20/99	10:45	6913.648		6/20/99	10:50	6914.125	
6/20/99 11:47	6/20/99	11:45	6913.647		6/20/99	11:50	6914.125	
6/20/99 12:47	6/20/99	12:45	6913.847		6/20/99	12:50	8914.123	
6/20/99 13:47	6/20/99	13:45	6913.844		6/20/99	13:50	6914.123	
6/20/99 14:47	6/20/99	14:45	6913.841		6/20/99	14:50	6914.125	
6/20/99 15:47	6/20/99	15:45	8913.836		6/20/99	15:50	6914.122	
6/20/99 16:47	6/20/99	18:45	6913.834		6/20/99	16:50	6914.12	
6/20/99 17:47	6/20/99	17:45	6913.836		6/20/99	17:50	6914.122	
6/20/99 18:47	6/20/99	18:45	6913.828		6/20/99	16:50	6914.118	
6/20/99 19:47	6/20/99	19:45	6913.819		6/20/99	19:50	6914.105	
6/20/99 20:47	6/20/99	20:45	8913.818		6/20/99	20:50	6914.097	
6/20/99 21:47	6/20/99	21:45	6913.816		6/20/99	21:50	6914.096	
6/20/99 22:47	6/20/99	22:45	6913.815		6/20/99	22:50	6914.097	
6/20/99 23:47	6/20/99	23:45	6913.819		6/20/99	23:50	6914.102	
6/21/99 0:47	6/21/99	0:45	6913.816		6/21/99	0:50	6914.099	
6/21/99 1:47	6/21/99	1:45	6913.816		8/21/99	1:50	6914.097	
6/21/99 2:47	6/21/99	2:45	6913.814		6/21/99	2:50	6914.097	
6/21/99 3:47	6/21/99	3:45	6913.814		6/21/99	3:50	6914.099	
6/21/99 4:47	6/21/99	4:45	6913.808		6/21/99	4:50	6914.094	
6/21/99 5:47	6/21/99	5:45	6913.802		6/21/99	5:50	6914.091	
6/21/99 6:47	6/21/99	6:45	6913.796		6/21/99	6:50	6914.087	
6/21/99 7:47	6/21/99	7:45	6913.792		6/21/99	7:50	6914.08	
6/21/99 8:47	6/21/99	8:45	6913.779		6/21/99	8:50	6914.07	
6/21/99 9:47	6/21/99	9:45	6913.782		6/21/99	9:50	6914.07	
6/21/99 10:47	6/21/99	10:45	6913.774		6/21/99	10:50	6914.065	
6/21/99 11:47	6/21/99	11:45	6913.768		6/21/99	11:50	6914.058	
6/21/99 12:47	6/21/99	12:45	6913.763		6/21/99	12:50	6914.054	
6/21/99 13:47	6/21/99	13:45	6913.759		6/21/99	13:50	6914.052	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manuel	Date	Time	10S Continuous	10S Manual
6/21/99 14:47	6/21/99	14:45	6913.757		6/21/99	14:50	6914.051	
6/21/99 15:47	6/21/99	15:45	6913.75		6/21/99	15:50	6914.045	
6/21/99 16:47	6/21/99	16:45	6913.749		6/21/99	16:50	6914.042	
6/21/99 17:47	6/21/99	17:45	6913.744		6/21/99	17:50	6914.038	
6/21/99 16:47	6/21/99	18:45	6913.735		6/21/99	16:50	6914.029	
6/21/99 19:47	6/21/99	19:45	6913.726		6/21/99	19:50	6914.016	
6/21/99 20:47	6/21/99	20:45	6913.715		6/21/99	20:50	6914.004	
6/21/99 21:47	6/21/99	21:45	6913.706		6/21/99	21:50	6913.994	
6/21/99 22:47	6/21/99	22:45	6913.701		6/21/99	22:50	6913.983	
6/21/99 23:47	6/21/99	23:45	6913.699		6/21/99	23:50	6913.977	
6/22/99 0:47	6/22/99	0:45	6913.698		6/22/99	0:50	6913.976	
6/22/99 1:47	6/22/99	1:45	6913.693		6/22/99	1:50	6913.974	
6/22/99 2:47	6/22/99	2:45	6913.69		6/22/99	2:50	6913.973	
6/22/99 3:47	6/22/99	3:45	6913.687		6/22/99	3:50	6913.97	
6/22/99 4:47	6/22/99	4:45	6913.682		6/22/99	4:50	6913.964	
6/22/99 5:47	6/22/99	5:45	6913.675		6/22/99	5:50	6913.957	
6/22/99 6:47	6/22/99	6:45	6913.666		6/22/99	6:50	6913.945	
6/22/99 7:47	6/22/99	7:45	6913.662		6/22/99	7:50	6913.942	
6/22/99 8:47	6/22/99	8:45	6913.653		6/22/99	8:50	6913.938	
6/22/99 9:47	6/22/99	9:45	6913.65		6/22/99	9:50	8913.932	
6/22/99 10:47	6/22/99	10:45	6913.646		6/22/99	10:50	6913.932	
6/22/99 11:47	6/22/99	11:45	6913.64		6/22/99	11:50	6913.923	
6/22/99 12:47	6/22/99	12:45	6913.634		6/22/99	12:50	6913.919	
6/22/99 13:47	6/22/99	13:45	6913.631		6/22/99	13:50	6913.918	
6/22/99 14:47	6/22/99	14:45	6913.63		6/22/99	14:50	8913.918	
6/22/99 15:47	6/22/99	15:45	6913.824		6/22/99	15:50	6913.915	
6/22/99 16:47	6/22/99	18:45	6913.621		6/22/99	16:50	6913.91	
6/22/99 17:47	6/22/99	17:45	8913.614		6/22/99	17:50	6913.904	
6/22/99 18:47	6/22/99	18:45	6913.606		6/22/99	18:50	6913.898	
6/22/99 19:47	6/22/99	19:45	6913.595		6/22/99	19:50	6913.884	
6/22/99 20:47	6/22/99	20:45	6913.586		6/22/99	20:50	8913.874	
6/22/99 21:47	6/22/99	21:45	6913.575		6/22/99	21:50	6913.857	
6/22/99 22:47	6/22/99	22:45	6913.569		6/22/99	22:50	6913.847	
6/22/99 23:47	6/22/99	23:45	6913.566		6/22/99	23:50	6913.844	
6/23/99 0:47	6/23/99	0:45	6913.568		6/23/99	0:50	6913.841	
6/23/99 1:47	6/23/99	1:45	6913.561		6/23/99	1:50	6913.838	
6/23/99 2:47	6/23/99	2:45	6913.565		6/23/99	2:50	6913.839	
6/23/99 3:47	6/23/99	3:45	6913.581		6/23/99	3:50	6913.836	
6/23/99 4:47	6/23/99	4:45	6913.556		6/23/99	4:50	6913.835	
6/23/99 5:47	6/23/99	5:45	6913.547		6/23/99	5:50	6913.829	
6/23/99 6:47	6/23/99	6:45	6913.54		6/23/99	6:50	6913.823	
6/23/99 7:47	6/23/99	7:45	6913.537		6/23/99	7:50	6913.82	
6/23/99 8:47	6/23/99	8:45	8913.533		6/23/99	8:50	6913.818	
6/23/99 9:47	6/23/99	9:45	6913.533		6/23/99	9:50	6913.818	
6/23/99 10:47	6/23/99	10:45	6913.53		6/23/99	10:50	6913.818	
6/23/99 11:47	6/23/99	11:45	6913.53		6/23/99	11:50	6913.818	
6/23/99 12:47	6/23/99	12:45	6913.534		6/23/99	12:50	6913.822	
6/23/99 13:47	6/23/99	13:45	6913.531		6/23/99	13:50	6913.826	
6/23/99 14:47	6/23/99	14:45	6913.531		6/23/99	14:50	6913.826	
6/23/99 15:47	6/23/99	15:45	6913.527		6/23/99	15:50	6913.823	
6/23/99 16:47	6/23/99	16:45	6913.526		6/23/99	16:50	6913.825	
6/23/99 17:47	6/23/99	17:45	6913.526		6/23/99	17:50	6913.823	
6/23/99 18:47	6/23/99	18:45	6913.516		6/23/99	18:50	6913.819	
6/23/99 19:47	6/23/99	19:45	6913.508		6/23/99	19:50	6913.811	
6/23/99 20:47	6/23/99	20:45	6913.502		6/23/99	20:50	6913.803	
6/23/99 21:47	6/23/99	21:45	6913.497		6/23/99	21:50	6913.796	
6/23/99 22:47	6/23/99	22:45	6913.492		6/23/99	22:50	6913.789	
6/23/99 23:47	6/23/99	23:45	6913.491		6/23/99	23:50	6913.789	
6/24/99 0:47	6/24/99	0:45	8913.489		6/24/99	0:50	6913.787	
6/24/99 1:47	6/24/99	1:45	6913.491		6/24/99	1:50	6913.787	
6/24/99 2:47	6/24/99	2:45	6913.489		6/24/99	2:50	6913.787	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
6/24/99 3:47	6/24/99	3:45	6913.487		6/24/99	3:50	6913.787	
6/24/99 4:47	6/24/99	4:45	6913.484		6/24/99	4:50	6913.786	
6/24/99 5:47	6/24/99	5:45	6913.482		6/24/99	5:50	6913.784	
6/24/99 6:47	6/24/99	6:45	6913.478		6/24/99	6:50	6913.781	
6/24/99 7:47	6/24/99	7:45	6913.471		6/24/99	7:50	6913.778	
6/24/99 8:47	6/24/99	8:45	6913.465		6/24/99	8:50	6913.774	
6/24/99 9:47	6/24/99	9:45	6913.458		6/24/99	9:50	6913.77	
6/24/99 10:47	6/24/99	10:45	6913.453		6/24/99	10:50	6913.764	
6/24/99 11:47	6/24/99	11:45	6913.452		6/24/99	11:50	6913.76	
6/24/99 12:47	6/24/99	12:45	6913.448		6/24/99	12:50	6913.758	
6/24/99 13:47	6/24/99	13:45	6913.449		6/24/99	13:50	6913.76	
6/24/99 14:47	6/24/99	14:45	6913.445		6/24/99	14:50	6913.758	
6/24/99 15:47	6/24/99	15:45	6913.443		6/24/99	15:50	6913.757	
6/24/99 16:47	6/24/99	16:45	8913.442		6/24/99	18:50	6913.755	
6/24/99 17:47	6/24/99	17:45	6913.439		6/24/99	17:50	6913.755	
6/24/99 18:47	8/24/99	18:45	6913.435		6/24/99	18:50	6913.752	
6/24/99 19:47	6/24/99	19:45	6913.427		6/24/99	19:50	6913.742	
6/24/99 20:47	6/24/99	20:45	6913.42		6/24/99	20:50	6913.732	
6/24/99 21:47	6/24/99	21:45	6913.416		6/24/99	21:50	6913.728	
6/24/99 22:47	6/24/99	22:45	6913.41		6/24/99	22:50	8913.718	
6/24/99 23:47	6/24/99	23:45	6913.407		6/24/99	23:50	6913.716	
6/25/99 0:47	6/25/99	0:45	6913.411		6/25/99	0:50	6913.718	
6/25/99 1:47	6/25/99	1:45	6913.413		6/25/99	1:50	6913.724	
6/25/99 2:47	6/25/99	2:45	6913.413		6/25/99	2:50	6913.724	
6/25/99 3:47	6/25/99	3:45	6913.411		6/25/99	3:50	8913.725	
6/25/99 4:47	6/25/99	4:45	6913.41		6/25/99	4:50	6913.728	
6/25/99 5:47	6/25/99	5:45	6913.404		6/25/99	5:50	6913.721	
6/25/99 6:47	6/25/99	6:45	6913.393		6/25/99	6:50	6913.713	
6/25/99 7:47	6/25/99	7:45	6913.384		6/25/99	7:50	6913.703	
6/25/99 8:47	6/25/99	8:45	6913.378		6/25/99	8:50	6913.697	
6/25/99 9:47	6/25/99	9:45	6913.372		6/25/99	9:50	8913.693	
6/25/99 10:47	6/25/99	10:45	6913.365		6/25/99	10:50	6913.689	
6/25/99 11:47	6/25/99	11:45	6913.361		6/25/99	11:50	6913.679	
6/25/99 12:47	6/25/99	12:45	8913.352		6/25/99	12:50	8913.673	
6/25/99 13:47	6/25/99	13:45	6913.352		6/25/99	13:50	6913.667	
6/25/99 14:47	6/25/99	14:45	6913.349		6/25/99	14:50	8913.663	
6/25/99 15:47	6/25/99	15:45	6913.345		6/25/99	15:50	6913.663	
6/25/99 16:47	6/25/99	16:45	6913.345		6/25/99	16:50	8913.663	
6/25/99 17:47	6/25/99	17:45	6913.343		6/25/99	17:50	6913.66	
6/25/99 18:47	6/25/99	18:45	8913.336		6/25/99	18:50	8913.655	
6/25/99 19:47	6/25/99	19:45	8913.332		6/25/99	19:50	6913.648	
6/25/99 20:47	6/25/99	20:45	6913.326		6/25/99	20:50	6913.643	
6/25/99 21:47	6/25/99	21:45	6913.322		6/25/99	21:50	6913.638	
6/25/99 22:47	6/25/99	22:45	6913.316		6/25/99	22:50	6913.631	
6/25/99 23:47	6/25/99	23:45	6913.313		6/25/99	23:50	6913.628	
6/26/99 0:47	6/26/99	0:45	6913.307		6/26/99	0:50	6913.622	
6/26/99 1:47	6/26/99	1:45	6913.315		6/26/99	1:50	6913.627	
6/26/99 2:47	6/26/99	2:45	6913.313		6/26/99	2:50	6913.627	
6/26/99 3:47	6/26/99	3:45	6913.31		6/26/99	3:50	8913.625	
6/26/99 4:47	6/26/99	4:45	8913.309		6/26/99	4:50	6913.624	
6/26/99 5:47	6/26/99	5:45	6913.304		6/26/99	5:50	8913.619	
6/26/99 6:47	6/26/99	6:45	6913.298		6/26/99	6:50	6913.615	
6/26/99 7:47	6/26/99	7:45	6913.293		6/26/99	7:50	6913.61	
6/26/99 8:47	6/26/99	8:45	6913.284		6/26/99	8:50	6913.608	
6/26/99 9:47	6/26/99	9:45	6913.281		6/26/99	9:50	6913.606	
6/26/99 10:47	6/26/99	10:45	6913.28		6/26/99	10:50	6913.605	
6/26/99 11:47	6/26/99	11:45	6913.274		6/26/99	11:50	6913.596	
6/26/99 12:47	6/26/99	12:45	6913.268		6/26/99	12:50	6913.593	
6/26/99 13:47	6/26/99	13:45	6913.267		6/26/99	13:50	6913.589	
6/26/99 14:47	6/26/99	14:45	6913.262		6/26/99	14:50	6913.586	
6/26/99 15:47	6/26/99	15:45	6913.264		6/26/99	15:50	6913.585	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Dste	Time	10S Continuous	10S Manual
6/26/99 16:47	6/26/99	16:45	6913.259		6/26/99	16:50	6913.583	
6/26/99 17:47	6/26/99	17:45	6913.253		6/26/99	17:50	6913.579	
6/26/99 18:47	6/26/99	18:45	6913.252		6/26/99	18:50	6913.576	
6/26/99 19:47	6/26/99	19:45	6913.244		6/26/99	19:50	6913.568	
6/26/99 20:47	6/26/99	20:45	6913.236		6/26/99	20:50	6913.559	
6/26/99 21:47	6/26/99	21:45	8913.226		6/26/99	21:50	6913.547	
6/26/99 22:47	6/26/99	22:45	8913.222		6/26/99	22:50	6913.54	
6/26/99 23:47	6/26/99	23:45	6913.22		6/26/99	23:50	6913.537	
6/27/99 0:47	6/27/99	0:45	6913.213		6/27/99	0:50	6913.528	
6/27/99 1:47	6/27/99	1:45	6913.212		6/27/99	1:50	6913.524	
6/27/99 2:47	6/27/99	2:45	6913.209		6/27/99	2:50	6913.521	
6/27/99 3:47	6/27/99	3:45	8913.206		6/27/99	3:50	6913.515	
6/27/99 4:47	6/27/99	4:45	6913.199		6/27/99	4:50	6913.509	
6/27/99 5:47	6/27/99	5:45	6913.191		6/27/99	5:50	6913.499	
6/27/99 6:47	6/27/99	6:45	6913.186		6/27/99	6:50	6913.492	
6/27/99 7:47	6/27/99	7:45	6913.174		6/27/99	7:50	6913.483	
6/27/99 8:47	6/27/99	8:45	6913.171		6/27/99	8:50	6913.481	
6/27/99 9:47	6/27/99	9:45	6913.169		6/27/99	9:50	6913.479	
6/27/99 10:47	6/27/99	10:45	6913.164		6/27/99	10:50	6913.475	
6/27/99 11:47	6/27/99	11:45	6913.158		6/27/99	11:50	6913.47	
6/27/99 12:47	6/27/99	12:45	6913.155		6/27/99	12:50	6913.464	
6/27/99 13:47	6/27/99	13:45	6913.152		6/27/99	13:50	6913.464	
6/27/99 14:47	6/27/99	14:45	6913.149		6/27/99	14:50	6913.461	
6/27/99 15:47	6/27/99	15:45	6913.149		6/27/99	15:50	6913.461	
6/27/99 16:47	6/27/99	16:45	6913.147		6/27/99	16:50	6913.461	
6/27/99 17:47	6/27/99	17:45	8913.145		6/27/99	17:50	6913.459	
6/27/99 18:47	6/27/99	18:45	6913.138		6/27/99	18:50	8913.45	
6/27/99 19:47	6/27/99	19:45	6913.127		6/27/99	19:50	8913.439	
6/27/99 20:47	6/27/99	20:45	8913.121		6/27/99	20:50	6913.427	
6/27/99 21:47	6/27/99	21:45	8913.106		6/27/99	21:50	6913.412	
6/27/99 22:47	6/27/99	22:45	6913.103		6/27/99	22:50	6913.402	
6/27/99 23:47	6/27/99	23:45	6913.099		6/27/99	23:50	6913.4	
6/28/99 0:47	6/28/99	0:45	6913.096		6/28/99	0:50	6913.397	
6/28/99 1:47	6/28/99	1:45	6913.097		6/28/99	1:50	6913.399	
6/28/99 2:47	6/28/99	2:45	6913.099		6/28/99	2:50	6913.399	
6/28/99 3:47	6/28/99	3:45	6913.094		6/28/99	3:50	6913.394	
6/28/99 4:47	6/28/99	4:45	6913.094		8/28/99	4:50	6913.394	
6/28/99 5:47	6/28/99	5:45	6913.086		6/28/99	5:50	8913.389	
6/28/99 6:47	6/28/99	8:45	6913.077		6/28/99	6:50	8913.377	
6/28/99 7:47	6/28/99	7:45	8913.07		6/28/99	7:50	6913.37	
6/28/99 8:47	6/28/99	8:45	6913.061		6/28/99	8:50	6913.366	
6/28/99 9:47	6/28/99	9:45	6913.054		6/28/99	9:50	6913.36	
6/28/99 10:47	8/28/99	10:45	8913.05		6/28/99	10:50	6913.356	
6/28/99 11:47	6/28/99	11:45	8913.043		6/28/99	11:50	6913.349	
6/28/99 12:47	6/28/99	12:45	6913.041		6/28/99	12:50	6913.346	
8/28/99 13:47	6/28/99	13:45	6913.034		6/28/99	13:50	6913.343	
8/28/99 14:47	6/28/99	14:45	6913.034		6/28/99	14:50	6913.343	
6/28/99 15:47	6/28/99	15:45	6913.032		6/28/99	15:50	8913.338	
8/28/99 16:47	6/28/99	16:45	6913.031		6/28/99	16:50	8913.338	
8/28/99 17:47	6/28/99	17:45	6913.031		6/28/99	17:50	6913.338	
6/28/99 18:47	6/28/99	18:45	6913.029		6/28/99	18:50	8913.337	
6/28/99 19:47	6/28/99	19:45	6913.019		6/28/99	19:50	6913.327	
6/28/99 20:47	6/28/99	20:45	6913.006		6/28/99	20:50	6913.313	
6/28/99 21:47	8/28/99	21:45	6912.995		6/28/99	21:50	8913.298	
6/28/99 22:47	6/28/99	22:45	6912.989		6/28/99	22:50	8913.288	
6/28/99 23:47	6/28/99	23:45	8912.986		6/28/99	23:50	6913.262	
6/29/99 0:47	6/29/99	0:45	6912.986		6/29/99	0:50	6913.283	
6/29/99 1:47	6/29/99	1:45	6912.992		6/29/99	1:50	6913.288	
6/29/99 2:47	6/29/99	2:45	6912.987		6/29/99	2:50	6913.288	
6/29/99 3:47	6/29/99	3:45	6912.984		6/29/99	3:50	6913.283	
6/29/99 4:47	6/29/99	4:45	6912.983		6/29/99	4:50	6913.28	

Water Level Data

Avg Tima+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
6/29/99 5:47	6/29/99	5:45	6912.98		6/29/99	5:50	6913.279	
6/29/99 6:47	6/29/99	6:45	6912.982		6/29/99	6:50	6913.28	
6/29/99 7:47	6/29/99	7:45	6912.975		6/29/99	7:50	6913.277	
6/29/99 8:47	6/29/99	8:45	6912.97		6/29/99	8:50	6913.276	
6/29/99 9:47	6/29/99	9:45	6912.963		6/29/99	9:50	6913.272	
6/29/99 10:47	6/29/99	10:45	6912.957		6/29/99	10:50	6913.268	
6/29/99 11:47	6/29/99	11:45	6912.951		6/29/99	11:50	6913.265	
6/29/99 12:47	6/29/99	12:45	6912.948		6/29/99	12:50	6913.263	
6/29/99 13:47	6/29/99	13:45	6912.942		6/29/99	13:50	6913.256	
6/29/99 14:47	6/29/99	14:45	6912.942		6/29/99	14:50	6913.257	
6/29/99 15:47	6/29/99	15:45	6912.942		6/29/99	15:50	6913.257	
6/29/99 16:47	6/29/99	16:45	6912.941		6/29/99	16:50	6913.256	
6/29/99 17:47	6/29/99	17:45	6912.941		6/29/99	17:50	6913.257	
6/29/99 18:47	6/29/99	18:45	6912.94		6/29/99	18:50	6913.253	
6/29/99 19:47	6/29/99	19:45	6912.934		6/29/99	19:50	6913.247	
6/29/99 20:47	6/29/99	20:45	6912.924		6/29/99	20:50	6913.233	
6/29/99 21:47	6/29/99	21:45	6912.919		8/29/99	21:50	6913.229	
6/29/99 22:47	6/29/99	22:45	6912.912		6/29/99	22:50	6913.22	
6/29/99 23:47	6/29/99	23:45	8912.912		6/29/99	23:50	6913.221	
6/30/99 0:47	6/30/99	0:45	6912.914		6/30/99	0:50	6913.221	
6/30/99 1:47	6/30/99	1:45	6912.911		6/30/99	1:50	6913.221	
6/30/99 2:47	6/30/99	2:45	6912.912		6/30/99	2:50	6913.218	
6/30/99 3:47	6/30/99	3:45	6912.908		6/30/99	3:50	6913.217	
6/30/99 4:47	6/30/99	4:45	6912.906		6/30/99	4:50	6913.214	
6/30/99 5:47	6/30/99	5:45	6912.903		6/30/99	5:50	6913.211	
6/30/99 6:47	6/30/99	6:45	6912.899		6/30/99	6:50	6913.207	
6/30/99 7:47	6/30/99	7:45	6912.895		8/30/99	7:50	6913.205	
6/30/99 8:47	6/30/99	8:45	8912.891		6/30/99	8:50	6913.202	
6/30/99 9:47	6/30/99	9:45	6912.889		6/30/99	9:50	6913.207	
6/30/99 10:47	6/30/99	10:45	6912.886		6/30/99	10:50	6913.207	
6/30/99 11:47	6/30/99	11:45	8912.882		6/30/99	11:50	6913.202	
6/30/99 12:47	6/30/99	12:45	6912.876		6/30/99	12:50	6913.199	
6/30/99 13:47	6/30/99	13:45	6912.876		6/30/99	13:50	6913.199	
6/30/99 14:47	6/30/99	14:45	6912.873		6/30/99	14:50	6913.195	
6/30/99 15:47	6/30/99	15:45	6912.87		6/30/99	15:50	6913.195	
6/30/99 18:47	6/30/99	18:45	6912.869		6/30/99	16:50	6913.195	
6/30/99 17:47	6/30/99	17:45	6912.87		6/30/99	17:50	6913.196	
6/30/99 18:47	6/30/99	18:45	6912.866		6/30/99	18:50	6913.191	
6/30/99 19:47	6/30/99	19:45	6912.866		6/30/99	19:50	6913.188	
6/30/99 20:47	6/30/99	20:45	6912.861		6/30/99	20:50	6913.182	
6/30/99 21:47	6/30/99	21:45	6912.849		6/30/99	21:50	6913.169	
6/30/99 22:47	6/30/99	22:45	6912.846		6/30/99	22:50	6913.182	
6/30/99 23:47	6/30/99	23:45	6912.849		6/30/99	23:50	6913.165	
7/1/99 0:47	7/1/99	0:45	6912.847		7/1/99	0:50	8913.165	
7/1/99 1:47	7/1/99	1:45	6912.849		7/1/99	1:50	6913.165	
7/1/99 2:47	7/1/99	2:45	6912.853		7/1/99	2:50	6913.17	
7/1/99 3:47	7/1/99	3:45	6912.853		7/1/99	3:50	6913.172	
7/1/99 4:47	7/1/99	4:45	6912.85		7/1/99	4:50	6913.169	
7/1/99 5:47	7/1/99	5:45	6912.846		7/1/99	5:50	8913.166	
7/1/99 6:47	7/1/99	6:45	6912.841		7/1/99	6:50	6913.16	
7/1/99 7:47	7/1/99	7:45	6912.833		7/1/99	7:50	6913.154	
7/1/99 8:47	7/1/99	8:45	6912.83		7/1/99	8:50	6913.15	
7/1/99 9:47	7/1/99	9:45	6912.825		7/1/99	9:50	6913.149	
7/1/99 10:47	7/1/99	10:45	6912.821		7/1/99	10:50	6913.153	
7/1/99 11:47	7/1/99	11:45	6912.818		7/1/99	11:50	6913.148	
7/1/99 12:47	7/1/99	12:45	6912.815		7/1/99	12:50	6913.146	
7/1/99 13:47	7/1/99	13:45	6912.814		7/1/99	13:50	6913.148	
7/1/99 14:47	7/1/99	14:45	6912.813		7/1/99	14:50	6913.146	
7/1/99 15:47	7/1/99	15:45	6912.813		7/1/99	15:50	6913.149	
7/1/99 18:47	7/1/99	18:45	6912.813		7/1/99	16:50	6913.149	
7/1/99 17:47	7/1/99	17:45	6912.814		7/1/99	17:50	6913.149	

Avg Time+Data	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/1/99 16:47	7/1/99	16:45	6912.808		7/1/99	16:50	6913.145	
7/1/99 19:47	7/1/99	19:45	6912.807		7/1/99	19:50	6913.139	
7/1/99 20:47	7/1/99	20:45	6912.805		7/1/99	20:50	6913.136	
7/1/99 21:47	7/1/99	21:45	6912.799		7/1/99	21:50	6913.13	
7/1/99 22:47	7/1/99	22:45	6912.799		7/1/99	22:50	6913.128	
7/1/99 23:47	7/1/99	23:45	6912.801		7/1/99	23:50	6913.128	
7/2/99 0:47	7/2/99	0:45	6912.799		7/2/99	0:50	6913.128	
7/2/99 1:47	7/2/99	1:45	6912.798		7/2/99	1:50	6913.128	
7/2/99 2:47	7/2/99	2:45	6912.799		7/2/99	2:50	6913.13	
7/2/99 3:47	7/2/99	3:45	6912.796		7/2/99	3:50	6913.13	
7/2/99 4:47	7/2/99	4:45	6912.601		7/2/99	4:50	6913.136	
7/2/99 5:47	7/2/99	5:45	6912.799		7/2/99	5:50	6913.133	
7/2/99 6:47	7/2/99	6:45	6912.794		7/2/99	6:50	6913.128	
7/2/99 7:47	7/2/99	7:45	6912.789		7/2/99	7:50	6913.126	
7/2/99 8:47	7/2/99	8:45	6912.791		7/2/99	6:50	6913.128	
7/2/99 9:47	7/2/99	9:45	6912.794		7/2/99	9:50	6913.134	
7/2/99 10:47	7/2/99	10:45	6912.766		7/2/99	10:50	6913.131	
7/2/99 11:47	7/2/99	11:45	6912.776		7/2/99	11:50	6913.124	
7/2/99 12:47	7/2/99	12:45	6912.772		7/2/99	12:50	6913.115	
7/2/99 13:47	7/2/99	13:45	6912.771		7/2/99	13:50	6913.117	
7/2/99 14:47	7/2/99	14:45	6912.771		7/2/99	14:50	6913.116	
7/2/99 15:47	7/2/99	15:45	6912.765		7/2/99	15:50	6913.115	
7/2/99 16:47	7/2/99	16:45	6912.762		7/2/99	16:50	6913.112	
7/2/99 17:47	7/2/99	17:45	6912.754		7/2/99	17:50	6913.103	
7/2/99 18:47	7/2/99	18:45	6912.754		7/2/99	18:50	6913.097	
7/2/99 19:47	7/2/99	19:45	6912.746		7/2/99	19:50	6913.069	
7/2/99 20:47	7/2/99	20:45	6912.739		7/2/99	20:50	6913.081	
7/2/99 21:47	7/2/99	21:45	6912.737		7/2/99	21:50	6913.07	
7/2/99 22:47	7/2/99	22:45	6912.734		7/2/99	22:50	6913.07	
7/2/99 23:47	7/2/99	23:45	6912.734		7/2/99	23:50	6913.07	
7/3/99 0:47	7/3/99	0:45	6912.736		7/3/99	0:50	6913.07	
7/3/99 1:47	7/3/99	1:45	6912.734		7/3/99	1:50	6913.07	
7/3/99 2:47	7/3/99	2:45	6912.737		7/3/99	2:50	6913.073	
7/3/99 3:47	7/3/99	3:45	6912.74		7/3/99	3:50	6913.076	
7/3/99 4:47	7/3/99	4:45	6912.736		7/3/99	4:50	6913.076	
7/3/99 5:47	7/3/99	5:45	6912.734		7/3/99	5:50	6913.072	
7/3/99 6:47	7/3/99	6:45	6912.732		7/3/99	6:50	6913.068	
7/3/99 7:47	7/3/99	7:45	6912.721		7/3/99	7:50	6913.064	
7/3/99 8:47	7/3/99	8:45	6912.712		7/3/99	6:50	6913.052	
7/3/99 9:47	7/3/99	9:45	6912.707		7/3/99	9:50	6913.05	
7/3/99 10:47	7/3/99	10:45	6912.705		7/3/99	10:50	6913.046	
7/3/99 11:47	7/3/99	11:45	6912.697		7/3/99	11:50	6913.039	
7/3/99 12:47	7/3/99	12:45	6912.687		7/3/99	12:50	6913.026	
7/3/99 13:47	7/3/99	13:45	6912.679		7/3/99	13:50	6913.02	
7/3/99 14:47	7/3/99	14:45	6912.673		7/3/99	14:50	6913.016	
7/3/99 15:47	7/3/99	15:45	6912.672		7/3/99	15:50	6913.011	
7/3/99 16:47	7/3/99	16:45	6912.669		7/3/99	16:50	6913.01	
7/3/99 17:47	7/3/99	17:45	6912.669		7/3/99	17:50	6913.008	
7/3/99 18:47	7/3/99	16:45	6912.665		7/3/99	16:50	6913.005	
7/3/99 19:47	7/3/99	19:45	6912.665		7/3/99	19:50	6913	
7/3/99 20:47	7/3/99	20:45	6912.665		7/3/99	20:50	6913.001	
7/3/99 21:47	7/3/99	21:45	6912.659		7/3/99	21:50	6912.994	
7/3/99 22:47	7/3/99	22:45	6912.653		7/3/99	22:50	6912.985	
7/3/99 23:47	7/3/99	23:45	6912.652		7/3/99	23:50	6912.982	
7/4/99 0:47	7/4/99	0:45	6912.648		7/4/99	0:50	6912.972	
7/4/99 1:47	7/4/99	1:45	6912.636		7/4/99	1:50	6912.962	
7/4/99 2:47	7/4/99	2:45	6912.627		7/4/99	2:50	6912.956	
7/4/99 3:47	7/4/99	3:45	6912.623		7/4/99	3:50	6912.947	
7/4/99 4:47	7/4/99	4:45	6912.616		7/4/99	4:50	6912.939	
7/4/99 5:47	7/4/99	5:45	6912.608		7/4/99	5:50	6912.926	
7/4/99 6:47	7/4/99	6:45	6912.6		7/4/99	6:50	6912.914	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/4/99 7:47	7/4/99	7:45	6912.588		7/4/99	7:50	6912.903	
7/4/99 8:47	7/4/99	8:45	6912.581		7/4/99	8:50	6912.89	
7/4/99 9:47	7/4/99	9:45	6912.574		7/4/99	9:50	6912.882	
7/4/99 10:47	7/4/99	10:45	6912.564		7/4/99	10:50	6912.872	
7/4/99 11:47	7/4/99	11:45	6912.552		7/4/99	11:50	6912.859	
7/4/99 12:47	7/4/99	12:45	6912.546		7/4/99	12:50	6912.851	
7/4/99 13:47	7/4/99	13:45	6912.539		7/4/99	13:50	6912.846	
7/4/99 14:47	7/4/99	14:45	6912.533		7/4/99	14:50	6912.839	
7/4/99 15:47	7/4/99	15:45	6912.529		7/4/99	15:50	6912.836	
7/4/99 16:47	7/4/99	16:45	6912.524		7/4/99	18:50	6912.83	
7/4/99 17:47	7/4/99	17:45	8912.52		7/4/99	17:50	6912.826	
7/4/99 18:47	7/4/99	18:45	6912.509		7/4/99	18:50	6912.814	
7/4/99 19:47	7/4/99	19:45	6912.504		7/4/99	19:50	6912.804	
7/4/99 20:47	7/4/99	20:45	6912.491		7/4/99	20:50	6912.791	
7/4/99 21:47	7/4/99	21:45	6912.481		7/4/99	21:50	6912.775	
7/4/99 22:47	7/4/99	22:45	6912.477		7/4/99	22:50	6912.767	
7/4/99 23:47	7/4/99	23:45	6912.468		7/4/99	23:50	6912.762	
7/5/99 0:47	7/5/99	0:45	6912.465		7/5/99	0:50	6912.756	
7/5/99 1:47	7/5/99	1:45	6912.465		7/5/99	1:50	6912.752	
7/5/99 2:47	7/5/99	2:45	6912.462		7/5/99	2:50	6912.751	
7/5/99 3:47	7/5/99	3:45	8912.457		7/5/99	3:50	6912.752	
7/5/99 4:47	7/5/99	4:45	6912.449		7/5/99	4:50	6912.745	
7/5/99 5:47	7/5/99	5:45	6912.451		7/5/99	5:50	6912.742	
7/5/99 6:47	7/5/99	6:45	8912.446		7/5/99	6:50	6912.742	
7/5/99 7:47	7/5/99	7:45	6912.439		7/5/99	7:50	6912.736	
7/5/99 8:47	7/5/99	8:45	8912.432		7/5/99	8:50	6912.731	
7/5/99 9:47	7/5/99	9:45	6912.432		7/5/99	9:50	6912.732	
7/5/99 10:47	7/5/99	10:45	6912.432		7/5/99	10:50	6912.738	
7/5/99 11:47	7/5/99	11:45	6912.428		7/5/99	11:50	6912.735	
7/5/99 12:47	7/5/99	12:45	6912.426		7/5/99	12:50	6912.736	
7/5/99 13:47	7/5/99	13:45	6912.422		7/5/99	13:50	6912.736	
7/5/99 14:47	7/5/99	14:45	6912.419		7/5/99	14:50	6912.736	
7/5/99 15:47	7/5/99	15:45	6912.412		7/5/99	15:50	6912.731	
7/5/99 16:47	7/5/99	16:45	6912.409		7/5/99	16:50	6912.729	
7/5/99 17:47	7/5/99	17:45	6912.406		7/5/99	17:50	6912.726	
7/5/99 18:47	7/5/99	18:45	6912.398		7/5/99	18:50	8912.72	
7/5/99 19:47	7/5/99	19:45	6912.392		7/5/99	19:50	6912.706	
7/5/99 20:47	7/5/99	20:45	6912.388		7/5/99	20:50	6912.899	
7/5/99 21:47	7/5/99	21:45	6912.374		7/5/99	21:50	6912.684	
7/5/99 22:47	7/5/99	22:45	6912.37		7/5/99	22:50	6912.675	
7/5/99 23:47	7/5/99	23:45	6912.387		7/5/99	23:50	6912.672	
7/6/99 0:47	7/6/99	0:45	6912.384		7/6/99	0:50	6912.669	
7/6/99 1:47	7/6/99	1:45	6912.362		7/6/99	1:50	6912.688	
7/6/99 2:47	7/6/99	2:45	6912.359		7/6/99	2:50	6912.662	
7/6/99 3:47	7/6/99	3:45	6912.354		7/6/99	3:50	8912.661	
7/6/99 4:47	7/6/99	4:45	6912.35		7/6/99	4:50	6912.661	
7/6/99 5:47	7/6/99	5:45	6912.345		7/6/99	5:50	6912.655	
7/6/99 6:47	7/6/99	6:45	6912.342		7/6/99	6:50	6912.651	
7/6/99 7:47	7/6/99	7:45	6912.338		7/6/99	7:50	6912.847	
7/6/99 8:47	7/6/99	8:45	6912.334		7/6/99	8:50	6912.647	
7/6/99 9:47	7/6/99	9:45	6912.332		7/6/99	9:50	6912.648	
7/6/99 10:47	7/6/99	10:45	6912.331		7/6/99	10:50	6912.647	
7/6/99 11:47	7/6/99	11:45	6912.326		7/6/99	11:50	6912.644	
7/6/99 12:47	7/6/99	12:45	8912.322		7/6/99	12:50	6912.642	
7/6/99 13:47	7/6/99	13:45	6912.315		7/6/99	13:50	6912.639	
7/6/99 14:47	7/6/99	14:45	6912.312		7/6/99	14:50	6912.636	
7/6/99 15:47	7/6/99	15:45	6912.311		7/6/99	15:50	6912.635	
7/6/99 16:47	7/6/99	16:45	6912.306		7/6/99	16:50	6912.636	
7/6/99 17:47	7/6/99	17:45	6912.305		7/6/99	17:50	6912.636	
7/6/99 18:47	7/6/99	18:45	6912.303		7/6/99	18:50	8912.63	
7/6/99 19:47	7/6/99	19:45	8912.296		7/6/99	19:50	6912.625	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/6/99 20:47	7/6/99	20:45	6912.29		7/6/99	20:50	6912.613	
7/6/99 21:47	7/6/99	21:45	6912.283		7/6/99	21:50	6912.603	
7/6/99 22:47	7/6/99	22:45	6912.274		7/6/99	22:50	6912.591	
7/6/99 23:47	7/6/99	23:45	6912.27		7/6/99	23:50	6912.567	
7/7/99 0:47	7/7/99	0:45	6912.272		7/7/99	0:50	6912.588	
7/7/99 1:47	7/7/99	1:45	6912.273		7/7/99	1:50	6912.588	
7/7/99 2:47	7/7/99	2:45	6912.273		7/7/99	2:50	6912.594	
7/7/99 3:47	7/7/99	3:45	6912.266		7/7/99	3:50	6912.588	
7/7/99 4:47	7/7/99	4:45	6912.261		7/7/99	4:50	8912.584	
7/7/99 5:47	7/7/99	5:45	8912.254		7/7/99	5:50	6912.577	
7/7/99 6:47	7/7/99	6:45	6912.248		7/7/99	6:50	6912.57	
7/7/99 7:47	7/7/99	7:45	6912.238		7/7/99	7:50	6912.56	
7/7/99 8:47	7/7/99	8:45	6912.231		7/7/99	8:50	6912.554	
7/7/99 9:47	7/7/99	9:45	6912.225		7/7/99	9:50	6912.543	
7/7/99 10:47	7/7/99	10:45	6912.218		7/7/99	10:50	6912.536	
7/7/99 11:47	7/7/99	11:45	6912.212		7/7/99	11:50	6912.532	
7/7/99 12:47	7/7/99	12:45	6912.206		7/7/99	12:50	6912.523	
7/7/99 13:47	7/7/99	13:45	6912.202		7/7/99	13:50	6912.521	
7/7/99 14:47	7/7/99	14:45	6912.201		7/7/99	14:50	6912.521	
7/7/99 15:47	7/7/99	15:45	6912.198		7/7/99	15:50	6912.523	
7/7/99 16:47	7/7/99	16:45	6912.201		7/7/99	16:50	6912.529	
7/7/99 17:47	7/7/99	17:45	6912.195		7/7/99	17:50	6912.522	
7/7/99 18:47	7/7/99	18:45	6912.188		7/7/99	18:50	6912.516	
7/7/99 19:47	7/7/99	19:45	6912.176		7/7/99	19:50	6912.503	
7/7/99 20:47	7/7/99	20:45	6912.166		7/7/99	20:50	6912.484	
7/7/99 21:47	7/7/99	21:45	6912.148		7/7/99	21:50	6912.464	
7/7/99 22:47	7/7/99	22:45	6912.14		7/7/99	22:50	6912.453	
7/7/99 23:47	7/7/99	23:45	6912.135		7/7/99	23:50	6912.445	
7/8/99 0:47	7/8/99	0:45	6912.134		7/8/99	0:50	6912.442	
7/8/99 1:47	7/8/99	1:45	6912.132		7/8/99	1:50	6912.444	
7/8/99 2:47	7/8/99	2:45	6912.131		7/8/99	2:50	6912.445	
7/8/99 3:47	7/8/99	3:45	6912.127		7/8/99	3:50	8912.439	
7/8/99 4:47	7/8/99	4:45	6912.123		7/8/99	4:50	6912.435	
7/6/99 5:47	7/8/99	5:45	6912.117		7/6/99	5:50	6912.428	
7/8/99 6:47	7/8/99	6:45	6912.108		7/8/99	6:50	6912.422	
7/8/99 7:47	7/8/99	7:45	6912.102		7/8/99	7:50	6912.415	
7/8/99 8:47	7/8/99	8:45	6912.099		7/8/99	8:50	6912.406	
7/8/99 9:47	7/8/99	9:45	6912.098		7/8/99	9:50	6912.413	
7/8/99 10:47	7/8/99	10:45	6912.093		7/8/99	10:50	6912.412	
7/8/99 11:47	7/8/99	11:45	6912.09		7/8/99	11:50	6912.408	
7/8/99 12:47	7/8/99	12:45	6912.09		7/8/99	12:50	6912.408	
7/8/99 13:47	7/8/99	13:45	6912.089		7/8/99	13:50	6912.413	
7/8/99 14:47	7/8/99	14:45	6912.088		7/8/99	14:50	6912.415	
7/8/99 15:47	7/8/99	15:45	6912.085		7/8/99	15:50	6912.413	
7/8/99 16:47	7/8/99	16:45	6912.078		7/8/99	16:50	6912.411	
7/8/99 17:47	7/8/99	17:45	6912.07		7/8/99	17:50	6912.405	
7/8/99 18:47	7/8/99	18:45	6912.063		7/8/99	18:50	6912.395	
7/8/99 19:47	7/8/99	19:45	6912.053		7/8/99	19:50	6912.361	
7/8/99 20:47	7/8/99	20:45	6912.043		7/8/99	20:50	6912.366	
7/8/99 21:47	7/8/99	21:45	6912.027		7/8/99	21:50	6912.345	
7/8/99 22:47	7/8/99	22:45	6912.024		7/8/99	22:50	6912.338	
7/8/99 23:47	7/8/99	23:45	6912.02		7/8/99	23:50	6912.332	
7/9/99 0:47	7/9/99	0:45	6912.02		7/9/99	0:50	6912.33	
7/9/99 1:47	7/9/99	1:45	6912.013		7/9/99	1:50	6912.321	
7/9/99 2:47	7/9/99	2:45	6912.013		7/9/99	2:50	6912.319	
7/9/99 3:47	7/9/99	3:45	6912.007		7/9/99	3:50	6912.319	
7/9/99 4:47	7/9/99	4:45	6912.001		7/9/99	4:50	6912.319	
7/9/99 5:47	7/9/99	5:45	6911.994		7/9/99	5:50	6912.293	
7/9/99 6:47	7/9/99	6:45	6911.983		7/9/99	6:50	6912.297	
7/9/99 7:47	7/9/99	7:45	6911.976		7/9/99	7:50	6912.289	
7/9/99 8:47	7/9/99	6:45	6911.972		7/9/99	8:50	6912.277	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/9/99 9:47	7/9/99	9:45	6911.968		7/9/99	9:50	6912.285	
7/9/99 10:47	7/9/99	10:45	6911.963		7/9/99	10:50	6912.283	
7/9/99 11:47	7/9/99	11:45	6911.961		7/9/99	11:50	6912.279	
7/9/99 12:47	7/9/99	12:45	6911.959		7/9/99	12:50	6912.26	
7/9/99 13:47	7/9/99	13:45	6911.961		7/9/99	13:50	6912.285	
7/9/99 14:47	7/9/99	14:45	6911.959		7/9/99	14:50	6912.292	
7/9/99 15:47	7/9/99	15:45	6911.955		7/9/99	15:50	8912.282	
7/9/99 16:47	7/9/99	16:45	6911.95		7/9/99	16:50	6912.283	
7/9/99 17:47	7/9/99	17:45	6911.944		7/9/99	17:50	6912.274	
7/9/99 18:47	7/9/99	18:45	6911.935		7/9/99	16:50	6912.264	
7/9/99 19:47	7/9/99	19:45	6911.923		7/9/99	19:50	6912.25	
7/9/99 20:47	7/9/99	20:45	6911.908		7/9/99	20:50	6912.231	
7/9/99 21:47	7/9/99	21:45	6911.698		7/9/99	21:50	6912.215	
7/9/99 22:47	7/9/99	22:45	6911.893		7/9/99	22:50	6912.208	
7/9/99 23:47	7/9/99	23:45	6911.888		7/9/99	23:50	6912.199	
7/10/99 0:47	7/10/99	0:45	6911.667		7/10/99	0:50	6912.198	
7/10/99 1:47	7/10/99	1:45	6911.862		7/10/99	1:50	6912.195	
7/10/99 2:47	7/10/99	2:45	6911.862		7/10/99	2:50	6912.195	
7/10/99 3:47	7/10/99	3:45	6911.677		7/10/99	3:50	6912.169	
7/10/99 4:47	7/10/99	4:45	6911.869		7/10/99	4:50	6912.182	
7/10/99 5:47	7/10/99	5:45	6911.863		7/10/99	5:50	6912.16	
7/10/99 6:47	7/10/99	6:45	6911.856		7/10/99	6:50	6912.17	
7/10/99 7:47	7/10/99	7:45	6911.848		7/10/99	7:50	6912.165	
7/10/99 8:47	7/10/99	8:45	6911.839		7/10/99	8:50	6912.156	
7/10/99 9:47	7/10/99	9:45	6911.835		7/10/99	9:50	8912.15	
7/10/99 10:47	7/10/99	10:45	6911.829		7/10/99	10:50	6912.148	
7/10/99 11:47	7/10/99	11:45	6911.826		7/10/99	11:50	6912.144	
7/10/99 12:47	7/10/99	12:45	6911.824		7/10/99	12:50	6912.147	
7/10/99 13:47	7/10/99	13:45	6911.827		7/10/99	13:50	6912.153	
7/10/99 14:47	7/10/99	14:45	6911.823		7/10/99	14:50	6912.146	
7/10/99 15:47	7/10/99	15:45	6911.817		7/10/99	15:50	8912.14	
7/10/99 18:47	7/10/99	16:45	6911.815		7/10/99	16:50	6912.143	
7/10/99 17:47	7/10/99	17:45	8911.812		7/10/99	17:50	8912.141	
7/10/99 18:47	7/10/99	18:45	6911.804		7/10/99	18:50	6912.135	
7/10/99 19:47	7/10/99	19:45	6911.793		7/10/99	19:50	6912.121	
7/10/99 20:47	7/10/99	20:45	6911.787		7/10/99	20:50	6912.117	
7/10/99 21:47	7/10/99	21:45	6911.773		7/10/99	21:50	6912.099	
7/10/99 22:47	7/10/99	22:45	6911.771		7/10/99	22:50	6912.093	
7/10/99 23:47	7/10/99	23:45	6911.764		7/10/99	23:50	8912.086	
7/11/99 0:47	7/11/99	0:45	6911.762		7/11/99	0:50	6912.064	
7/11/99 1:47	7/11/99	1:45	6911.764		7/11/99	1:50	6912.086	
7/11/99 2:47	7/11/99	2:45	6911.762		7/11/99	2:50	6912.086	
7/11/99 3:47	7/11/99	3:45	6911.759		7/11/99	3:50	6912.085	
7/11/99 4:47	7/11/99	4:45	6911.755		7/11/99	4:50	6912.085	
7/11/99 5:47	7/11/99	5:45	6911.749		7/11/99	5:50	6912.078	
7/11/99 6:47	7/11/99	6:45	6911.739		7/11/99	6:50	6912.072	
7/11/99 7:47	7/11/99	7:45	8911.732		7/11/99	7:50	6912.064	
7/11/99 8:47	7/11/99	8:45	6911.722		7/11/99	8:50	6912.054	
7/11/99 9:47	7/11/99	9:45	6911.713		7/11/99	9:50	6912.047	
7/11/99 10:47	7/11/99	10:45	6911.706		7/11/99	10:50	8912.039	
7/11/99 11:47	7/11/99	11:45	6911.703		7/11/99	11:50	6912.033	
7/11/99 12:47	7/11/99	12:45	6911.705		7/11/99	12:50	6912.037	
7/11/99 13:47	7/11/99	13:45	6911.708		7/11/99	13:50	6912.044	
7/11/99 14:47	7/11/99	14:45	6911.711		7/11/99	14:50	6912.053	
7/11/99 15:47	7/11/99	15:45	6911.711		7/11/99	15:50	6912.057	
7/11/99 18:47	7/11/99	16:45	6911.708		7/11/99	16:50	6912.059	
7/11/99 17:47	7/11/99	17:45	6911.705		7/11/99	17:50	6912.057	
7/11/99 18:47	7/11/99	18:45	6911.697		7/11/99	18:50	8912.05	
7/11/99 19:47	7/11/99	19:45	6911.687		7/11/99	19:50	6912.037	
7/11/99 20:47	7/11/99	20:45	6911.678		7/11/99	20:50	6912.027	
7/11/99 21:47	7/11/99	21:45	6911.666		7/11/99	21:50	6912.012	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/11/99 22:47	7/11/99	22:45	6911.663		7/11/99	22:50	6912.008	
7/11/99 23:47	7/11/99	23:45	6911.66		7/11/99	23:50	6912.004	
7/12/99 0:47	7/12/99	0:45	6911.654		7/12/99	0:50	6912.001	
7/12/99 1:47	7/12/99	1:45	6911.657		7/12/99	1:50	6912.004	
7/12/99 2:47	7/12/99	2:45	6911.654		7/12/99	2:50	6912.004	
7/12/99 3:47	7/12/99	3:45	6911.652		7/12/99	3:50	6912.001	
7/12/99 4:47	7/12/99	4:45	6911.645		7/12/99	4:50	6911.994	
7/12/99 5:47	7/12/99	5:45	6911.836		7/12/99	5:50	6911.985	
7/12/99 6:47	7/12/99	6:45	6911.829		7/12/99	6:50	6911.978	
7/12/99 7:47	7/12/99	7:45	6911.622		7/12/99	7:50	6911.969	
7/12/99 8:47	7/12/99	8:45	6911.61		7/12/99	8:50	6911.963	
7/12/99 9:47	7/12/99	9:45	6911.602		7/12/99	9:50	6911.958	
7/12/99 10:47	7/12/99	10:45	6911.599		7/12/99	10:50	6911.955	
7/12/99 11:47	7/12/99	11:45	6911.592		7/12/99	11:50	6911.952	
7/12/99 12:47	7/12/99	12:45	6911.595		7/12/99	12:50	6911.955	
7/12/99 13:47	7/12/99	13:45	6911.595		7/12/99	13:50	6911.958	
7/12/99 14:47	7/12/99	14:45	6911.595		7/12/99	14:50	6911.959	
7/12/99 15:47	7/12/99	15:45	6911.596		7/12/99	15:50	6911.965	
7/12/99 16:47	7/12/99	18:45	6911.8		7/12/99	16:50	6911.969	
7/12/99 17:47	7/12/99	17:45	6911.595		7/12/99	17:50	6911.966	
7/12/99 18:47	7/12/99	18:45	6911.589		7/12/99	18:50	6911.962	
7/12/99 19:47	7/12/99	19:45	6911.576		7/12/99	19:50	6911.943	
7/12/99 20:47	7/12/99	20:45	6911.564		7/12/99	20:50	6911.93	
7/12/99 21:47	7/12/99	21:45	6911.554		7/12/99	21:50	6911.916	
7/12/99 22:47	7/12/99	22:45	6911.548		7/12/99	22:50	6911.913	
7/12/99 23:47	7/12/99	23:45	6911.548		7/12/99	23:50	6911.913	
7/13/99 0:47	7/13/99	0:45	6911.544		7/13/99	0:50	6911.91	
7/13/99 1:47	7/13/99	1:45	6911.54		7/13/99	1:50	6911.907	
7/13/99 2:47	7/13/99	2:45	6911.541		7/13/99	2:50	6911.908	
7/13/99 3:47	7/13/99	3:45	6911.543		7/13/99	3:50	6911.908	
7/13/99 4:47	7/13/99	4:45	6911.537		7/13/99	4:50	6911.904	
7/13/99 5:47	7/13/99	5:45	6911.528		7/13/99	5:50	6911.899	
7/13/99 6:47	7/13/99	6:45	6911.521		7/13/99	6:50	6911.889	
7/13/99 7:47	7/13/99	7:45	6911.515		7/13/99	7:50	6911.884	
7/13/99 8:47	7/13/99	8:45	6911.506		7/13/99	8:50	6911.878	
7/13/99 9:47	7/13/99	9:45	6911.503		7/13/99	9:50	6911.877	
7/13/99 10:47	7/13/99	10:45	6911.498		7/13/99	10:50	6911.878	
7/13/99 11:47	7/13/99	11:45	6911.493		7/13/99	11:50	6911.875	
7/13/99 12:47	7/13/99	12:45	6911.492		7/13/99	12:50	6911.875	
7/13/99 13:47	7/13/99	13:45	6911.495		7/13/99	13:50	6911.878	
7/13/99 14:47	7/13/99	14:45	6911.496		7/13/99	14:50	6911.879	
7/13/99 15:47	7/13/99	15:45	6911.487		7/13/99	15:50	6911.869	
7/13/99 16:47	7/13/99	16:45	6911.479		7/13/99	16:50	6911.856	
7/13/99 17:47	7/13/99	17:45	6911.493		7/13/99	17:50	6911.874	
7/13/99 18:47	7/13/99	18:45	6911.476		7/13/99	18:50	6911.856	
7/13/99 19:47	7/13/99	19:45	6911.464		7/13/99	19:50	6911.847	
7/13/99 20:47	7/13/99	20:45	6911.451		7/13/99	20:50	6911.832	
7/13/99 21:47	7/13/99	21:45	6911.441		7/13/99	21:50	6911.816	
7/13/99 22:47	7/13/99	22:45	6911.447		7/13/99	22:50	6911.823	
7/13/99 23:47	7/13/99	23:45	6911.444		7/13/99	23:50	6911.824	
7/14/99 0:47	7/14/99	0:45	6911.437		7/14/99	0:50	6911.817	
7/14/99 1:47	7/14/99	1:45	6911.44		7/14/99	1:50	6911.816	
7/14/99 2:47	7/14/99	2:45	6911.436		7/14/99	2:50	6911.62	
7/14/99 3:47	7/14/99	3:45	6911.436		7/14/99	3:50	6911.815	
7/14/99 4:47	7/14/99	4:45	6911.431		7/14/99	4:50	6911.815	
7/14/99 5:47	7/14/99	5:45	6911.425		7/14/99	5:50	6911.805	
7/14/99 6:47	7/14/99	6:45	6911.421		7/14/99	6:50	6911.801	
7/14/99 7:47	7/14/99	7:45	6911.412		7/14/99	7:50	6911.796	
7/14/99 8:47	7/14/99	8:45	6911.402		7/14/99	8:50	6911.791	
7/14/99 9:47	7/14/99	9:45	6911.401		7/14/99	9:50	6911.794	
7/14/99 10:47	7/14/99	10:45	6911.395		7/14/99	10:50	6911.781	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/14/99 11:47	7/14/99	11:45	6911.382		7/14/99	11:50	6911.772	
7/14/99 12:47	7/14/99	12:45	6911.377		7/14/99	12:50	6911.769	
7/14/99 13:47	7/14/99	13:45	6911.373		7/14/99	13:50	6911.768	
7/14/99 14:47	7/14/99	14:45	6911.371		7/14/99	14:50	6911.765	
7/14/99 15:47	7/14/99	15:45	6911.369		7/14/99	15:50	6911.765	
7/14/99 16:47	7/14/99	16:45	6911.372		7/14/99	16:50	6911.766	
7/14/99 17:47	7/14/99	17:45	6911.368		7/14/99	17:50	6911.762	
7/14/99 18:47	7/14/99	18:45	6911.365		7/14/99	18:50	6911.756	
7/14/99 19:47	7/14/99	19:45	6911.35		7/14/99	19:50	6911.745	
7/14/99 20:47	7/14/99	20:45	6911.343		7/14/99	20:50	6911.734	
7/14/99 21:47	7/14/99	21:45	6911.335		7/14/99	21:50	6911.724	
7/14/99 22:47	7/14/99	22:45	6911.33		7/14/99	22:50	6911.716	
7/14/99 23:47	7/14/99	23:45	6911.326		7/14/99	23:50	6911.714	
7/15/99 0:47	7/15/99	0:45	6911.321		7/15/99	0:50	6911.709	
7/15/99 1:47	7/15/99	1:45	6911.318		7/15/99	1:50	6911.706	
7/15/99 2:47	7/15/99	2:45	6911.317		7/15/99	2:50	6911.704	
7/15/99 3:47	7/15/99	3:45	6911.315		7/15/99	3:50	6911.704	
7/15/99 4:47	7/15/99	4:45	8911.307		7/15/99	4:50	6911.695	
7/15/99 5:47	7/15/99	5:45	6911.302		7/15/99	5:50	6911.689	
7/15/99 6:47	7/15/99	6:45	6911.293		7/15/99	6:50	6911.68	
7/15/99 7:47	7/15/99	7:45	6911.282		7/15/99	7:50	6911.671	
7/15/99 8:47	7/15/99	8:45	8911.273		7/15/99	8:50	6911.665	
7/15/99 9:47	7/15/99	9:45	6911.266		7/15/99	9:50	8911.656	
7/15/99 10:47	7/15/99	10:45	6911.261		7/15/99	10:50	6911.649	
7/15/99 11:47	7/15/99	11:45	6911.255		7/15/99	11:50	6911.642	
7/15/99 12:47	7/15/99	12:45	6911.245		7/15/99	12:50	6911.636	
7/15/99 13:47	7/15/99	13:45	6911.242		7/15/99	13:50	6911.636	
7/15/99 14:47	7/15/99	14:45	6911.239		7/15/99	14:50	6911.635	
7/15/99 15:47	7/15/99	15:45	6911.234		7/15/99	15:50	6911.633	
7/15/99 16:47	7/15/99	16:45	6911.23		7/15/99	16:50	6911.627	
7/15/99 17:47	7/15/99	17:45	6911.23		7/15/99	17:50	6911.625	
7/15/99 16:47	7/15/99	18:45	6911.224		7/15/99	18:50	6911.62	
7/15/99 19:47	7/15/99	19:45	6911.217		7/15/99	19:50	6911.61	
7/15/99 20:47	7/15/99	20:45	6911.213		7/15/99	20:50	6911.602	
7/15/99 21:47	7/15/99	21:45	6911.201		7/15/99	21:50	6911.596	
7/15/99 22:47	7/15/99	22:45	6911.191		7/15/99	22:50	6911.585	
7/15/99 23:47	7/15/99	23:45	6911.187		7/15/99	23:50	6911.58	
7/16/99 0:47	7/16/99	0:45	6911.188		7/16/99	0:50	6911.578	
7/16/99 1:47	7/16/99	1:45	6911.178		7/16/99	1:50	8911.572	
7/16/99 2:47	7/16/99	2:45	6911.174		7/16/99	2:50	6911.568	
7/16/99 3:47	7/16/99	3:45	6911.171		7/16/99	3:50	6911.565	
7/16/99 4:47	7/16/99	4:45	6911.165		7/16/99	4:50	6911.561	
7/16/99 5:47	7/16/99	5:45	6911.161		7/16/99	5:50	6911.555	
7/16/99 6:47	7/16/99	6:45	6911.149		7/16/99	6:50	6911.546	
7/16/99 7:47	7/16/99	7:45	6911.147		7/16/99	7:50	6911.542	
7/16/99 8:47	7/16/99	8:45	6911.136		7/16/99	8:50	6911.532	
7/16/99 9:47	7/16/99	9:45	6911.125		7/16/99	9:50	6911.523	
7/16/99 10:47	7/16/99	10:45	6911.12		7/16/99	10:50	6911.515	
7/16/99 11:47	7/16/99	11:45	6911.109		7/16/99	11:50	6911.507	
7/16/99 12:47	7/16/99	12:45	6911.105		7/16/99	12:50	6911.503	
7/16/99 13:47	7/16/99	13:45	6911.097		7/16/99	13:50	6911.496	
7/16/99 14:47	7/16/99	14:45	6911.091		7/16/99	14:50	6911.494	
7/16/99 15:47	7/16/99	15:45	6911.09		7/16/99	15:50	6911.488	
7/16/99 16:47	7/16/99	16:45	6911.084		7/16/99	16:50	8911.487	
7/16/99 17:47	7/16/99	17:45	6911.083		7/16/99	17:50	6911.484	
7/16/99 18:47	7/16/99	18:45	6911.077		7/16/99	18:50	6911.481	
7/16/99 19:47	7/16/99	19:45	6911.07		7/16/99	19:50	6911.473	
7/16/99 20:47	7/16/99	20:45	6911.064		7/16/99	20:50	6911.464	
7/16/99 21:47	7/16/99	21:45	6911.052		7/16/99	21:50	6911.451	
7/16/99 22:47	7/16/99	22:45	6911.042		7/16/99	22:50	6911.439	
7/16/99 23:47	7/16/99	23:45	6911.038		7/16/99	23:50	6911.431	

Avg Time+Date	Date	Time	10D Continuous	10D Menual	Date	Time	10S Continuous	10S Manual
7/17/99 0:47	7/17/99	0:45	6911.029		7/17/99	0:50	6911.425	
7/17/99 1:47	7/17/99	1:45	6911.025		7/17/99	1:50	6911.42	
7/17/99 2:47	7/17/99	2:45	6911.018		7/17/99	2:50	6911.418	
7/17/99 3:47	7/17/99	3:45	6911.016		7/17/99	3:50	6911.413	
7/17/99 4:47	7/17/99	4:45	6911.01		7/17/99	4:50	6911.407	
7/17/99 5:47	7/17/99	5:45	6911.006		7/17/99	5:50	6911.402	
7/17/99 8:47	7/17/99	8:45	6910.99		7/17/99	6:50	6911.392	
7/17/99 7:47	7/17/99	7:45	6910.993		7/17/99	7:50	6911.387	
7/17/99 8:47	7/17/99	8:45	6910.983		7/17/99	8:50	6911.383	
7/17/99 9:47	7/17/99	9:45	6910.977		7/17/99	9:50	6911.374	
7/17/99 10:47	7/17/99	10:45	6910.967		7/17/99	10:50	6911.371	
7/17/99 11:47	7/17/99	11:45	6910.961		7/17/99	11:50	6911.363	
7/17/99 12:47	7/17/99	12:45	6910.959		7/17/99	12:50	6911.36	
7/17/99 13:47	7/17/99	13:45	6910.948		7/17/99	13:50	6911.353	
7/17/99 14:47	7/17/99	14:45	6910.941		7/17/99	14:50	6911.348	
7/17/99 15:47	7/17/99	15:45	6910.938		7/17/99	15:50	6911.344	
7/17/99 16:47	7/17/99	16:45	6910.931		7/17/99	16:50	6911.339	
7/17/99 17:47	7/17/99	17:45	6910.927		7/17/99	17:50	6911.336	
7/17/99 16:47	7/17/99	18:45	6910.924		7/17/99	18:50	6911.332	
7/17/99 19:47	7/17/99	19:45	6910.915		7/17/99	19:50	6911.323	
7/17/99 20:47	7/17/99	20:45	6910.911		7/17/99	20:50	6911.315	
7/17/99 21:47	7/17/99	21:45	6910.902		7/17/99	21:50	6911.303	
7/17/99 22:47	7/17/99	22:45	6910.892		7/17/99	22:50	6911.294	
7/17/99 23:47	7/17/99	23:45	6910.879		7/17/99	23:50	6911.28	
7/18/99 0:47	7/18/99	0:45	6910.867		7/18/99	0:50	6911.267	
7/18/99 1:47	7/18/99	1:45	6910.864		7/18/99	1:50	6911.261	
7/18/99 2:47	7/18/99	2:45	6910.863		7/18/99	2:50	6911.26	
7/18/99 3:47	7/18/99	3:45	6910.857		7/18/99	3:50	6911.257	
7/18/99 4:47	7/18/99	4:45	6910.85		7/18/99	4:50	6911.252	
7/18/99 5:47	7/18/99	5:45	6910.843		7/18/99	5:50	6911.243	
7/18/99 6:47	7/18/99	6:45	6910.838		7/18/99	6:50	6911.234	
7/18/99 7:47	7/18/99	7:45	6910.833		7/18/99	7:50	6911.23	
7/18/99 8:47	7/18/99	8:45	6910.627		7/18/99	8:50	6911.23	
7/18/99 9:47	7/18/99	9:45	6910.822		7/18/99	9:50	6911.228	
7/18/99 10:47	7/18/99	10:45	6910.817		7/18/99	10:50	6911.222	
7/18/99 11:47	7/18/99	11:45	6910.811		7/18/99	11:50	6911.218	
7/18/99 12:47	7/18/99	12:45	6910.81		7/18/99	12:50	6911.215	
7/18/99 13:47	7/18/99	13:45	6910.804		7/18/99	13:50	6911.216	
7/18/99 14:47	7/18/99	14:45	6910.795		7/18/99	14:50	6911.213	
7/18/99 15:47	7/18/99	15:45	6910.792		7/18/99	15:50	6911.21	
7/18/99 16:47	7/18/99	16:45	6910.788		7/18/99	16:50	6911.203	
7/18/99 17:47	7/18/99	17:45	6910.782		7/18/99	17:50	6911.199	
7/18/99 18:47	7/18/99	18:45	6910.772		7/16/99	18:50	6911.19	
7/18/99 19:47	7/18/99	19:45	6910.762		7/18/99	19:50	6911.177	
7/18/99 20:47	7/18/99	20:45	6910.754		7/18/99	20:50	6911.186	
7/18/99 21:47	7/18/99	21:45	6910.746		7/18/99	21:50	6911.154	
7/18/99 22:47	7/18/99	22:45	6910.74		7/18/99	22:50	6911.146	
7/18/99 23:47	7/18/99	23:45	6910.739		7/18/99	23:50	6911.143	
7/19/99 0:47	7/19/99	0:45	6910.732		7/19/99	0:50	6911.137	
7/19/99 1:47	7/19/99	1:45	6910.724		7/19/99	1:50	6911.132	
7/19/99 2:47	7/19/99	2:45	6910.721		7/19/99	2:50	6911.129	
7/19/99 3:47	7/19/99	3:45	6910.714		7/19/99	3:50	6911.124	
7/19/99 4:47	7/19/99	4:45	6910.708		7/19/99	4:50	6911.117	
7/19/99 5:47	7/19/99	5:45	6910.697		7/19/99	5:50	6911.106	
7/19/99 6:47	7/19/99	6:45	6910.691		7/19/99	6:50	6911.101	
7/19/99 7:47	7/19/99	7:45	6910.685		7/19/99	7:50	6911.096	
7/19/99 8:47	7/19/99	8:45	6910.681		7/19/99	8:50	6911.092	
7/19/99 9:47	7/19/99	9:45	6910.676		7/19/99	9:50	6911.09	
7/19/99 10:47	7/19/99	10:45	6910.671		7/19/99	10:50	6911.087	
7/19/99 11:47	7/19/99	11:45	6910.669		7/19/99	11:50	6911.085	
7/19/99 12:47	7/19/99	12:45	6910.667		7/19/99	12:50	6911.085	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/19/99 13:47	7/19/99	13:45	6910.665		7/19/99	13:50	6911.086	
7/19/99 14:47	7/19/99	14:45	6910.659		7/19/99	14:50	6911.084	
7/19/99 15:47	7/19/99	15:45	6910.652		7/19/99	15:50	6911.081	
7/19/99 16:47	7/19/99	16:45	6910.648		7/19/99	16:50	6911.075	
7/19/99 17:47	7/19/99	17:45	6910.645		7/19/99	17:50	6911.072	
7/19/99 18:47	7/19/99	18:45	6910.636		7/19/99	18:50	6911.063	
7/19/99 19:47	7/19/99	19:45	6910.63		7/19/99	19:50	6911.056	
7/19/99 20:47	7/19/99	20:45	6910.823		7/19/99	20:50	6911.048	
7/19/99 21:47	7/19/99	21:45	6910.616		7/19/99	21:50	8911.037	
7/19/99 22:47	7/19/99	22:45	6910.607		7/19/99	22:50	6911.027	
7/19/99 23:47	7/19/99	23:45	6910.601		7/19/99	23:50	6911.02	
7/20/99 0:47	7/20/99	0:45	6910.596		7/20/99	0:50	6911.015	
7/20/99 1:47	7/20/99	1:45	6910.593		7/20/99	1:50	6911.015	
7/20/99 2:47	7/20/99	2:45	6910.591		7/20/99	2:50	6911.012	
7/20/99 3:47	7/20/99	3:45	6910.583		7/20/99	3:50	6911.005	
7/20/99 4:47	7/20/99	4:45	6910.575		7/20/99	4:50	6911	
7/20/99 5:47	7/20/99	5:45	8910.565		7/20/99	5:50	6910.991	
7/20/99 6:47	7/20/99	6:45	6910.558		7/20/99	8:50	6910.983	
7/20/99 7:47	7/20/99	7:45	6910.552		7/20/99	7:50	6910.973	
7/20/99 8:47	7/20/99	8:45	6910.548		7/20/99	8:50	6910.972	
7/20/99 9:47	7/20/99	9:45	6910.542		7/20/99	9:50	6910.97	
7/20/99 10:47	7/20/99	10:45	6910.538		7/20/99	10:50	6910.965	
7/20/99 11:47	7/20/99	11:45	6910.529		7/20/99	11:50	6910.959	
7/20/99 12:47	7/20/99	12:45	6910.525		7/20/99	12:50	6910.953	
7/20/99 13:47	7/20/99	13:45	6910.522		7/20/99	13:50	6910.953	
7/20/99 14:47	7/20/99	14:45	6910.516		7/20/99	14:50	6910.949	
7/20/99 15:47	7/20/99	15:45	6910.513		7/20/99	15:50	6910.949	
7/20/99 18:47	7/20/99	16:45	6910.509		7/20/99	18:50	6910.946	
7/20/99 17:47	7/20/99	17:45	6910.503		7/20/99	17:50	6910.941	
7/20/99 18:47	7/20/99	18:45	6910.493		7/20/99	18:50	6910.933	
7/20/99 19:47	7/20/99	19:45	6910.484		7/20/99	19:50	6910.921	
7/20/99 20:47	7/20/99	20:45	6910.479		7/20/99	20:50	6910.911	
7/20/99 21:47	7/20/99	21:45	8910.47		7/20/99	21:50	6910.901	
7/20/99 22:47	7/20/99	22:45	8910.462		7/20/99	22:50	6910.895	
7/20/99 23:47	7/20/99	23:45	6910.457		7/20/99	23:50	6910.888	
7/21/99 0:47	7/21/99	0:45	6910.447		7/21/99	0:50	6910.877	
7/21/99 1:47	7/21/99	1:45	6910.434		7/21/99	1:50	6910.863	
7/21/99 2:47	7/21/99	2:45	6910.428		7/21/99	2:50	8910.856	
7/21/99 3:47	7/21/99	3:45	6910.422		7/21/99	3:50	8910.85	
7/21/99 4:47	7/21/99	4:45	6910.414		7/21/99	4:50	6910.84	
7/21/99 5:47	7/21/99	5:45	6910.405		7/21/99	5:50	6910.83	
7/21/99 6:47	7/21/99	6:45	6910.399		7/21/99	6:50	6910.82	
7/21/99 7:47	7/21/99	7:45	6910.387		7/21/99	7:50	6910.81	
7/21/99 8:47	7/21/99	8:45	6910.383		7/21/99	8:50	6910.806	
7/21/99 9:47	7/21/99	9:45	6910.375		7/21/99	9:50	6910.801	
7/21/99 10:47	7/21/99	10:45	6910.37		7/21/99	10:50	6910.797	
7/21/99 11:47	7/21/99	11:45	6910.364		7/21/99	11:50	8910.793	
7/21/99 12:47	7/21/99	12:45	6910.361		7/21/99	12:50	6910.791	
7/21/99 13:47	7/21/99	13:45	6910.358		7/21/99	13:50	6910.787	
7/21/99 14:47	7/21/99	14:45	6910.351		7/21/99	14:50	6910.782	
7/21/99 15:47	7/21/99	15:45	6910.345		7/21/99	15:50	6910.779	
7/21/99 16:47	7/21/99	16:45	6910.34		7/21/99	16:50	6910.775	
7/21/99 17:47	7/21/99	17:45	6910.331		7/21/99	17:50	6910.771	
7/21/99 18:47	7/21/99	18:45	6910.325		7/21/99	18:50	6910.781	
7/21/99 19:47	7/21/99	19:45	6910.311		7/21/99	19:50	6910.743	
7/21/99 20:47	7/21/99	20:45	6910.301		7/21/99	20:50	6910.73	
7/21/99 21:47	7/21/99	21:45	6910.289		7/21/99	21:50	6910.717	
7/21/99 22:47	7/21/99	22:45	6910.279		7/21/99	22:50	6910.704	
7/21/99 23:47	7/21/99	23:45	6910.273		7/21/99	23:50	6910.695	
7/22/99 0:47	7/22/99	0:45	6910.265		7/22/99	0:50	6910.688	
7/22/99 1:47	7/22/99	1:45	6910.26		7/22/99	1:50	6910.683	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/22/99 2:47	7/22/99	2:45	6910.254		7/22/99	2:50	6910.677	
7/22/99 3:47	7/22/99	3:45	6910.249		7/22/99	3:50	6910.672	
7/22/99 4:47	7/22/99	4:45	6910.24		7/22/99	4:50	6910.667	
7/22/99 5:47	7/22/99	5:45	6910.233		7/22/99	5:50	6910.656	
7/22/99 6:47	7/22/99	6:45	6910.224		7/22/99	6:50	6910.645	
7/22/99 7:47	7/22/99	7:45	6910.214		7/22/99	7:50	6910.638	
7/22/99 8:47	7/22/99	8:45	6910.205		7/22/99	8:50	6910.832	
7/22/99 9:47	7/22/99	9:45	6910.202		7/22/99	9:50	6910.832	
7/22/99 10:47	7/22/99	10:45	6910.197		7/22/99	10:50	6910.626	
7/22/99 11:47	7/22/99	11:45	6910.19		7/22/99	11:50	6910.62	
7/22/99 12:47	7/22/99	12:45	6910.184		7/22/99	12:50	6910.614	
7/22/99 13:47	7/22/99	13:45	6910.176		7/22/99	13:50	6910.61	
7/22/99 14:47	7/22/99	14:45	6910.173		7/22/99	14:50	6910.609	
7/22/99 15:47	7/22/99	15:45	6910.166		7/22/99	15:50	6910.606	
7/22/99 16:47	7/22/99	16:45	6910.163		7/22/99	18:50	6910.605	
7/22/99 17:47	7/22/99	17:45	6910.158		7/22/99	17:50	6910.602	
7/22/99 18:47	7/22/99	18:45	6910.148		7/22/99	18:50	6910.59	
7/22/99 19:47	7/22/99	19:45	6910.134		7/22/99	19:50	6910.575	
7/22/99 20:47	7/22/99	20:45	6910.126		7/22/99	20:50	6910.564	
7/22/99 21:47	7/22/99	21:45	6910.114		7/22/99	21:50	6910.549	
7/22/99 22:47	7/22/99	22:45	6910.108		7/22/99	22:50	6910.538	
7/22/99 23:47	7/22/99	23:45	6910.101		7/22/99	23:50	6910.535	
7/23/99 0:47	7/23/99	0:45	8910.094		7/23/99	0:50	6910.523	
7/23/99 1:47	7/23/99	1:45	6910.091		7/23/99	1:50	6910.521	
7/23/99 2:47	7/23/99	2:45	6910.086		7/23/99	2:50	6910.519	
7/23/99 3:47	7/23/99	3:45	6910.081		7/23/99	3:50	6910.516	
7/23/99 4:47	7/23/99	4:45	6910.077		7/23/99	4:50	6910.51	
7/23/99 5:47	7/23/99	5:45	6910.068		7/23/99	5:50	6910.503	
7/23/99 8:47	7/23/99	6:45	6910.066		7/23/99	6:50	6910.499	
7/23/99 7:47	7/23/99	7:45	6910.054		7/23/99	7:50	6910.491	
7/23/99 8:47	7/23/99	8:45	6910.046		7/23/99	8:50	6910.484	
7/23/99 9:47	7/23/99	9:45	6910.042		7/23/99	9:50	8910.483	
7/23/99 10:47	7/23/99	10:45	6910.036		7/23/99	10:50	6910.48	
7/23/99 11:47	7/23/99	11:45	6910.033		7/23/99	11:50	6910.476	
7/23/99 12:47	7/23/99	12:45	6910.024		7/23/99	12:50	6910.47	
7/23/99 13:47	7/23/99	13:45	6910.022		7/23/99	13:50	6910.467	
7/23/99 14:47	7/23/99	14:45	6910.015		7/23/99	14:50	6910.467	
7/23/99 15:47	7/23/99	15:45	6910.013		7/23/99	15:50	6910.465	
7/23/99 16:47	7/23/99	16:45	6910.007		7/23/99	16:50	6910.461	
7/23/99 17:47	7/23/99	17:45	6910.004		7/23/99	17:50	6910.458	
7/23/99 18:47	7/23/99	18:45	6909.999		7/23/99	18:50	6910.452	
7/23/99 19:47	7/23/99	19:45	6909.99		7/23/99	19:50	6910.445	
7/23/99 20:47	7/23/99	20:45	6909.985		7/23/99	20:50	6910.439	
7/23/99 21:47	7/23/99	21:45	6909.974		7/23/99	21:50	6910.426	
7/23/99 22:47	7/23/99	22:45	6909.967		7/23/99	22:50	6910.416	
7/23/99 23:47	7/23/99	23:45	6909.958		7/23/99	23:50	8910.408	
7/24/99 0:47	7/24/99	0:45	6909.954		7/24/99	0:50	6910.402	
7/24/99 1:47	7/24/99	1:45	6909.948		7/24/99	1:50	6910.4	
7/24/99 2:47	7/24/99	2:45	6909.946		7/24/99	2:50	6910.398	
7/24/99 3:47	7/24/99	3:45	6909.942		7/24/99	3:50	6910.396	
7/24/99 4:47	7/24/99	4:45	6909.932		7/24/99	4:50	6910.386	
7/24/99 5:47	7/24/99	5:45	6909.922		7/24/99	5:50	6910.374	
7/24/99 6:47	7/24/99	6:45	6909.918		7/24/99	6:50	6910.37	
7/24/99 7:47	7/24/99	7:45	6909.905		7/24/99	7:50	6910.361	
7/24/99 8:47	7/24/99	8:45	6909.896		7/24/99	8:50	6910.351	
7/24/99 9:47	7/24/99	9:45	6909.89		7/24/99	9:50	6910.348	
7/24/99 10:47	7/24/99	10:45	6909.886		7/24/99	10:50	6910.344	
7/24/99 11:47	7/24/99	11:45	6909.878		7/24/99	11:50	6910.336	
7/24/99 12:47	7/24/99	12:45	6909.876		7/24/99	12:50	6910.335	
7/24/99 13:47	7/24/99	13:45	6909.87		7/24/99	13:50	6910.331	
7/24/99 14:47	7/24/99	14:45	6909.867		7/24/99	14:50	6910.33	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/24/99 15:47	7/24/99	15:45	6909.864		7/24/99	15:50	6910.33	
7/24/99 16:47	7/24/99	16:45	6909.861		7/24/99	16:50	6910.327	
7/24/99 17:47	7/24/99	17:45	6909.853		7/24/99	17:50	6910.322	
7/24/99 18:47	7/24/99	18:45	6909.842		7/24/99	18:50	6910.312	
7/24/99 19:47	7/24/99	19:45	6909.831		7/24/99	19:50	6910.299	
7/24/99 20:47	7/24/99	20:45	6909.821		7/24/99	20:50	6910.286	
7/24/99 21:47	7/24/99	21:45	6909.808		7/24/99	21:50	6910.269	
7/24/99 22:47	7/24/99	22:45	6909.801		7/24/99	22:50	6910.261	
7/24/99 23:47	7/24/99	23:45	6909.795		7/24/99	23:50	6910.254	
7/25/99 0:47	7/25/99	0:45	6909.789		7/25/99	0:50	6910.249	
7/25/99 1:47	7/25/99	1:45	6909.786		7/25/99	1:50	6910.247	
7/25/99 2:47	7/25/99	2:45	6909.783		7/25/99	2:50	6910.246	
7/25/99 3:47	7/25/99	3:45	6909.779		7/25/99	3:50	6910.243	
7/25/99 4:47	7/25/99	4:45	6909.773		7/25/99	4:50	6910.235	
7/25/99 5:47	7/25/99	5:45	6909.765		7/25/99	5:50	6910.228	
7/25/99 6:47	7/25/99	6:45	6909.754		7/25/99	6:50	6910.219	
7/25/99 7:47	7/25/99	7:45	6909.744		7/25/99	7:50	6910.211	
7/25/99 8:47	7/25/99	8:45	6909.735		7/25/99	8:50	6910.204	
7/25/99 9:47	7/25/99	9:45	6909.732		7/25/99	9:50	6910.199	
7/25/99 10:47	7/25/99	10:45	6909.724		7/25/99	10:50	6910.196	
7/25/99 11:47	7/25/99	11:45	6909.716		7/25/99	11:50	6910.188	
7/25/99 12:47	7/25/99	12:45	6909.715		7/25/99	12:50	6910.189	
7/25/99 13:47	7/25/99	13:45	6909.714		7/25/99	13:50	6910.189	
7/25/99 14:47	7/25/99	14:45	6909.71		7/25/99	14:50	6910.166	
7/25/99 15:47	7/25/99	15:45	6909.707		7/25/99	15:50	6910.188	
7/25/99 16:47	7/25/99	16:45	6909.704		7/25/99	16:50	6910.185	
7/25/99 17:47	7/25/99	17:45	6909.695		7/25/99	17:50	6910.176	
7/25/99 18:47	7/25/99	18:45	6909.664		7/25/99	16:50	6910.166	
7/25/99 19:47	7/25/99	19:45	6909.672		7/25/99	19:50	6910.151	
7/25/99 20:47	7/25/99	20:45	6909.66		7/25/99	20:50	8910.139	
7/25/99 21:47	7/25/99	21:45	6909.646		7/25/99	21:50	6910.123	
7/25/99 22:47	7/25/99	22:45	6909.64		7/25/99	22:50	6910.112	
7/25/99 23:47	7/25/99	23:45	6909.634		7/25/99	23:50	6910.104	
7/26/99 0:47	7/26/99	0:45	6909.627		7/26/99	0:50	6910.097	
7/26/99 1:47	7/26/99	1:45	6909.625		7/26/99	1:50	6910.095	
7/26/99 2:47	7/26/99	2:45	6909.617		7/26/99	2:50	6910.091	
7/26/99 3:47	7/26/99	3:45	6909.613		7/26/99	3:50	6910.086	
7/26/99 4:47	7/26/99	4:45	6909.606		7/26/99	4:50	6910.084	
7/26/99 5:47	7/26/99	5:45	6909.601		7/26/99	5:50	6910.075	
7/26/99 6:47	7/26/99	6:45	6909.591		7/26/99	6:50	6910.067	
7/26/99 7:47	7/26/99	7:45	6909.581		7/26/99	7:50	6910.056	
7/26/99 8:47	7/26/99	8:45	6909.571		7/26/99	6:50	6910.05	
7/26/99 9:47	7/26/99	9:45	6909.565		7/26/99	9:50	6910.043	
7/26/99 10:47	7/26/99	10:45	6909.556		7/26/99	10:50	6910.039	
7/26/99 11:47	7/26/99	11:45	6909.552		7/26/99	11:50	6910.036	
7/26/99 12:47	7/26/99	12:45	6909.551		7/26/99	12:50	6910.034	
7/26/99 13:47	7/26/99	13:45	6909.549		7/26/99	13:50	6910.037	
7/26/99 14:47	7/26/99	14:45	6909.544		7/26/99	14:50	6910.031	
7/26/99 15:47	7/26/99	15:45	6909.536		7/26/99	15:50	6910.027	
7/26/99 16:47	7/26/99	16:45	6909.53		7/26/99	16:50	6910.025	
7/26/99 17:47	7/26/99	17:45	6909.523		7/26/99	17:50	6910.02	
7/26/99 18:47	7/26/99	18:45	6909.513		7/26/99	18:50	6910.01	
7/26/99 19:47	7/26/99	19:45	6909.503		7/26/99	19:50	6909.997	
7/26/99 20:47	7/26/99	20:45	6909.486		7/26/99	20:50	6909.983	
7/26/99 21:47	7/26/99	21:45	6909.476		7/26/99	21:50	6909.969	
7/26/99 22:47	7/26/99	22:45	6909.467		7/26/99	22:50	6909.958	
7/26/99 23:47	7/26/99	23:45	6909.457		7/26/99	23:50	6909.947	
7/27/99 0:47	7/27/99	0:45	6909.451		7/27/99	0:50	6909.939	
7/27/99 1:47	7/27/99	1:45	6909.447		7/27/99	1:50	6909.936	
7/27/99 2:47	7/27/99	2:45	6909.445		7/27/99	2:50	6909.933	
7/27/99 3:47	7/27/99	3:45	6909.437		7/27/99	3:50	6909.927	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
7/27/99 4:47	7/27/99	4:45	6909.426		7/27/99	4:50	6909.917	
7/27/99 5:47	7/27/99	5:45	6909.415		7/27/99	5:50	6909.908	
7/27/99 6:47	7/27/99	6:45	6909.403		7/27/99	6:50	6909.894	
7/27/99 7:47	7/27/99	7:45	6909.392		7/27/99	7:50	6909.884	
7/27/99 8:47	7/27/99	8:45	6909.381		7/27/99	8:50	6909.875	
7/27/99 9:47	7/27/99	9:45	6909.376		7/27/99	9:50	6909.872	
7/27/99 10:47	7/27/99	10:45	6909.369		7/27/99	10:50	6909.868	
7/27/99 11:47	7/27/99	11:45	6909.364		7/27/99	11:50	6909.864	
7/27/99 12:47	7/27/99	12:45	6909.358		7/27/99	12:50	6909.859	
7/27/99 13:47	7/27/99	13:45	6909.354		7/27/99	13:50	6909.859	
7/27/99 14:47	7/27/99	14:45	6909.348		7/27/99	14:50	6909.856	
7/27/99 15:47	7/27/99	15:45	6909.344		7/27/99	15:50	6909.851	
7/27/99 16:47	7/27/99	16:45	6909.336		7/27/99	16:50	6909.845	
7/27/99 17:47	7/27/99	17:45	6909.328		7/27/99	17:50	6909.837	
7/27/99 18:47	7/27/99	18:45	6909.318		7/27/99	18:50	6909.826	
7/27/99 19:47	7/27/99	19:45	6909.309		7/27/99	19:50	6909.817	
7/27/99 20:47	7/27/99	20:45	6909.301		7/27/99	20:50	6909.806	
7/27/99 21:47	7/27/99	21:45	6909.285		7/27/99	21:50	6909.791	
7/27/99 22:47	7/27/99	22:45	6909.277		7/27/99	22:50	6909.783	
7/27/99 23:47	7/27/99	23:45	6909.271		7/27/99	23:50	6909.774	
7/28/99 0:47	7/28/99	0:45	6909.265		7/28/99	0:50	6909.767	
7/28/99 1:47	7/28/99	1:45	6909.262		7/28/99	1:50	6909.764	
7/28/99 2:47	7/28/99	2:45	6909.253		7/28/99	2:50	6909.759	
7/28/99 3:47	7/28/99	3:45	6909.246		7/28/99	3:50	6909.751	
7/28/99 4:47	7/28/99	4:45	6909.238		7/28/99	4:50	6909.744	
7/28/99 5:47	7/28/99	5:45	6909.226		7/28/99	5:50	6909.735	
7/28/99 6:47	7/28/99	6:45	6909.214		7/28/99	6:50	6909.72	
7/28/99 7:47	7/28/99	7:45	6909.202		7/28/99	7:50	6909.71	
7/28/99 8:47	7/28/99	8:45	6909.192		7/28/99	8:50	6909.703	
7/28/99 9:47	7/28/99	9:45	6909.182		7/28/99	9:50	6909.697	
7/28/99 10:47	7/28/99	10:45	6909.176		7/28/99	10:50	6909.689	
7/28/99 11:47	7/28/99	11:45	6909.169		7/28/99	11:50	6909.683	
7/28/99 12:47	7/28/99	12:45	6909.162		7/28/99	12:50	6909.677	
7/28/99 13:47	7/28/99	13:45	6909.159		7/28/99	13:50	6909.672	
7/28/99 14:47	7/28/99	14:45	6909.155		7/28/99	14:50	6909.671	
7/28/99 15:47	7/28/99	15:45	6909.149		7/28/99	15:50	6909.668	
7/28/99 16:47	7/28/99	16:45	6909.14		7/28/99	16:50	6909.684	
7/28/99 17:47	7/28/99	17:45	6909.131		7/28/99	17:50	6909.654	
7/28/99 18:47	7/28/99	18:45	6909.123		7/28/99	18:50	6909.645	
7/28/99 19:47	7/28/99	19:45	6909.113		7/28/99	19:50	6909.632	
7/28/99 20:47	7/28/99	20:45	6909.104		7/28/99	20:50	6909.619	
7/28/99 21:47	7/28/99	21:45	6909.093		7/28/99	21:50	6909.607	
7/28/99 22:47	7/28/99	22:45	6909.084		7/28/99	22:50	6909.602	
7/28/99 23:47	7/28/99	23:45	6909.072		7/28/99	23:50	6909.589	
7/29/99 0:47	7/29/99	0:45	6909.065		7/29/99	0:50	6909.58	
7/29/99 1:47	7/29/99	1:45	6909.062		7/29/99	1:50	6909.576	
7/29/99 2:47	7/29/99	2:45	6909.057		7/29/99	2:50	6909.573	
7/29/99 3:47	7/29/99	3:45	6909.052		7/29/99	3:50	6909.568	
7/29/99 4:47	7/29/99	4:45	6909.044		7/29/99	4:50	6909.561	
7/29/99 5:47	7/29/99	5:45	6909.033		7/29/99	5:50	6909.554	
7/29/99 6:47	7/29/99	6:45	6909.023		7/29/99	6:50	6909.543	
7/29/99 7:47	7/29/99	7:45	6909.015		7/29/99	7:50	6909.534	
7/29/99 8:47	7/29/99	8:45	6909.002		7/29/99	8:50	6909.523	
7/29/99 9:47	7/29/99	9:45	6908.993		7/29/99	9:50	6909.517	
7/29/99 10:47	7/29/99	10:45	6908.982		7/29/99	10:50	6909.506	
7/29/99 11:47	7/29/99	11:45	6908.974		7/29/99	11:50	6909.505	
7/29/99 12:47	7/29/99	12:45	6908.965		7/29/99	12:50	6909.489	
7/29/99 13:47	7/29/99	13:45	6908.962		7/29/99	13:50	6909.489	
7/29/99 14:47	7/29/99	14:45	6908.957		7/29/99	14:50	6909.486	
7/29/99 15:47	7/29/99	15:45	6908.951		7/29/99	15:50	6909.481	
7/29/99 16:47	7/29/99	16:45	6908.945		7/29/99	16:50	6909.479	

Avg Time+Date	Date	Time	10D Continuous	10D Menual	Date	Time	10S Continuous	10S Manual
7/29/99 17:47	7/29/99	17:45	6908.945		7/29/99	17:50	6909.479	
7/29/99 18:47	7/29/99	18:45	6908.935		7/29/99	18:50	6909.472	
7/29/99 19:47	7/29/99	19:45	6908.923		7/29/99	19:50	6909.459	
7/29/99 20:47	7/29/99	20:45	6908.911		7/29/99	20:50	6909.441	
7/29/99 21:47	7/29/99	21:45	6908.895		7/29/99	21:50	6909.425	
7/29/99 22:47	7/29/99	22:45	6908.886		7/29/99	22:50	6909.415	
7/29/99 23:47	7/29/99	23:45	6908.882		7/29/99	23:50	6909.409	
7/30/99 0:47	7/30/99	0:45	6908.876		7/30/99	0:50	6909.405	
7/30/99 1:47	7/30/99	1:45	6908.875		7/30/99	1:50	6909.403	
7/30/99 2:47	7/30/99	2:45	6908.869		7/30/99	2:50	6909.401	
7/30/99 3:47	7/30/99	3:45	6908.864		7/30/99	3:50	6909.399	
7/30/99 4:47	7/30/99	4:45	6908.861		7/30/99	4:50	6909.397	
7/30/99 5:47	7/30/99	5:45	6908.854		7/30/99	5:50	6909.391	
7/30/99 6:47	7/30/99	6:45	6908.844		7/30/99	6:50	6909.38	
7/30/99 7:47	7/30/99	7:45	6908.834		7/30/99	7:50	6909.373	
7/30/99 8:47	7/30/99	8:45	6908.825		7/30/99	8:50	6909.366	
7/30/99 9:47	7/30/99	9:45	6908.819		7/30/99	9:50	6909.363	
7/30/99 10:47	7/30/99	10:45	6908.811		7/30/99	10:50	6909.359	
7/30/99 11:47	7/30/99	11:45	6908.808		7/30/99	11:50	6909.357	
7/30/99 12:47	7/30/99	12:45	6908.804		7/30/99	12:50	6909.356	
7/30/99 13:47	7/30/99	13:45	6908.798		7/30/99	13:50	6909.355	
7/30/99 14:47	7/30/99	14:45	6908.794		7/30/99	14:50	6909.352	
7/30/99 15:47	7/30/99	15:45	6908.791		7/30/99	15:50	6909.349	
7/30/99 16:47	7/30/99	16:45	6908.788		7/30/99	16:50	6909.346	
7/30/99 17:47	7/30/99	17:45	6908.782		7/30/99	17:50	6909.341	
7/30/99 18:47	7/30/99	18:45	6908.778		7/30/99	18:50	6909.334	
7/30/99 19:47	7/30/99	19:45	6908.768		7/30/99	19:50	6909.327	
7/30/99 20:47	7/30/99	20:45	6908.756		7/30/99	20:50	6909.317	
7/30/99 21:47	7/30/99	21:45	6908.745		7/30/99	21:50	6909.305	
7/30/99 22:47	7/30/99	22:45	6908.739		7/30/99	22:50	6909.298	
7/30/99 23:47	7/30/99	23:45	6908.729		7/30/99	23:50	6909.286	
7/31/99 0:47	7/31/99	0:45	6908.721		7/31/99	0:50	6909.279	
7/31/99 1:47	7/31/99	1:45	6908.715		7/31/99	1:50	6909.275	
7/31/99 2:47	7/31/99	2:45	6908.712		7/31/99	2:50	6909.272	
7/31/99 3:47	7/31/99	3:45	6908.707		7/31/99	3:50	6909.268	
7/31/99 4:47	7/31/99	4:45	6908.698		7/31/99	4:50	6909.262	
7/31/99 5:47	7/31/99	5:45	6908.692		7/31/99	5:50	6909.253	
7/31/99 6:47	7/31/99	6:45	6908.684		7/31/99	6:50	6909.245	
7/31/99 7:47	7/31/99	7:45	6908.677		7/31/99	7:50	6909.239	
7/31/99 6:47	7/31/99	8:45	8908.669		7/31/99	8:50	6909.233	
7/31/99 9:47	7/31/99	9:45	6908.664		7/31/99	9:50	6909.231	
7/31/99 10:47	7/31/99	10:45	6908.655		7/31/99	10:50	6909.226	
7/31/99 11:47	7/31/99	11:45	6908.652		7/31/99	11:50	6909.226	
7/31/99 12:47	7/31/99	12:45	6908.648		7/31/99	12:50	6909.223	
7/31/99 13:47	7/31/99	13:45	6908.842		7/31/99	13:50	6909.218	
7/31/99 14:47	7/31/99	14:45	6908.641		7/31/99	14:50	6909.218	
7/31/99 15:47	7/31/99	15:45	6908.636		7/31/99	15:50	6909.215	
7/31/99 16:47	7/31/99	16:45	6908.627		7/31/99	16:50	6909.21	
7/31/99 17:47	7/31/99	17:45	6908.614		7/31/99	17:50	6909.197	
7/31/99 18:47	7/31/99	18:45	6908.6		7/31/99	18:50	6909.178	
7/31/99 19:47	7/31/99	19:45	6908.602		7/31/99	19:50	6909.178	
7/31/99 20:47	7/31/99	20:45	6908.593		7/31/99	20:50	6909.169	
7/31/99 21:47	7/31/99	21:45	6908.58		7/31/99	21:50	6909.159	
7/31/99 22:47	7/31/99	22:45	6908.574		7/31/99	22:50	6909.149	
7/31/99 23:47	7/31/99	23:45	6908.565		7/31/99	23:50	6909.142	
8/1/99 0:47	8/1/99	0:45	6908.558		8/1/99	0:50	6909.133	
8/1/99 1:47	8/1/99	1:45	6908.552		8/1/99	1:50	6909.132	
8/1/99 2:47	8/1/99	2:45	6908.545		8/1/99	2:50	6909.125	
8/1/99 3:47	8/1/99	3:45	6908.541		8/1/99	3:50	6909.123	
8/1/99 4:47	8/1/99	4:45	6908.534		8/1/99	4:50	6909.116	
8/1/99 5:47	8/1/99	5:45	6908.523		8/1/99	5:50	6909.106	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
8/1/99 6:47	8/1/99	6:45	6908.515		8/1/99	6:50	6909.094	
8/1/99 7:47	8/1/99	7:45	6908.506		8/1/99	7:50	6909.087	
8/1/99 6:47	8/1/99	8:45	6908.499		8/1/99	8:50	6909.083	
8/1/99 9:47	8/1/99	9:45	6908.495		8/1/99	9:50	6909.078	
8/1/99 10:47	8/1/99	10:45	6908.482		8/1/99	10:50	6909.071	
8/1/99 11:47	8/1/99	11:45	6908.474		8/1/99	11:50	6909.062	
8/1/99 12:47	8/1/99	12:45	6908.47		8/1/99	12:50	6909.058	
8/1/99 13:47	8/1/99	13:45	6908.46		8/1/99	13:50	6909.056	
8/1/99 14:47	8/1/99	14:45	6908.453		8/1/99	14:50	6909.051	
8/1/99 15:47	8/1/99	15:45	6908.45		8/1/99	15:50	6909.046	
8/1/99 16:47	8/1/99	18:45	6908.441		8/1/99	16:50	6909.041	
8/1/99 17:47	8/1/99	17:45	6908.435		8/1/99	17:50	6909.032	
8/1/99 18:47	8/1/99	18:45	6908.425		8/1/99	18:50	6909.022	
8/1/99 19:47	8/1/99	19:45	6908.412		8/1/99	19:50	6909.003	
8/1/99 20:47	8/1/99	20:45	6908.4		8/1/99	20:50	6908.988	
8/1/99 21:47	8/1/99	21:45	6908.382		8/1/99	21:50	6908.988	
8/1/99 22:47	8/1/99	22:45	6908.376		8/1/99	22:50	8908.96	
8/1/99 23:47	8/1/99	23:45	6908.37		8/1/99	23:50	6908.951	
8/2/99 0:47	8/2/99	0:45	6908.357		8/2/99	0:50	6908.942	
8/2/99 1:47	8/2/99	1:45	6908.35		8/2/99	1:50	6908.932	
8/2/99 2:47	8/2/99	2:45	6908.34		8/2/99	2:50	6908.925	
8/2/99 3:47	8/2/99	3:45	6908.333		8/2/99	3:50	6908.919	
8/2/99 4:47	8/2/99	4:45	6908.327		8/2/99	4:50	6908.912	
8/2/99 5:47	8/2/99	5:45	6908.318		8/2/99	5:50	6908.904	
8/2/99 6:47	8/2/99	6:45	6908.311		8/2/99	6:50	6908.893	
8/2/99 7:47	8/2/99	7:45	6908.301		8/2/99	7:50	6908.886	
8/2/99 8:47	8/2/99	8:45	8908.294		8/2/99	8:50	6908.883	
8/2/99 9:47	8/2/99	9:45	6908.288		8/2/99	9:50	6908.878	
8/2/99 10:47	8/2/99	10:45	6908.278		8/2/99	10:50	6908.871	
8/2/99 11:47	8/2/99	11:45	6908.271		8/2/99	11:50	6908.863	
8/2/99 12:47	8/2/99	12:45	8908.263		8/2/99	12:50	6908.861	
8/2/99 13:47	8/2/99	13:45	6908.259		8/2/99	13:50	6908.88	
8/2/99 14:47	8/2/99	14:45	6908.252	6908.23	8/2/99	14:50	6908.658	6908.82
8/2/99 16:06	8/2/99	17:00	6908.256		8/2/99	15:12	6908.858	
8/2/99 22:06	8/2/99	23:00	6908.207		8/2/99	21:12	6908.798	
8/3/99 4:06	8/3/99	5:00	6908.164		8/3/99	3:12	6908.754	
8/3/99 10:06	8/3/99	11:00	6908.125		8/3/99	9:12	6908.717	
8/3/99 16:06	8/3/99	17:00	8908.088		8/3/99	15:12	6908.701	
8/3/99 22:06	8/3/99	23:00	6908.047		8/3/99	21:12	6908.661	
8/4/99 4:06	8/4/99	5:00	6908.012		8/4/99	3:12	6908.832	
8/4/99 10:06	8/4/99	11:00	6907.978		8/4/99	9:12	6908.606	
8/4/99 16:06	8/4/99	17:00	6907.934		8/4/99	15:12	6908.586	
8/4/99 22:06	8/4/99	23:00	6907.907		8/4/99	21:12	6908.56	
8/5/99 4:06	8/5/99	5:00	6907.877		8/5/99	3:12	6908.529	
8/5/99 10:06	8/5/99	11:00	6907.849		8/5/99	9:12	6906.51	
8/5/99 16:06	8/5/99	17:00	6907.823		8/5/99	15:12	6908.512	
8/5/99 22:06	8/5/99	23:00	6907.776		8/5/99	21:12	6908.464	
8/6/99 4:06	8/6/99	5:00	6907.747		8/6/99	3:12	6908.432	
8/6/99 10:06	8/6/99	11:00	6907.683		8/6/99	9:12	6908.386	
8/6/99 16:06	8/6/99	17:00	6907.646		8/6/99	15:12	6908.342	
8/6/99 22:06	8/6/99	23:00	6907.596		8/6/99	21:12	6908.294	
8/7/99 4:06	8/7/99	5:00	6907.553		8/7/99	3:12	6908.249	
8/7/99 10:06	8/7/99	11:00	6907.497		8/7/99	9:12	6908.169	
8/7/99 16:06	8/7/99	17:00	6907.471		8/7/99	15:12	6908.175	
8/7/99 22:06	8/7/99	23:00	6907.413		8/7/99	21:12	6908.124	
8/8/99 4:06	8/8/99	5:00	6907.381		8/8/99	3:12	6908.082	
8/8/99 10:06	8/8/99	11:00	6907.344		8/8/99	9:12	6908.047	
8/8/99 16:06	8/8/99	17:00	6907.315		8/8/99	15:12	8908.03	
8/8/99 22:06	8/8/99	23:00	6907.263		8/8/99	21:12	6907.99	
8/9/99 4:06	8/9/99	5:00	6907.241		8/9/99	3:12	6907.963	
8/9/99 10:06	8/9/99	11:00	6907.198		8/9/99	9:12	6907.927	

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
8/9/99 16:06	8/9/99	17:00	6907.176		8/9/99	15:12	6907.926	
8/9/99 22:06	8/9/99	23:00	6907.124		8/9/99	21:12	6907.868	
8/10/99 4:06	8/10/99	5:00	6907.11		8/10/99	3:12	6907.851	
8/10/99 10:06	8/10/99	11:00	6907.056		8/10/99	9:12	6907.819	
8/10/99 16:06	8/10/99	17:00	6907.018		8/10/99	15:12	6907.783	
8/10/99 22:06	8/10/99	23:00	6906.971		8/10/99	21:12	6907.739	
8/11/99 4:06	8/11/99	5:00	6906.937		8/11/99	3:12	6907.692	
8/11/99 10:06	8/11/99	11:00	6906.873		8/11/99	9:12	6907.643	
8/11/99 16:06	8/11/99	17:00	6906.839		8/11/99	15:12	6907.609	
8/11/99 22:06	8/11/99	23:00	6906.788		8/11/99	21:12	6907.56	
8/12/99 4:06	8/12/99	5:00	6908.759		8/12/99	3:12	6907.531	
8/12/99 10:06	8/12/99	11:00	6906.713		8/12/99	9:12	6907.494	
8/12/99 16:06	8/12/99	17:00	8906.688		8/12/99	15:12	6907.482	
8/12/99 22:06	8/12/99	23:00	6906.659		8/12/99	21:12	6907.452	
8/13/99 4:06	8/13/99	5:00	6906.628		8/13/99	3:12	6907.432	
8/13/99 10:06	8/13/99	11:00	6906.585		8/13/99	9:12	6907.399	
8/13/99 16:06	8/13/99	17:00	6906.569		8/13/99	15:12	6907.377	
8/13/99 22:06	8/13/99	23:00	6906.527		8/13/99	21:12	6907.351	
8/14/99 4:06	8/14/99	5:00	6906.504		8/14/99	3:12	6907.32	
8/14/99 10:06	8/14/99	11:00	6906.473		8/14/99	9:12	6907.3	
8/14/99 16:06	8/14/99	17:00	6906.446		8/14/99	15:12	6907.287	
8/14/99 22:06	8/14/99	23:00	6908.395		8/14/99	21:12	6907.245	
8/15/99 4:06	8/15/99	5:00	6906.359		8/15/99	3:12	6907.186	
8/15/99 10:06	8/15/99	11:00	6906.313		8/15/99	9:12	6907.145	
8/15/99 16:06	8/15/99	17:00	6906.289		8/15/99	15:12	6907.129	
8/15/99 22:06	8/15/99	23:00	6906.232		8/15/99	21:12	6907.074	
8/16/99 4:06	8/16/99	5:00	6906.197		8/16/99	3:12	6907.031	
8/16/99 10:06	8/16/99	11:00	6906.159		8/16/99	9:12	6906.999	
8/16/99 16:06	8/18/99	17:00	6906.131		8/16/99	15:12	6906.988	
8/16/99 22:06	8/16/99	23:00	6906.087		8/16/99	21:12	6906.934	
8/17/99 4:06	8/17/99	5:00	6906.053		8/17/99	3:12	6908.905	
8/17/99 10:06	8/17/99	11:00	6906.022		8/17/99	9:12	6906.875	
8/17/99 16:06	8/17/99	17:00	6906.001		8/17/99	15:12	6906.878	
8/17/99 22:06	8/17/99	23:00	8905.968		8/17/99	21:12	6906.849	
8/18/99 4:06	8/16/99	5:00	6905.946		8/16/99	3:12	6906.832	
8/16/99 10:06	8/18/99	11:00	6905.913		8/16/99	9:12	6906.803	
8/16/99 16:06	8/16/99	17:00	6905.89		8/18/99	15:12	6906.791	
8/18/99 22:06	8/18/99	23:00	6905.85		8/18/99	21:12	6906.761	
8/19/99 4:06	8/19/99	5:00	6905.818		8/19/99	3:12	6906.723	
8/19/99 10:06	8/19/99	11:00	6905.788		8/19/99	9:12	6906.69	
8/19/99 16:06	8/19/99	17:00	6905.763		8/19/99	15:12	6906.687	
8/19/99 22:06	8/19/99	23:00	6905.715		8/19/99	21:12	6906.636	
8/20/99 4:06	8/20/99	5:00	6905.684		8/20/99	3:12	6906.602	
8/20/99 10:06	8/20/99	11:00	6905.651		8/20/99	9:12	6906.571	
8/20/99 16:06	8/20/99	17:00	6905.625		8/20/99	15:12	6906.56	
8/20/99 22:06	8/20/99	23:00	6905.586		8/20/99	21:12	6906.524	
8/21/99 4:06	8/21/99	5:00	6905.557		8/21/99	3:12	6906.492	
8/21/99 10:06	8/21/99	11:00	6905.524		8/21/99	9:12	6906.459	
8/21/99 16:06	8/21/99	17:00	6905.508		8/21/99	15:12	6906.487	
8/21/99 22:06	8/21/99	23:00	6905.483		8/21/99	21:12	6906.418	
8/22/99 4:06	8/22/99	5:00	6905.439		8/22/99	3:12	6906.4	
8/22/99 10:06	8/22/99	11:00	6905.402		8/22/99	9:12	6906.359	
8/22/99 18:06	8/22/99	17:00	6905.378		8/22/99	15:12	6906.363	
8/22/99 22:06	8/22/99	23:00	6905.342		8/22/99	21:12	6906.306	
8/23/99 4:06	8/23/99	5:00	6905.323		8/23/99	3:12	6906.291	
8/23/99 10:06	8/23/99	11:00	6905.286		8/23/99	9:12	6906.269	
8/23/99 18:06	8/23/99	17:00	6905.267		8/23/99	15:12	6906.263	
8/23/99 22:06	8/23/99	23:00	6905.224		8/23/99	21:12	6906.212	
8/24/99 4:06	8/24/99	5:00	6905.197		8/24/99	3:12	6906.187	
8/24/99 10:06	8/24/99	11:00	6905.16		8/24/99	9:12	6906.155	
8/24/99 16:06	8/24/99	17:00	6905.144		8/24/99	15:12	6906.152	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Dete	Time	10S Continuous	10S Manual
8/24/99 22:06	8/24/99	23:00	6905.097		8/24/99	21:12	6906.103	
6/25/99 4:06	8/25/99	5:00	6905.073		8/25/99	3:12	6906.074	
8/25/99 10:06	8/25/99	11:00	6905.033		8/25/99	9:12	6906.044	
8/25/99 16:06	8/25/99	17:00	6905.029		8/25/99	15:12	6906.049	
8/25/99 22:06	8/25/99	23:00	6904.981		8/25/99	21:12	6906.004	
8/26/99 4:06	8/26/99	5:00	6904.985		8/26/99	3:12	6905.982	
8/26/99 10:06	8/26/99	11:00	6904.926		8/26/99	9:12	6905.957	
8/26/99 16:06	8/26/99	17:00	6904.909		8/26/99	15:12	8905.924	
8/26/99 22:06	8/26/99	23:00	6904.879		8/26/99	21:12	6905.917	
8/27/99 4:06	8/27/99	5:00	6904.856		8/27/99	3:12	6905.9	
8/27/99 10:06	8/27/99	11:00	6904.815		8/27/99	9:12	6905.867	
8/27/99 16:06	8/27/99	17:00	6904.797		8/27/99	15:12	6905.853	
8/27/99 22:06	8/27/99	23:00	6904.753		8/27/99	21:12	6905.81	
8/26/99 4:06	8/28/99	5:00	6904.73		8/28/99	3:12	6905.778	
8/28/99 10:06	8/28/99	11:00	6904.693		8/28/99	9:12	6905.749	
8/28/99 16:06	8/28/99	17:00	6904.684		8/28/99	15:12	6905.746	
8/28/99 22:06	8/28/99	23:00	6904.644		8/28/99	21:12	6905.716	
8/29/99 4:06	8/29/99	5:00	6904.627		8/29/99	3:12	6905.7	
8/29/99 10:06	8/29/99	11:00	6904.593		8/29/99	9:12	6905.675	
8/29/99 16:06	8/29/99	17:00	6904.588		8/29/99	15:12	6905.68	
8/29/99 22:06	8/29/99	23:00	6904.559		8/29/99	21:12	6905.655	
8/30/99 4:06	8/30/99	5:00	6904.546		8/30/99	3:12	6905.641	
8/30/99 10:06	8/30/99	11:00	6904.509		8/30/99	9:12	6905.635	
8/30/99 16:06	8/30/99	17:00	6904.481		8/30/99	15:12	6905.597	
8/30/99 22:06	8/30/99	23:00	6904.433		8/30/99	21:12	6905.542	
8/31/99 4:06	8/31/99	5:00	6904.414		8/31/99	3:12	6905.51	
8/31/99 10:06	8/31/99	11:00	6904.399		8/31/99	9:12	6905.506	
8/31/99 16:06	8/31/99	17:00	6904.393		8/31/99	15:12	6905.529	
8/31/99 22:06	8/31/99	23:00	6904.36		8/31/99	21:12	6905.498	
9/1/99 4:06	9/1/99	5:00	6904.345		9/1/99	3:12	6905.476	
9/1/99 10:06	9/1/99	11:00	6904.323		9/1/99	9:12	6905.487	
9/1/99 16:06	9/1/99	17:00	6904.298		9/1/99	15:12	6905.448	
9/1/99 22:06	9/1/99	23:00	6904.269		9/1/99	21:12	6905.409	
9/2/99 4:06	9/2/99	5:00	6904.244		9/2/99	3:12	6905.365	
9/2/99 10:06	9/2/99	11:00	6904.214		9/2/99	9:12	6905.355	
9/2/99 16:06	9/2/99	17:00	6904.191		9/2/99	15:12	6905.346	
9/2/99 22:06	9/2/99	23:00	6904.16		9/2/99	21:12	6905.298	
9/3/99 4:06	9/3/99	5:00	6904.133		9/3/99	3:12	6905.274	
9/3/99 10:06	9/3/99	11:00	6904.101		9/3/99	9:12	6905.239	
9/3/99 16:06	9/3/99	17:00	6904.084		9/3/99	15:12	6905.245	
9/3/99 22:06	9/3/99	23:00	6904.048		9/3/99	21:12	6905.197	
9/4/99 4:06	9/4/99	5:00	6904.019		9/4/99	3:12	6905.188	
9/4/99 10:06	9/4/99	11:00	6903.992		9/4/99	9:12	6905.167	
9/4/99 16:06	9/4/99	17:00	6903.983		9/4/99	15:12	6905.194	
9/4/99 22:06	9/4/99	23:00	6903.94		9/4/99	21:12	6905.19	
9/5/99 4:06	9/5/99	5:00	6903.921		9/5/99	3:12	6905.19	
9/5/99 10:06	9/5/99	11:00	6903.889		9/5/99	9:12	6905.188	
9/5/99 16:06	9/5/99	17:00	6903.883		9/5/99	15:12	6905.191	
9/5/99 22:06	9/5/99	23:00	6903.848		9/5/99	21:12	6905.187	
9/6/99 4:06	9/6/99	5:00	6903.832		9/6/99	3:12	6905.187	
9/8/99 10:06	9/6/99	11:00	6903.798		9/6/99	9:12	6905.167	
9/6/99 16:06	9/8/99	17:00	6903.787		9/6/99	15:12	6905.201	
9/6/99 22:06	9/6/99	23:00	6903.75		9/6/99	21:12	6905.201	
9/7/99 4:06	9/7/99	5:00	6903.725		9/7/99	3:12	6905.201	
9/7/99 10:06	9/7/99	11:00	6903.694		9/7/99	9:12	6905.2	
9/7/99 16:06	9/7/99	17:00	6903.666		9/7/99	15:12	6905.198	
9/7/99 22:06	9/7/99	23:00	6903.647		9/7/99	21:12	6905.197	
9/8/99 4:06	9/8/99	5:00	6903.629		9/8/99	3:12	6905.197	
9/8/99 10:06	9/8/99	11:00	6903.596		9/8/99	9:12	6905.194	
9/8/99 16:06	9/8/99	17:00	6903.595		9/8/99	15:12	6905.195	
9/8/99 22:06	9/8/99	23:00	6903.561		9/8/99	21:12	6905.207	

Water Level Data

Avg Time+Date	Date	Time	10D Continuous	10D Manual	Date	Time	10S Continuous	10S Manual
9/9/99 4:06	9/9/99	5:00	6903.546		9/9/99	3:12	6905.207	
9/9/99 10:06	9/9/99	11:00	6903.517	6903.42	9/9/99	9:12	6905.207	6904.77

Appendix C
Water Quality Data

Appendix C.1
Water Quality Data
September 1998

LEVIATHAN MINE

Surface Water Lab Results
Date Collected
9-23,25/98

Sample Name	Lab Codes		
Pond 2 Runoff	K9806762-	001	76201
Pit Underdrain	K9806762-	002	76202
Adit Drain	K9806762-	003	76203
Leviathan below Delta Seep	K9806762-	004	76204
Lower Aspen Creek	K9806762-	005	76205
Lower Aspen Seep	K9806762-	006	76206
Channel Underdrain	K9806762-	007	76207
Leviathan below Underdrain	K9806762-	008	76208
Delta Seep	K9806762-	009	76209
Aspen above Leviathan	K9806762-	010	76210
Wetlands Seep	K9806762-	011	76211
Station 22	K9806762-	012	76212
Diversion Channel	K9806762-	013	76213
Leviathan above Aspen	K9806762-	014	76214
Leviathan Creek	K9806762-	015	76215
Pond 4 Overflow	K9806762-	016	76216
Upper Tributary	K9806762-	017	76217

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/23-25/98
Date Received: 9/30/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte:		Alkalinity, Total as $CaCO_3$	Solids, Total Dissolved (TDS)	Solids, Total Suspended (TSS)	Sulfate
EPA Method:		310.1	160.1	160.2	300.0
Method Reporting Limit:		2	5	5	0.2
Date Analyzed:		10/6,8/98	10/1,2/98	10/1,2/98	10/2/98
Sample Name	**Lab Code**				
Pond 2 Surface Drainage	K9806762-001	ND	208	1820	208
Pit Under Drain	K9806762-002	ND	5430	ND	7640
Adit Drainage	K9806762-003	ND	5160	ND	5240
Leviathan Creek Below Delta Seep	K9806762-004	ND	1070	74	667
Lower Aspen Creek	K9806762-005	ND	358	ND	342
Lower Aspen Seep	K9806762-006	ND	2840	ND	1649
Underdrain (Channel Underdrain)	K9806762-007	ND	3170	10	2306
Leviathan Creek Below Diversion Ch	K9806762-008	ND	1150	82	672
Delta Seep	K9806762-009	23	1860	24	1171
Aspen Creek Above Leviathan Creek	K9806762-010	ND	430 (H)	6 (H)	273
Aspen Wetland Spring/Seep	K9806762-011	ND	1260 (H)	ND (H)	795
Aspen Creek Station #22	K9806762-012	98	106 (H)	6 (H)	1.2
Diversion Channel	K9806762-013	ND	72 (H)	31 (H)	8.6
Leviathan Creek Above Aspen Creek	K9806762-014	ND	964 (H)	66 (H)	695
Station #1 Leviathan Creek	K9806762-015	68	114 (H)	6 (H)	6.9
Pond 4 Discharge	K9806762-016	ND	23500	6	6068
Upper Tributary	K9806762-017	96	202	ND	11.1
Method Blank	K9806762-MB	ND	ND	ND	ND

H The Sample was received past the recommended hold time.

Approved By: _____ Date: 10/19/98

4A4M_DA/102194

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98

Hardness, Total as CaCO3

Prep Method: CLAA
Analysis Method: 6010B/SM 2340B
Test Notes:

Units: mg/L (ppm)
Basis: NA

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
Pond 2 Surface Drainage	K9806762-001	0.2	1	10/22/98	10/27/98	265	
Pit Under Drain	K9806762-002	0.2	1	10/22/98	10/27/98	551	
Adit Drainage	K9806762-003	0.2	1	10/22/98	10/27/98	457	
Leviathan Creek Below Delta Seep	K9806762-004	0.2	1	10/22/98	10/27/98	495	
Lower Aspen Creek	K9806762-005	0.2	1	10/22/98	10/27/98	197	
Lower Aspen Seep	K9806762-006	0.2	1	10/22/98	10/27/98	1380	
Underdrain (Channel Underdrain)	K9806762-007	0.2	1	10/22/98	10/27/98	1150	
Leviathan Creek Below Diversion C	K9806762-008	0.2	1	10/22/98	10/27/98	468	
Delta Seep	K9806762-009	0.2	1	10/22/98	10/27/98	1140	
Aspen Creek Above Leviathan Creel	K9806762-010	0.2	1	10/22/98	10/27/98	264	
Aspen Wetland Spring/Seep	K9806762-011	0.2	1	10/22/98	10/27/98	603	
Aspen Creek Station #22	K9806762-012	0.2	1	10/22/98	10/27/98	80.5	
Diversion Channel	K9806762-013	0.2	1	10/22/98	10/27/98	55.7	
Leviathan Creek Above Aspen Creel	K9806762-014	0.2	1	10/22/98	10/27/98	470	
Station #1 Leviathan Creek	K9806762-015	0.2	1	10/22/98	10/27/98	54.8	
Pond 4 Discharge	K9806762-016	0.2	2	10/22/98	10/27/98	1150	
Upper Tributary	K9806762-017	0.2	1	10/22/98	10/27/98	94.6	
Method Blank	K9806762-MB	0.2	1	10/22/98	10/27/98	ND	

Approved By: _____ Date: 10/29/98

LA/052595

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/6,8/98

Alkalinity, Total as $CaCO_3$
EPA Method 310.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	ERA Lot#9980	211	183	87
	ERA Lot#9980	211	218	103

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
pH Buffer Check 1	4.00	3.99	100
pH Buffer Check 2	4.00	4.00	100
pH Buffer Check 3	4.00	4.01	100
pH Buffer Check 4	4.00	4.01	100
pH Buffer Check 5	4.00	4.00	100
pH Buffer Check 6	4.00	4.00	100

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Underdrain (Channel Underdrain)	K9806762-007D	2	ND	ND	ND	-

Approved By: _____ Date: 10/19/98

COMBOQCP/042695

06762WET.LJ1 - alk 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1,2/98

Solids, Total Dissolved (TDS)
EPA Method 160.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #48370	616	641	104
	APG 3664 Lot #48370	616	643	104

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	5	208	220	214	6

Approved By: _____ Date: 10/19/98

COMBOQCG (2)/060695

06762WET.LJ1 - tds 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1,2/98

Solids, Total Suspended (TSS)
EPA Method 160.2
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot#48370	316	301	95
	APG 3664 Lot#48370	312	304	97

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	5	1820	1840	1830	1

Approved By: _____ Date: 10/19/98

COMBOQCG (3)/060695

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/2/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	150	104

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	5.0	5.0	100
CCV 2 Result	5.0	5.0	100
CCV 3 Result	5.0	5.0	100
CCV 4 Result	5.0	5.0	100
CCV 5 Result	5.0	4.9	98
CCV 6 Result	5.0	4.9	98

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	0.2	208	209	208	< 1

MATRIX SPIKE ANALYSIS

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
Pond 2 Surface Drainage	K9806762-001MS	0.2	100	208	357	149 (A)

A Outside acceptance limits: see case narrative.

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

06762WET.LJ1 - so4 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	145	100

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	5.0	4.8	96
CCV 2 Result	5.0	4.9	98
CCV 3 Result	5.0	4.8	96
CCV 4 Result	5.0	4.9	98
CCV 5 Result	5.0	4.8	96
CCV 6 Result	5.0	4.8	96

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

06762WET.LJ1 - so4 (2) 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/5/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	146	101

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	144	4.9	98
CCV 2 Result	144	4.9	98
CCV 3 Result	144	5.3	106
CCV 4 Result	144	5.5	110
CCV 5 Result	144	5.1	102
CCV 6 Result	144	5.0	100

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Extracted: 10/22/98
Date Analyzed: 10/27/98

Duplicate Summary
Total Metals

Sample Name: Pit Under Drain
Lab Code: K9806762-002
Test Notes:

Units: mg/L (ppm)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
Hardness, Total as CaCO3	EPA 3010A	6010B/SM 2340B	0.2	551	561	556	2	

Approved By: JC Date: 10/29/98

DUP/052595
06762ICP.JC1 - DUP 10/29/98

TOTAL CLP METALS

Sample Identification Summary

Client Sample No. :	CAS Lab Code:	Metals CLP ID. (Dissolved) :	Metals CLP ID. (Total) :
Pond 2 Surface Drainage	K9806762-001	D76201	T76201
Pit Under Drain	K9806762-002	D76202	T76202
Adit Drainage	K9806762-003	D76203	T76203
Leviathan Creek Below Delta Seep	K9806762-004	D76204	T76204
Lower Aspen Creek	K9806762-005	D76205	T76205
Lower Aspen Seep	K9806762-006	D76206	T76206
Underdrain (Channel Underdrain)	K9806762-007	D76207	T76207
Leviathan Creek Below Diversion Channel	K9806762-008	D76208	T76208
Delta Seep	K9806762-009	D76209	T76209
Aspen Creek Above Leviathan Creek	K9806762-010	D76210	T76210
Aspen Wetland Spring/Seep	K9806762-011	D76211	T76211
Aspen Creek Station #22	K9806762-012	D76212	T76212
Diversion Channel	K9806762-013	D76213	T76213
Leviathan Creek Above Aspen Creek	K9806762-014	D76214	T76214
Station #1 Leviathan Creek	K9806762-015	D76215	T76215
Pond 4 Discharge	K9806762-016	D76216	T76216
Upper Tributary	K9806762-017	D76217	T76217

ENVIROFORMS/INORGANIC CLP

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
T76201	Pond 2 Sur
T76202	Pit u Drai
T76202D	Pit u Drai
T76202S	Pit u Drai
T76203	Adit Drain
T76204	LCreeK/Del
T76205	LAspenCree
T76206	LAspenSeep
T76207	ChannUnder
T76208	LCrK/DivCh
T76209	Delta Seep
T76210	ACreek ab
T76211	Aspen Seep
T76212	Aspen St22
T76213	DiverChann
T76214	LCreek/Asp
T76215	Sta1 LCree
T76216	Pond 4 Dis
T76217	Upper Trib

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: _____ Name: _____

Date: _____ Title: _____

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76201

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pond 2 Sur

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	59200			P
7440-36-0	Antimony	21.2	B		P
7440-38-2	Arsenic	102		*	F
7440-39-3	Barium	333		E	P
7440-41-7	Beryllium	6.9			P
	Boron	53.7			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	76800			P
7440-47-3	Chromium	113			P
7440-48-4	Cobalt	94.0			P
7440-50-8	Copper	302			P
7439-89-6	Iron	37100			P
7439-92-1	Lead	9.4			F
7439-95-4	Magnesium	17800			P
7439-96-5	Manganese	2720			P
7439-97-6	Mercury	4.8			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	178			P
7440-09-7	Potassium	7430			P
7782-49-2	Selenium	5.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	1900	B		P
7440-28-0	Thallium	10.6			F
7440-62-2	Vanadium	123			P
7440-66-6	Zinc	222			P

Color Before: BROWN Clarity Before: CLOUDY Texture:

Color After: BROWN Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76202

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pit u Drai

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	253000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	10800		*	F
7440-39-3	Barium	14.6	B	E	P
7440-41-7	Beryllium	10.5			P
	Boron	393			P
7440-43-9	Cadmium	26.4			P
7440-70-2	Calcium	146000			P
7440-47-3	Chromium	956			P
7440-48-4	Cobalt	1740			P
7440-50-8	Copper	1140			P
7439-89-6	Iron	729000			P
7439-92-1	Lead	7.0		W	F
7439-95-4	Magnesium	45200			P
7439-96-5	Manganese	8970			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	4690			P
7440-09-7	Potassium	15300			P
7782-49-2	Selenium	5.0	U	NW	F
7440-22-4	Silver	6.0	B		P
7440-23-5	Sodium	25100			P
7440-28-0	Thallium	470			F
7440-62-2	Vanadium	458			P
7440-66-6	Zinc	835			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76203

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Adit Drain

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	256000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	12800		*	F
7440-39-3	Barium	13.9	B	E	P
7440-41-7	Beryllium	8.0			P
	Boron	391			P
7440-43-9	Cadmium	26.3			P
7440-70-2	Calcium	122000			P
7440-47-3	Chromium	1050			P
7440-48-4	Cobalt	2040			P
7440-50-8	Copper	1420			P
7439-89-6	Iron	696000			P
7439-92-1	Lead	10.5		S	F
7439-95-4	Magnesium	37000			P
7439-96-5	Manganese	7100			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	5430			P
7440-09-7	Potassium	14300			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	4.8	B		P
7440-23-5	Sodium	22500			P
7440-28-0	Thallium	562			F
7440-62-2	Vanadium	475			P
7440-66-6	Zinc	732			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76204

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCreeK/Del

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14200			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	156		*	F
7440-39-3	Barium	76.4	B	E	P
7440-41-7	Beryllium	2.1	B		P
	Boron	143			P
7440-43-9	Cadmium	3.6	B		P
7440-70-2	Calcium	140000			P
7440-47-3	Chromium	8.6	B		P
7440-48-4	Cobalt	272			P
7440-50-8	Copper	20.0	B		P
7439-89-6	Iron	104000			P
7439-92-1	Lead	1.3	B		F
7439-95-4	Magnesium	35400			P
7439-96-5	Manganese	6700			P
7439-97-6	Mercury	0.17	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	606			P
7440-09-7	Potassium	8040			P
7782-49-2	Selenium	1.3	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	14800			P
7440-28-0	Thallium	10.3			F
7440-62-2	Vanadium	26.7	B		P
7440-66-6	Zinc	119			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76205

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LAspenCree

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3040			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.5	B	*	F
7440-39-3	Barium	26.9	B	E	P
7440-41-7	Beryllium	1.1	B		P
	Boron	51.6			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	57100			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	29.4	B		P
7440-50-8	Copper	78.7			P
7439-89-6	Iron	602			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	13300			P
7439-96-5	Manganese	1850			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	54.0			P
7440-09-7	Potassium	6060			P
7782-49-2	Selenium	8.3		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9320			P
7440-28-0	Thallium	3.0	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	69.0			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76206

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LAspenSeep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51500			P
7440-36-0	Antimony	32.0	B		P
7440-38-2	Arsenic	1.8	B	*	F
7440-39-3	Barium	8.3	B	E	P
7440-41-7	Beryllium	10.8			P
	Boron	314			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	396000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	394			P
7440-50-8	Copper	1290			P
7439-89-6	Iron	96900			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	95900			P
7439-96-5	Manganese	22300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	631			P
7440-09-7	Potassium	23600			P
7782-49-2	Selenium	1.2	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15800			P
7440-28-0	Thallium	11.3			F
7440-62-2	Vanadium	7.0	B		P
7440-66-6	Zinc	900			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76207

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: ChannUnder

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	43500			P
7440-36-0	Antimony	49.7	B		P
7440-38-2	Arsenic	544		*	F
7440-39-3	Barium	18.3	B	E	P
7440-41-7	Beryllium	6.9			P
	Boron	345			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	330000			P
7440-47-3	Chromium	21.0			P
7440-48-4	Cobalt	904			P
7440-50-8	Copper	15.7	B		P
7439-89-6	Iron	365000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	78000			P
7439-96-5	Manganese	18000			P
7439-97-6	Mercury	0.50			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	2030			P
7440-09-7	Potassium	17500			P
7782-49-2	Selenium	1.6	B	NW	F
7440-22-4	Silver	5.5	B		P
7440-23-5	Sodium	24000			P
7440-28-0	Thallium	31.3			F
7440-62-2	Vanadium	86.7			P
7440-66-6	Zinc	399			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76208

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCrK/DivCh

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	16400			P
7440-36-0	Antimony	31.6	B		P
7440-38-2	Arsenic	202		*	F
7440-39-3	Barium	60.8	B	E	P
7440-41-7	Beryllium	2.5	B		P
	Boron	140			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	135000			P
7440-47-3	Chromium	8.1	B		P
7440-48-4	Cobalt	339			P
7440-50-8	Copper	10.1	B		P
7439-89-6	Iron	137000			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	31800			P
7439-96-5	Manganese	6770			P
7439-97-6	Mercury	0.13	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	766			P
7440-09-7	Potassium	10100			P
7782-49-2	Selenium	1.2	B	NW	F
7440-22-4	Silver	2.0	B		P
7440-23-5	Sodium	13900			P
7440-28-0	Thallium	13.6			F
7440-62-2	Vanadium	33.5	B		P
7440-66-6	Zinc	152			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76209

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Delta Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3510			P
7440-36-0	Antimony	23.9	B		P
7440-38-2	Arsenic	72.2		*	F
7440-39-3	Barium	18.6	B	E	P
7440-41-7	Beryllium	2.2	B		P
	Boron	176			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	321000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	255			P
7440-50-8	Copper	35.0			P
7439-89-6	Iron	24300			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	87200			P
7439-96-5	Manganese	15000			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	576			P
7440-09-7	Potassium	7730			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	2.1	B		P
7440-23-5	Sodium	23800			P
7440-28-0	Thallium	3.0	B		F
7440-62-2	Vanadium	6.0	B		P
7440-66-6	Zinc	109			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76210

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: ACreek ab

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1990			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.2	B	*	F
7440-39-3	Barium	33.1	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	53.5			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	75000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	23.7	B		P
7440-50-8	Copper	58.6			P
7439-89-6	Iron	233			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	18600			P
7439-96-5	Manganese	1770			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	45.2			P
7440-09-7	Potassium	3630	B		P
7782-49-2	Selenium	7.3		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10400			P
7440-28-0	Thallium	2.2	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	58.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76211

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Aspen Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	45600			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.3	B	*	F
7440-39-3	Barium	10.2	B	E	P
7440-41-7	Beryllium	3.0	B		P
	Boron	61.5			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	159000			P
7440-47-3	Chromium	4.9	B		P
7440-48-4	Cobalt	171			P
7440-50-8	Copper	1060			P
7439-89-6	Iron	306			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	49900			P
7439-96-5	Manganese	3570			P
7439-97-6	Mercury	7.7			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	347			P
7440-09-7	Potassium	7400			P
7782-49-2	Selenium	26.2		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9740			P
7440-28-0	Thallium	18.8			F
7440-62-2	Vanadium	2.5	B		P
7440-66-6	Zinc	410			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76212

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Aspen St22

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	210			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.2	B	*	F
7440-39-3	Barium	12.2	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	24.6	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	23700			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.6	B		P
7439-89-6	Iron	228			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5120			P
7439-96-5	Manganese	13.4	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	1260	B		P
7782-49-2	Selenium	1.8	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9230			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.6	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76213

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: DiverChann

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	93.4	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.1	B	*	F
7440-39-3	Barium	65.0	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	21.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	15000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.1	B		P
7439-89-6	Iron	182			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4400	B		P
7439-96-5	Manganese	9.3	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3150	B		P
7782-49-2	Selenium	1.1	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8230			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76214

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCreek/Asp

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10300			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	44.4		*	F
7440-39-3	Barium	38.9	B	E	P
7440-41-7	Beryllium	1.5	B		P
	Boron	98.4			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	135000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	237			P
7440-50-8	Copper	6.6	B		P
7439-89-6	Iron	51100			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	32200			P
7439-96-5	Manganese	5730			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	511			P
7440-09-7	Potassium	6020			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	13400			P
7440-28-0	Thallium	7.6	B		F
7440-62-2	Vanadium	8.8	B		P
7440-66-6	Zinc	96.3			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76215

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Sta1 LCree

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	120	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.3	B	*	F
7440-39-3	Barium	70.4	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	21.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	14300			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	215			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4640	B		P
7439-96-5	Manganese	10.7	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3440	B		P
7782-49-2	Selenium	1.6	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8410			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76216

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pond 4 Dis

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1550000			P
7440-36-0	Antimony	37.4	U		P
7440-38-2	Arsenic	41200		*	F
7440-39-3	Barium	20.5	B	E	P
7440-41-7	Beryllium	53.7			P
	Boron	1220			P
7440-43-9	Cadmium	324			P
7440-70-2	Calcium	519000			P
7440-47-3	Chromium	5080			P
7440-48-4	Cobalt	9810			P
7440-50-8	Copper	13000			P
7439-89-6	Iron	2410000			P
7439-92-1	Lead	4.3			F
7439-95-4	Magnesium	244000			P
7439-96-5	Manganese	47600			P
7439-97-6	Mercury	0.17	B		CV
	Molybdenum	8.8	U		P
7440-02-0	Nickel	25100			P
7440-09-7	Potassium	757	U		P
7782-49-2	Selenium	25.0	U	NW	F
7440-22-4	Silver	3.6	U		P
7440-23-5	Sodium	18500			P
7440-28-0	Thallium	1.5	B		F
7440-62-2	Vanadium	1700			P
7440-66-6	Zinc	4750			P

Color Before: YELLOW Clarity Before: CLEAR Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76217

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Upper Trib

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	122	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.4	B	*	F
7440-39-3	Barium	135	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	19.8	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	28900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.1	B		P
7439-89-6	Iron	178			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5470			P
7439-96-5	Manganese	29.2			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2990	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10600			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.7	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76201

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Pond 2 Sur

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5010			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	37.0		*	F
7440-39-3	Barium	22.2	B		P
7440-41-7	Beryllium	2.6	B		P
	Boron	20.4	B		P
7440-43-9	Cadmium	2.5	B		P
7440-70-2	Calcium	32400			P
7440-47-3	Chromium	10.6			P
7440-48-4	Cobalt	24.5	B		P
7440-50-8	Copper	84.4			P
7439-89-6	Iron	1860			P
7439-92-1	Lead	1.2	B		F
7439-95-4	Magnesium	4920	B		P
7439-96-5	Manganese	640			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	63.4			P
7440-09-7	Potassium	2720	B		P
7782-49-2	Selenium	1.4	B	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	1840	B		P
7440-28-0	Thallium	3.0	B		F
7440-62-2	Vanadium	11.3	B		P
7440-66-6	Zinc	52.9			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76202

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Pit U Drai

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	258000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	10500		*	F
7440-39-3	Barium	14.4	B		P
7440-41-7	Beryllium	11.1			P
	Boron	415			P
7440-43-9	Cadmium	59.0			P
7440-70-2	Calcium	147000			P
7440-47-3	Chromium	976			P
7440-48-4	Cobalt	1780			P
7440-50-8	Copper	1170			P
7439-89-6	Iron	727000			P
7439-92-1	Lead	7.8			F
7439-95-4	Magnesium	45500			P
7439-96-5	Manganese	9140			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	4790			P
7440-09-7	Potassium	15500			P
7782-49-2	Selenium	7.8		N+	F
7440-22-4	Silver	6.1	B		P
7440-23-5	Sodium	26100			P
7440-28-0	Thallium	428			F
7440-62-2	Vanadium	468			P
7440-66-6	Zinc	846			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76203

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Adit Drain

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	247000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	12800		*	F
7440-39-3	Barium	13.1	B		P
7440-41-7	Beryllium	8.1			P
	Boron	362			P
7440-43-9	Cadmium	63.8			P
7440-70-2	Calcium	116000			P
7440-47-3	Chromium	1010			P
7440-48-4	Cobalt	1960			P
7440-50-8	Copper	1350			P
7439-89-6	Iron	690000			P
7439-92-1	Lead	10.1			F
7439-95-4	Magnesium	35000			P
7439-96-5	Manganese	6800			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	5140			P
7440-09-7	Potassium	13500			P
7782-49-2	Selenium	4.4	B	NS	F
7440-22-4	Silver	5.4	B		P
7440-23-5	Sodium	22000			P
7440-28-0	Thallium	532			F
7440-62-2	Vanadium	457			P
7440-66-6	Zinc	701			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
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ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D76204

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: LCreek/DSe

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1970			P
7440-36-0	Antimony	32.4	B		P
7440-38-2	Arsenic	95.5		*	F
7440-39-3	Barium	51.4	B		P
7440-41-7	Beryllium	1.5	B		P
	Boron	126			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	133000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	268			P
7440-50-8	Copper	14.0	B		P
7439-89-6	Iron	95200			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	34400			P
7439-96-5	Manganese	6520			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	592			P
7440-09-7	Potassium	6760			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15600			P
7440-28-0	Thallium	8.6	B		F
7440-62-2	Vanadium	8.5	B		P
7440-66-6	Zinc	121			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76205

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: LAspenCree

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3060			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U	*	F
7440-39-3	Barium	27.2	B		P
7440-41-7	Beryllium	1.1	B		P
	Boron	57.8			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	54200			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	29.8	B		P
7440-50-8	Copper	81.7			P
7439-89-6	Iron	570			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	12900			P
7439-96-5	Manganese	1800			P
7439-97-6	Mercury	0.77			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	58.5			P
7440-09-7	Potassium	4900	B		P
7782-49-2	Selenium	7.4		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	12500			P
7440-28-0	Thallium	2.5	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	69.6			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76206

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: LAspenSeep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	52500			P
7440-36-0	Antimony	25.6	B		P
7440-38-2	Arsenic	1.0	U	*	F
7440-39-3	Barium	7.4	B		P
7440-41-7	Beryllium	10.8			P
	Boron	328			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	380000			P
7440-47-3	Chromium	5.8	B		P
7440-48-4	Cobalt	390			P
7440-50-8	Copper	1320			P
7439-89-6	Iron	92600			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	95700			P
7439-96-5	Manganese	22000			P
7439-97-6	Mercury	0.11	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	612			P
7440-09-7	Potassium	23100			P
7782-49-2	Selenium	1.7	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	16600			P
7440-28-0	Thallium	9.5	B		F
7440-62-2	Vanadium	8.4	B		P
7440-66-6	Zinc	873			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D76207

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Chann Unde

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	42800			P
7440-36-0	Antimony	19.9	B		P
7440-38-2	Arsenic	412		*	F
7440-39-3	Barium	20.2	B		P
7440-41-7	Beryllium	6.7			P
	Boron	336			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	308000			P
7440-47-3	Chromium	20.6			P
7440-48-4	Cobalt	866			P
7440-50-8	Copper	9.7	B		P
7439-89-6	Iron	347000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	74800			P
7439-96-5	Manganese	17200			P
7439-97-6	Mercury	0.21			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1940			P
7440-09-7	Potassium	16900			P
7782-49-2	Selenium	1.0	B	NW	F
7440-22-4	Silver	5.2	B		P
7440-23-5	Sodium	24800			P
7440-28-0	Thallium	43.9		S	F
7440-62-2	Vanadium	82.7			P
7440-66-6	Zinc	379			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76208

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: LCrk/Div C

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7020			P
7440-36-0	Antimony	37.6	B		P
7440-38-2	Arsenic	138		*	F
7440-39-3	Barium	56.8	B		P
7440-41-7	Beryllium	2.2	B		P
	Boron	150			P
7440-43-9	Cadmium	3.6	B		P
7440-70-2	Calcium	130000			P
7440-47-3	Chromium	5.0	B		P
7440-48-4	Cobalt	341			P
7440-50-8	Copper	5.3	B		P
7439-89-6	Iron	136000			P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	32300			P
7439-96-5	Manganese	6740			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	754			P
7440-09-7	Potassium	8390			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	2.6	B		P
7440-23-5	Sodium	15300			P
7440-28-0	Thallium	10.8			F
7440-62-2	Vanadium	17.9	B		P
7440-66-6	Zinc	145			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76209

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Delta Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2040			P
7440-36-0	Antimony	29.2	B		P
7440-38-2	Arsenic	52.2		*	F
7440-39-3	Barium	13.8	B		P
7440-41-7	Beryllium	1.9	B		P
	Boron	168			P
7440-43-9	Cadmium	2.6	B		P
7440-70-2	Calcium	304000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	248			P
7440-50-8	Copper	11.3	B		P
7439-89-6	Iron	22900			P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	87800			P
7439-96-5	Manganese	14700			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	563			P
7440-09-7	Potassium	5200			P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	25800			P
7440-28-0	Thallium	2.0	B		F
7440-62-2	Vanadium	4.7	B		P
7440-66-6	Zinc	105			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76210

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: ACreek ab

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	582			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U	*	F
7440-39-3	Barium	32.6	B		P
7440-41-7	Beryllium	0.74	B		P
	Boron	54.4			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	74400			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	22.6	B		P
7440-50-8	Copper	52.6			P
7439-89-6	Iron	96.3	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	18500			P
7439-96-5	Manganese	1710			P
7439-97-6	Mercury	0.12	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	48.6			P
7440-09-7	Potassium	4370	B		P
7782-49-2	Selenium	8.4		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10800			P
7440-28-0	Thallium	1.4	B		F
7440-62-2	Vanadium	2.7	B		P
7440-66-6	Zinc	62.0			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

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ENVIROFORMS/INORGANIC CLP

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INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76211

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Aspen Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	44200			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U	*	F
7440-39-3	Barium	7.7	B		P
7440-41-7	Beryllium	3.4	B		P
	Boron	64.6			P
7440-43-9	Cadmium	6.1			P
7440-70-2	Calcium	155000			P
7440-47-3	Chromium	3.9	B		P
7440-48-4	Cobalt	165			P
7440-50-8	Copper	1050			P
7439-89-6	Iron	255			P
7439-92-1	Lead	1.2	B		F
7439-95-4	Magnesium	50100			P
7439-96-5	Manganese	3440			P
7439-97-6	Mercury	7.5			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	345			P
7440-09-7	Potassium	6990			P
7782-49-2	Selenium	51.4		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10500			P
7440-28-0	Thallium	17.7			F
7440-62-2	Vanadium	2.9	B		P
7440-66-6	Zinc	407			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D76212

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Aspen St#2

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	148	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U	*	F
7440-39-3	Barium	10.4	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	22.1	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	24200			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	31.4	B		P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	5440			P
7439-96-5	Manganese	11.9	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	910	B		P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10100			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	4.2	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76213

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Diver Chan

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	131	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.0	B	*	F
7440-39-3	Barium	70.2	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	20.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	15700			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.2	B		P
7439-89-6	Iron	161			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4900	B		P
7439-96-5	Manganese	9.4	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2940	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9200			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	4.7	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76214

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: LCreek/Asp

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12100			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	6.5	B	*	F
7440-39-3	Barium	52.8	B		P
7440-41-7	Beryllium	2.4	B		P
	Boron	98.6			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	151000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	277			P
7440-50-8	Copper	13.9	B		P
7439-89-6	Iron	11900			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	39100			P
7439-96-5	Manganese	6720			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	637			P
7440-09-7	Potassium	7510			P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	16900			P
7440-28-0	Thallium	8.6	B		F
7440-62-2	Vanadium	3.9	B		P
7440-66-6	Zinc	127			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D76215

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Sta#1 LCre

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51.4	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.2	B	*	F
7440-39-3	Barium	69.9	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	20.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	13900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	82.6	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4670	B		P
7439-96-5	Manganese	9.9	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3220	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9730			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	4.5	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D76216

Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Pond 4 Dis

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1420000			P
7440-36-0	Antimony	37.4	U		P
7440-38-2	Arsenic	39200		*	F
7440-39-3	Barium	18.1	B		P
7440-41-7	Beryllium	54.2			P
	Boron	1190			P
7440-43-9	Cadmium	270			P
7440-70-2	Calcium	478000			P
7440-47-3	Chromium	4910			P
7440-48-4	Cobalt	9010			P
7440-50-8	Copper	12400			P
7439-89-6	Iron	2080000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	235000			P
7439-96-5	Manganese	43600			P
7439-97-6	Mercury	0.14	B		CV
	Molybdenum	8.8	U		P
7440-02-0	Nickel	24600			P
7440-09-7	Potassium	757	U		P
7782-49-2	Selenium	50.0	B	NW	F
7440-22-4	Silver	3.6	U		P
7440-23-5	Sodium	19400			P
7440-28-0	Thallium	2.6	B		F
7440-62-2	Vanadium	1630			P
7440-66-6	Zinc	4520			P

Color Before: YELLOW Clarity Before: CLEAR Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D76217

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W76201

Matrix (soil/water): WATER Lab Sample ID: Upper Trib

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	125	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	6.3	B	*	F
7440-39-3	Barium	139	B		P
7440-41-7	Beryllium	0.74	B		P
	Boron	25.5	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	28000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	172			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5560			P
7439-96-5	Manganese	28.2			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2310	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	11800			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.9	B		P
7440-66-6	Zinc	2.6	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

Appendix C.2
Water Quality Data
October 1998

LEVIATHAN MINE

Groundwater Lab Results
Date Collected
10/20/98

Sample Name	Lab Code
MW-7	10209800
MW-8	10209801
MW-6	10209802

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807354
Date Collected: 10/20/98
Date Received: 10/23/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10209800	10209801	10209802
		Lab Code:	K9807354-001	K9807354-002	K9807354-003
			MW7	MW-8	MW-6
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.42	3.83	4.76
Conductivity (µmhos/cm)	120.1	2	268	1720	2640
Alkalinity, Total as $CaCO_3$	310.1	2	81	ND	ND
Bromide	300.0	0.2	ND	<0.5 (D)	<0.5 (D)
Chloride	300.0	0.2	1.2	3.1	3.1
Fluoride	300.0	0.2	ND	2.5	4.5
Nitrate as Nitrogen	300.0	0.2	ND	<0.5 (D)	<0.5 (D)
Nitrite as Nitrogen	300.0	0.2	ND	<0.5 (D)	<0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.13	0.11	0.03
Phosphorus, Total	365.3	0.01	0.18	0.03	0.02
Solids, Total Dissolved (TDS)	160.1	5	217	1820	347
Solids, Total Suspended (TSS)	160.2	5	100	58	25
Sulfate	300.0	0.2	63.7	1120	2390

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/20/98

3530EPA/102094

07354WET.LJ1 - Mixed 11/20/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807354
Date Collected: NA
Date Received: NA
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name: **Method Blank**
Lab Code: K9807354-MB

Analyte	EPA Method	MRL	
pH (units)	150.1	–	-
Conductivity (µmhos/cm)	120.1	2	ND
Alkalinity, Total as $CaCO_3$	310.1	2	ND
Bromide	300.0	0.2	ND
Chloride	300.0	0.2	ND
Fluoride	300.0	0.2	ND
Nitrate as Nitrogen	300.0	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND
Orthophosphate as Phosphorus	365.3	0.01	ND
Phosphorus, Total	365.3	0.01	ND
Solids, Total Dissolved (TDS)	160.1	5	ND
Solids, Total Suspended (TSS)	160.2	5	ND
Sulfate	300.0	0.2	ND

Approved By: _____ Date: 11/20/98

3S30EPA/102094

07354WET.LJ1 - Mixed (2) 11/20/98

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807354

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W35401

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D35401	10209800
D35401D	10209800
D35401S	10209800
D35402	10209801
D35403	10209802

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CORONADO

Date: 11/17/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D35401

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807354

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W35401

Matrix (soil/water): WATER Lab Sample ID: 10209800

Level (low/med): LOW Date Received: 10/23/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	28.9	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	61.2			F
7440-39-3	Barium	41.9	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	25.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	34500			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	8.2	B		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	4240			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	7010			P
7439-96-5	Manganese	457			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	19.9	B		P
7440-09-7	Potassium	3250	B		P
7782-49-2	Selenium	2.4	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	12800			P
7440-28-0	Thallium	4.4	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	16.5	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D35401

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W625

Matrix (soil/water): WATER Lab Sample ID: 10209800

Level (low/med): LOW Date Received: 11/05/98 MW-7

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	28.9	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	61.2			F
7440-39-3	Barium	41.9	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	25.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	34500			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	8.2	B		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	4240			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	7010			P
7439-96-5	Manganese	457			P
7439-97-6	Mercury				
	Molybdenum	4.4	U		P
7440-02-0	Nickel	19.9	B		P
7440-09-7	Potassium	3250	B		P
7782-49-2	Selenium	2.4	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	12800			P
7440-28-0	Thallium	4.4	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	16.5	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D35402

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807354

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W35401

Matrix (soil/water): WATER Lab Sample ID: 10209801

Level (low/med): LOW Date Received: 10/23/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	29600			P
7440-36-0	Antimony	20.1	B		P
7440-38-2	Arsenic	375			F
7440-39-3	Barium	12.6	B	E	P
7440-41-7	Beryllium	3.5	B		P
	Boron	300			P
7440-43-9	Cadmium	12.6			P
7440-70-2	Calcium	179000			P
7440-47-3	Chromium	19.1			P
7440-48-4	Cobalt	108			P
7440-50-8	Copper	13.1	B		P
7439-89-6	Iron	228000			P
7439-92-1	Lead	1.8	B		F
7439-95-4	Magnesium	33900			P
7439-96-5	Manganese	10300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	313			P
7440-09-7	Potassium	19000			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	2.7	B		P
7440-23-5	Sodium	17700			P
7440-28-0	Thallium	199			F
7440-62-2	Vanadium	53.7			P
7440-66-6	Zinc	310			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D35403

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807354

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W35401

Matrix (soil/water): WATER Lab Sample ID: 10209802

mw-6

Level (low/med): LOW Date Received: 10/23/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	18700			P
7440-36-0	Antimony	57.5	B		P
7440-38-2	Arsenic	305			F
7440-39-3	Barium	12.6	B	E	P
7440-41-7	Beryllium	6.0			P
	Boron	350			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	441000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	585			P
7440-50-8	Copper	7.5	B		P
7439-89-6	Iron	347000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	80700			P
7439-96-5	Manganese	22400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1280			P
7440-09-7	Potassium	24200			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	4.4	B		P
7440-23-5	Sodium	25600			P
7440-28-0	Thallium	33.1		S	F
7440-62-2	Vanadium	51.8			P
7440-66-6	Zinc	247			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

LEVIATHAN MINE

Groundwater Lab Results
Date Collected
10/16/98

Sample Name	Lab Code
MW-10s	10169801
MW-4	10169802
MW-5d	10199801
MW-3	10199803
MW-2s	10199804
MW-2d	10199805
MW-3 DUP	10199800

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: 10/16/9
Date Received: 10/22/
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10199812	10169801	10169802
		Lab Code:	K9807299-007	K9807299-008	K9807299-0
			[illegible]	MW-10S	MW-
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	2.62	3.49	3.72
Conductivity (µmhos/cm)	120.1	2	3970	2950	2380
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	< 1.0 (D)	< 1.0 (D)	< 1.0 (D)
Chloride	300.0	0.2	1.1	6.5	3.7
Fluoride	300.0	0.2	4.0	5.2	4.6
Nitrate as Nitrogen	300.0	0.2	< 1.0 (D)	< 1.0 (D)	1.3
Nitrite as Nitrogen	300.0	0.2	1.1	< 1.0 (D)	< 1.0 (D)
Orthophosphate as Phosphorus	365.3	0.01	3.69	ND	0.02
Phosphorus, Total	365.3	0.01	7.75	0.07	0.21
Solids, Total Dissolved (TDS)	160.1	5	5000	3830	
Solids, Total Suspended (TSS)	160.2	5	ND	84	
Sulfate	300.0	0.2	2360	2440	2560

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/10/98

3S30EPA/102094

07299WET.LJ1 - Mixed (3) 11/10/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: 10/16/98
Date Received: 10/22/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10199800	10199801	10199802
		Lab Code:	K9807299-010	K9807299-011	K9807299-012
			Dupe	MW-5d	Blank
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	2.22	3.05	5.62
Conductivity (µmhos/cm)	120.1	2	6400	5030	4
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	< 1.0 (D)	< 1.0 (D)	ND
Chloride	300.0	0.2	1.7	6.8	ND
Fluoride	300.0	0.2	3.1	7.8	ND
Nitrate as Nitrogen	300.0	0.2	< 1.0 (D)	1.3	ND
Nitrite as Nitrogen	300.0	0.2	< 1.0 (D)	< 1.0 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01	0.11	ND	ND
Phosphorus, Total	365.3	0.01	7.10	0.32	ND
Solids, Total Dissolved (TDS)	160.1	5	6520	5770	30
Solids, Total Suspended (TSS)	160.2	5	29	1040	ND
Sulfate	300.0	0.2	7760	6670	6.8

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/10/98

3S30EPA/102094

07299WET.LJ1 - Mixed (4) 11/10/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: 10/16/98
Date Received: 10/22/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10199803	10199804	10199805
		Lab Code:	K9807299-013	K9807299-014	K9807299-015
			MW-3	MW-2S	MW-2a
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	2.22	3.56	3.60
Conductivity (µmhos/cm)	120.1	2	6710	3940	4940
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	< 1.0 (D)	< 1.0 (D)	< 1.0 (D)
Chloride	300.0	0.2	1.7	1.3	2.1
Fluoride	300.0	0.2	3.0	5.3	11.3
Nitrate as Nitrogen	300.0	0.2	< 1.0 (D)	< 1.0 (D)	< 1.0 (D)
Nitrite as Nitrogen	300.0	0.2	< 1.0 (D)	< 1.0 (D)	< 1.0 (D)
Orthophosphate as Phosphorus	365.3	0.01	4.71	0.29	0.10
Phosphorus, Total	365.3	0.01	6.67	0.02	0.31
Solids, Total Dissolved (TDS)	160.1	5	6340	6180	75
Solids, Total Suspended (TSS)	160.2	5	12	67	28
Sulfate	300.0	0.2	9370	8400	8860

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/10/98

3S30EPA/102094

07299WET.LJ1 - Mixed (5) 11/10/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: NA
Date Received: NA
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name: **Method Blank**
Lab Code: K9807299-MB

Analyte	**EPA Method**	**MRL**	
pH (units)	150.1	--	-
Conductivity (µmhos/cm)	120.1	2	ND
Alkalinity, Total as $CaCO_3$	310.1	2	ND
Bromide	300.0	0.2	ND
Chloride	300.0	0.2	ND
Fluoride	300.0	0.2	ND
Nitrate as Nitrogen	300.0	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND
Orthophosphate as Phosphorus	365.3	0.01	ND
Phosphorus, Total	365.3	0.01	ND
Solids, Total Dissolved (TDS)	160.1	5	ND
Solids, Total Suspended (TSS)	160.2	5	ND
Sulfate	300.0	0.2	ND

Approved By: _____ Date: 11/10/98

3530EPA/102094

07299WET.LJ1 - Mixed (6) 11/10/98

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D29908

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169801

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	22000			P
7440-36-0	Antimony	56.2	B		P
7440-38-2	Arsenic	690			F
7440-39-3	Barium	12.3	B	E	P
7440-41-7	Beryllium	5.5			P
	Boron	547			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	320000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	504		E	P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	463000			P
7439-92-1	Lead	2.0	B	W	F
7439-95-4	Magnesium	114000			P
7439-96-5	Manganese	21400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1650			P
7440-09-7	Potassium	28300			P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	30400			P
7440-28-0	Thallium	13.0			F
7440-62-2	Vanadium	22.5	B		P
7440-66-6	Zinc	362			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D29909

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169802

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	112000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	11.5		S	F
7440-39-3	Barium	12.3	B	E	P
7440-41-7	Beryllium	10.7			P
	Boron	113			P
7440-43-9	Cadmium	13.4			P
7440-70-2	Calcium	404000			P
7440-47-3	Chromium	10.2			P
7440-48-4	Cobalt	484		E	P
7440-50-8	Copper	4620			P
7439-89-6	Iron	531			P
7439-92-1	Lead	3.1			F
7439-95-4	Magnesium	102000			P
7439-96-5	Manganese	15200			P
7439-97-6	Mercury	33.5			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	792			P
7440-09-7	Potassium	14900			P
7782-49-2	Selenium	36.4		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9280			P
7440-28-0	Thallium	15.5			F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	1240			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29910

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199800

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	306000			P
7440-36-0	Antimony	26.3	B		P
7440-38-2	Arsenic	6680			F
7440-39-3	Barium	16.2	B	E	P
7440-41-7	Beryllium	5.2			P
	Boron	581			P
7440-43-9	Cadmium	23.6			P
7440-70-2	Calcium	212000			P
7440-47-3	Chromium	1410			P
7440-48-4	Cobalt	538		E	P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	818000			P
7439-92-1	Lead	16.0		S	F
7439-95-4	Magnesium	65900			P
7439-96-5	Manganese	6620			P
7439-97-6	Mercury	0.11	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	2660			P
7440-09-7	Potassium	27400			P
7782-49-2	Selenium	5.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	30700			P
7440-28-0	Thallium	114			F
7440-62-2	Vanadium	647			P
7440-66-6	Zinc	801			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29911

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199801

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	128000			P
7440-36-0	Antimony	41.8	B		P
7440-38-2	Arsenic	8.8	B	S	F
7440-39-3	Barium	23.4	B	E	P
7440-41-7	Beryllium	25.7			P
	Boron	588			P
7440-43-9	Cadmium	16.4			P
7440-70-2	Calcium	487000			P
7440-47-3	Chromium	80.6			P
7440-48-4	Cobalt	1090		E	P
7440-50-8	Copper	3040			P
7439-89-6	Iron	297000			P
7439-92-1	Lead	2.0	B	W	F
7439-95-4	Magnesium	178000			P
7439-96-5	Manganese	19200			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1410			P
7440-09-7	Potassium	46500			P
7782-49-2	Selenium	178		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	414000			P
7440-28-0	Thallium	148			F
7440-62-2	Vanadium	22.2	B		P
7440-66-6	Zinc	1240			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D29912

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199802

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	62.9	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.4	B		F
7440-39-3	Barium	0.20	U	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	215	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U	E	P
7440-50-8	Copper	2.4	B		P
7439-89-6	Iron	128			P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	70.7	B		P
7439-96-5	Manganese	7.0	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U		P
7782-49-2	Selenium	2.6	B		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	164	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29913

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199803

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	280000			P
7440-36-0	Antimony	37.4	B		P
7440-38-2	Arsenic	6600			F
7440-39-3	Barium	15.1	B	E	P
7440-41-7	Beryllium	4.9	B		P
	Boron	533			P
7440-43-9	Cadmium	19.7			P
7440-70-2	Calcium	196000			P
7440-47-3	Chromium	1270			P
7440-48-4	Cobalt	497		E	P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	788000			P
7439-92-1	Lead	15.5		S	F
7439-95-4	Magnesium	61900			P
7439-96-5	Manganese	6330			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	2500			P
7440-09-7	Potassium	26400			P
7782-49-2	Selenium	5.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	29700			P
7440-28-0	Thallium	106			F
7440-62-2	Vanadium	602			P
7440-66-6	Zinc	744			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D29914

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199804

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	294000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U	+	F
7440-39-3	Barium	12.5	B	E	P
7440-41-7	Beryllium	9.8			P
	Boron	421			P
7440-43-9	Cadmium	55.8			P
7440-70-2	Calcium	170000			P
7440-47-3	Chromium	55.2			P
7440-48-4	Cobalt	2170		E	P
7440-50-8	Copper	1880			P
7439-89-6	Iron	823000			P
7439-92-1	Lead	1.0	U	W	F
7439-95-4	Magnesium	34800			P
7439-96-5	Manganese	6780			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	5700			P
7440-09-7	Potassium	14600			P
7782-49-2	Selenium	5.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21400			P
7440-28-0	Thallium	307			F
7440-62-2	Vanadium	482			P
7440-66-6	Zinc	910			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29915

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199805

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	283000			P
7440-36-0	Antimony	49.7	B		P
7440-38-2	Arsenic	16.5	B		F
7440-39-3	Barium	16.8	B	E	P
7440-41-7	Beryllium	85.1			P
	Boron	481			P
7440-43-9	Cadmium	169			P
7440-70-2	Calcium	379000			P
7440-47-3	Chromium	7.2	B		P
7440-48-4	Cobalt	6990		E	P
7440-50-8	Copper	8490			P
7439-89-6	Iron	863000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	94100			P
7439-96-5	Manganese	79200			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	9620			P
7440-09-7	Potassium	20100			P
7782-49-2	Selenium	5.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	65800			P
7440-28-0	Thallium	30.1			F
7440-62-2	Vanadium	84.3			P
7440-66-6	Zinc	2140			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

LEVIATHAN MINE

Surface Water Lab Results
Date Collected
10/16/98

Sample Name	Lab Code
Leviathan below Delta Seep	10169812
Delta Seep	10169813
Upper Tributary	10199810
Lower tributary	10199811
Adit	10199812

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: 10/16/98
Date Received: 10/22/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte	EPA Method	MRL	10169810	10169811	10169812
Sample Name:			10169810	10169811	10169812
Lab Code:			K9807299-001	K9807299-002	K9807299-003
			Bryant Above Intn	Mint Above Bryant	Lev. Bel Delta Sys
pH (units)	150.1	--	3.76	7.98	4.68
Conductivity (µmhos/cm)	120.1	2	710	140	1170
Alkalinity, Total as $CaCO_3$	310.1	2	ND	80	ND
Bromide	300.0	0.2	ND	ND	< 0.5 (D)
Chloride	300.0	0.2	1.3	1.2	1.8
Fluoride	300.0	0.2	0.9	ND	1.7
Nitrate as Nitrogen	300.0	0.2	0.2	0.3	< 0.5 (D)
Nitrite as Nitrogen	300.0	0.2	ND	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.03	0.03	ND
Phosphorus, Total	365.3	0.01	0.03	0.04	0.12
Solids, Total Dissolved (TDS)	160.1	5	638	126	1080
Solids, Total Suspended (TSS)	160.2	5	29	ND	73
Sulfate	300.0	0.2	388	1.1	586

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/10/98

3S30EPA/102094

07299WET.LJ1 - Mixed 11/10/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27/19333
Sample Matrix: Water

Service Request: K9807299
Date Collected: 10/16/98
Date Received: 10/22/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10169813	10199810	10199811
		Lab Code:	K9807299-004	K9807299-005	K9807299-006
			Delta Sup	Upper Tank	[illegible]
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	5.67	7.82	7.73
Conductivity (µmhos/cm)	120.1	2	1620	244	490
Alkalinity, Total as $CaCO_3$	310.1	2	20	100	280
Bromide	300.0	0.2	< 0.5 (D)	ND	ND
Chloride	300.0	0.2	2.3	1.4	1.0
Fluoride	300.0	0.2	2.5	ND	ND
Nitrate as Nitrogen	300.0	0.2	< 0.5 (D)	ND	ND
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	ND	0.13	0.05
Phosphorus, Total	365.3	0.01	0.03	0.15	0.23
Solids, Total Dissolved (TDS)	160.1	5	1820	175	3[illegible]
Solids, Total Suspended (TSS)	160.2	5	15	9	1[illegible]
Sulfate	300.0	0.2	1140	12.0	27.0

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/10/98

3S30EPA/102094

07299WET.LJ1 - Mixed (2) 11/10/98

ENVIROFORMS/INORGANIC CLP

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D29901	10169810
D29901D	10169810
D29901S	10169810
D29902	10169811
D29903	10169812
D29904	10169813
D29905	10199810
D29906	10199811
D29907	10199812
D29908	10169801
D29909	10169802
D29910	10199800
D29911	10199801
D29912	10199802
D29913	10199803
D29914	10199804
D29915	10199805
T29901	10169810
T29901D	10169810
T29901S	10169810

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CORONADO

Date: 11/9/98 Title: METALS LAB MANAGER

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
T29902	10169811
T29903	10169812
T29904	10169813
T29905	10199810
T29906	10199811
T29907	10199812

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CORONADO

Date: 11/9/96 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D29901

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169810

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	5.4	B		F
7440-39-3	Barium	43.7	B	E	P
7440-41-7	Beryllium	0.98	B		P
	Boron	70.0			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	98000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	104		E	P
7440-50-8	Copper	32.0			P
7439-89-6	Iron	9800			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	25300			P
7439-96-5	Manganese	3230			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	236			P
7440-09-7	Potassium	4990	B		P
7782-49-2	Selenium	3.7	B	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	13300			P
7440-28-0	Thallium	3.4	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	70.2			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29902

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169811

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	25.1	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.7	B		F
7440-39-3	Barium	28.4	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	18.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	16000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U	E	P
7440-50-8	Copper	3.2	B		P
7439-89-6	Iron	39.0	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5780			P
7439-96-5	Manganese	5.5	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2350	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	7050			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.0	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29903

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169812

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1550			P
7440-36-0	Antimony	24.2	B		P
7440-38-2	Arsenic	114			F
7440-39-3	Barium	49.7	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	135			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	135000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	268		E	P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	96200			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	33900			P
7439-96-5	Manganese	6550			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	584			P
7440-09-7	Potassium	7040			P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15000			P
7440-28-0	Thallium	8.7	B		F
7440-62-2	Vanadium	2.9	B		P
7440-66-6	Zinc	109			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29904

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169813

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2100			P
7440-36-0	Antimony	21.4	B		P
7440-38-2	Arsenic	73.5			F
7440-39-3	Barium	14.4	B	E	P
7440-41-7	Beryllium	1.6	B		P
	Boron	169			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	291000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	239		E	P
7440-50-8	Copper	1.8	B		P
7439-89-6	Iron	22500			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	83300			P
7439-96-5	Manganese	14300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	538			P
7440-09-7	Potassium	5220			P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	24700			P
7440-28-0	Thallium	1.8	B		F
7440-62-2	Vanadium	2.5	B		P
7440-66-6	Zinc	88.8			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29905

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199810

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	46.8	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.1	B		F
7440-39-3	Barium	130	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	19.8	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	27900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U	E	P
7440-50-8	Copper	3.2	B		P
7439-89-6	Iron	69.4	B		P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	5170			P
7439-96-5	Manganese	20.8			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	1890	B		P
7782-49-2	Selenium	1.1	B	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	11200			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29906

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199811

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	16.6	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.4	B		F
7440-39-3	Barium	151	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	38.0	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	74600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U	E	P
7440-50-8	Copper	1.1	B		P
7439-89-6	Iron	23.5	B		P
7439-92-1	Lead	1.4	B		F
7439-95-4	Magnesium	15100			P
7439-96-5	Manganese	37.1			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	575	B		P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	22800			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D29907

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199812

Level (low/med): LOW Date Received: 10/22/98 avit ✓

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	249000			P
7440-36-0	Antimony	53.1	B		P
7440-38-2	Arsenic	12000			F
7440-39-3	Barium	13.5	B	E	P
7440-41-7	Beryllium	6.8			P
	Boron	388			P
7440-43-9	Cadmium	34.8			P
7440-70-2	Calcium	113000			P
7440-47-3	Chromium	984			P
7440-48-4	Cobalt	1930		E	P
7440-50-8	Copper	1240			P
7439-89-6	Iron	614000			P
7439-92-1	Lead	7.4		W	F
7439-95-4	Magnesium	34600			P
7439-96-5	Manganese	6620			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	4980			P
7440-09-7	Potassium	12900			P
7782-49-2	Selenium	5.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21700			P
7440-28-0	Thallium	510			F
7440-62-2	Vanadium	428			P
7440-66-6	Zinc	674			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T29901

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169810

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5010			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	11.4			F
7440-39-3	Barium	44.3	B	E	P
7440-41-7	Beryllium	1.2	B		P
	Boron	78.8			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	97600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	103			P
7440-50-8	Copper	29.7			P
7439-89-6	Iron	12100			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	25000			P
7439-96-5	Manganese	3240			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	229			P
7440-09-7	Potassium	5850			P
7782-49-2	Selenium	3.6	B	S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	12800			P
7440-28-0	Thallium	3.7	B		F
7440-62-2	Vanadium	5.3	B		P
7440-66-6	Zinc	66.8			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T29902

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169811

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	75.5	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	31.6	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	16.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	16400			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	114			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	6160			P
7439-96-5	Manganese	9.7	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	1390	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	7480			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.1	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T29903

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169812

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11800			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	130			F
7440-39-3	Barium	50.2	B	E	P
7440-41-7	Beryllium	2.2	B		P
	Boron	142			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	128000			P
7440-47-3	Chromium	5.6	B		P
7440-48-4	Cobalt	258			P
7440-50-8	Copper	3.9	B		P
7439-89-6	Iron	94600			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	33600			P
7439-96-5	Manganese	6400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	548			P
7440-09-7	Potassium	6550			P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	14900			P
7440-28-0	Thallium	8.4	B		F
7440-62-2	Vanadium	17.2	B		P
7440-66-6	Zinc	105			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T29904

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10169813

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2470			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	69.0			F
7440-39-3	Barium	13.6	B	E	P
7440-41-7	Beryllium	1.9	B		P
	Boron	173			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	289000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	238			P
7440-50-8	Copper	17.6	B		P
7439-89-6	Iron	22700			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	84500			P
7439-96-5	Manganese	14400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	517			P
7440-09-7	Potassium	4950	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	24700			P
7440-28-0	Thallium	1.9	B		F
7440-62-2	Vanadium	3.1	B		P
7440-66-6	Zinc	86.9			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T29905

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199810

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	324			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.1	B		F
7440-39-3	Barium	139	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	27.0	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	26600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.6	B		P
7439-89-6	Iron	511			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5020			P
7439-96-5	Manganese	70.8			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3000	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10400			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.6	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T29906

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199811

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	998			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.9	B		F
7440-39-3	Barium	165	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	41.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	73200			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.3	B		P
7439-89-6	Iron	856			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	15100			P
7439-96-5	Manganese	120			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2440	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21600			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	5.8	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T29907

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807299

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W29901

Matrix (soil/water): WATER Lab Sample ID: 10199812

Level (low/med): LOW Date Received: 10/22/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	236000			P
7440-36-0	Antimony	55.1	B		P
7440-38-2	Arsenic	12600			F
7440-39-3	Barium	15.1	B	E	P
7440-41-7	Beryllium	6.7			P
	Boron	51.0			P
7440-43-9	Cadmium	37.0			P
7440-70-2	Calcium	111000			P
7440-47-3	Chromium	923			P
7440-48-4	Cobalt	1850			P
7440-50-8	Copper	1170			P
7439-89-6	Iron	675000			P
7439-92-1	Lead	8.9		S	F
7439-95-4	Magnesium	32800			P
7439-96-5	Manganese	6420			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	4620			P
7440-09-7	Potassium	14500			P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	19800			P
7440-28-0	Thallium	448			F
7440-62-2	Vanadium	405			P
7440-66-6	Zinc	656			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL METALS

LEVIATHAN MINE

Groundwater Lab Results
Date Collected
10-12,14/98

Sample Name	Lab Code
MW-1	10139803
MW-12	10139804
MW-11	10149801
MW-10d	10149802

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/98
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10139803	10139804	10149801
		Lab Code:	K9807177-010	K9807177-011	K9807177-012
			mw 11	mw -12	mw-13
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.91	5.86	7.27
Conductivity (µmhos/cm)	120.1	2	1890	2070	513
Alkalinity, Total as $CaCO_3$	310.1	2	378	85	260
Bromide	300.0	0.2	ND	<0.5 (D)	ND
Chloride	300.0	0.2	3.5	4.2	0.9
Fluoride	300.0	0.2	< 1.0 (D)	< 1.0 (D)	ND
Nitrate as Nitrogen	300.0	0.2	0.3	<0.5 (D)	ND
Nitrite as Nitrogen	300.0	0.2	ND	<0.5 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01	0.09	4.96	0.02
Phosphorus, Total	365.3	0.01	0.15	19.22	0.03
Solids, Total Dissolved (TDS)	160.1	10	1820	2340	31[illegible]
Solids, Total Suspended (TSS)	160.2	5	160	36700	N[illegible]
Sulfate	300.0	0.2	846	1140	24[illegible]

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3S30EPA/102094

07177WET.LJ1 - Mixed (4) 11/6/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/98
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name:			10149802	10149810	10149811
Lab Code:			K9807177-013	K9807177-014	K9807177-015
			MW-10d	U asp. creek	Aspio wet
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.93	7.94	3.68
Conductivity (μmhos/cm)	120.1	2	1480	186	1390
Alkalinity, Total as $CaCO_3$	310.1	2	236	101	ND
Bromide	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Chloride	300.0	0.2	4.7	0.7	2.4
Fluoride	300.0	0.2	< 1.0 (D)	ND	1.1
Nitrate as Nitrogen	300.0	0.2	1.3	0.5	2.2
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.05	0.01	ND
Phosphorus, Total	365.3	0.01	0.10	0.18	0.01
Solids, Total Dissolved (TDS)	160.1	10	1250	125	1280
Solids, Total Suspended (TSS)	160.2	5	21	16	10
Sulfate	300.0	0.2	617	1.2	814

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3530EPA/102094

07177WET.LJ1 - Mixed (5) 11/6/98

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17710

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10139803

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	60.0	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.0	U	W	F
7440-39-3	Barium	29.3	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	69.9			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	282000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	122			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	129000			P
7439-96-5	Manganese	205			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	13100		E	P
7782-49-2	Selenium	7.6		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	40500			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	5.4	B		P
7440-66-6	Zinc	3.9	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17711

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10139804

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	174	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	44.0			F
7440-39-3	Barium	20.6	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	189			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	281000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	90.0			P
7440-50-8	Copper	2.9	B		P
7439-89-6	Iron	102000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	85600			P
7439-96-5	Manganese	20400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	89.9			P
7440-09-7	Potassium	12700		E	P
7782-49-2	Selenium	1.4	B	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	26000			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	7.6	B		P
7440-66-6	Zinc	38.0			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17712

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149801

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	18.2	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	109	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	40.0	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	73900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	62.8	B		P
7439-92-1	Lead	3.4			F
7439-95-4	Magnesium	15300			P
7439-96-5	Manganese	7.5	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	573	B	E	P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	22300			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	5.5	B		P
7440-66-6	Zinc	4.9	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17713

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149802

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	27.9	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	28.2			F
7440-39-3	Barium	34.2	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	71.5			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	246000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	B		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	7220			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	63900			P
7439-96-5	Manganese	1030			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2040	B	E	P
7782-49-2	Selenium	9.5		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	33600			P
7440-28-0	Thallium	1.1	B		F
7440-62-2	Vanadium	4.7	B		P
7440-66-6	Zinc	11.0	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

Columbia Analytical Services INC.
An Employee-Owned Company

November 3, 1998

Service Request No: K9806762

Tony Schwartz
Atlantic Richfield Company
444 South Flower Street
Los Angeles, CA 90071

Re: Leviathan/WO 27

Dear Tony:

Enclosed are the results of the sample(s) submitted to our laboratory on September 30, 1998. For your reference, these analyses have been assigned our service request number K9806762.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 260.

Respectfully submitted,

Columbia Analytical Services, Inc.

Teena Jones

Teena Jones
Project Chemist

TJ/clb

cc: Chris tenBraak [SRK/Lakewood], Dana Brown [SRK/Reno], Terry Braun [SRK/Tucson]

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 360/ 577-7222 • Fax 360/636-10

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
J	Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

LEVIATHAN MINE

Surface Water Lab Results
Date Collected
10-12,14/98

Sample Name	Lab Code
Upper Aspen	10149810
Wetland Seep	10149811
Lower Aspen	10149812
Aspen/Landslide	10149813
Station 16	10149814
Slide Creek	10149815
BLANK	10129800
Diversion Channel	10129801
Channel Underdrain	10129802
Station 15	10129804
Leviation below Underdrain	10129805
Upper Leviathan	10139801
Pond 4	10139802

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/98
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name:			10149802	10149810	10149811
Lab Code:			K9807177-013	K9807177-014	K9807177-0
			MW-10d	U asp. Creek	Aspio wet
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.93	7.94	3.68
Conductivity (µmhos/cm)	120.1	2	1480	186	1390
Alkalinity, Total as $CaCO_3$	310.1	2	236	101	ND
Bromide	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Chloride	300.0	0.2	4.7	0.7	2.4
Fluoride	300.0	0.2	< 1.0 (D)	ND	1.1
Nitrate as Nitrogen	300.0	0.2	1.3	0.5	2.2
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.05	0.01	ND
Phosphorus, Total	365.3	0.01	0.10	0.18	0.01
Solids, Total Dissolved (TDS)	160.1	10	1250	125	1280
Solids, Total Suspended (TSS)	160.2	5	21	16	10
Sulfate	300.0	0.2	617	1.2	814

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3S30EPA/102094

07177WET.LJ1 - Mixed (5) 11/6/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/9[illegible]
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte	EPA Method	MRL	10149812	10149813	10149814
Sample Name:			10149812	10149813	10149814
Lab Code:			K9807177-016	K9807177-017	K9807177-018
			Flow Cap. Creek Sup.	W Cap Creek Bel. Bioc	SP 16
pH (units)	150.1	--	3.07	4.39	5.90
Conductivity (µmhos/cm)	120.1	2	3060	462	542
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	< 1.0 (D)	ND	ND
Chloride	300.0	0.2	5.0	1.2	1.2
Fluoride	300.0	0.2	6.4	0.8	0.8
Nitrate as Nitrogen	300.0	0.2	< 1.0 (D)	0.3	0.2
Nitrite as Nitrogen	300.0	0.2	<1.0 (D)	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.02	0.02	ND
Phosphorus, Total	365.3	0.01	ND	0.01	ND
Solids, Total Dissolved (TDS)	160.1	10	2950	371	4[illegible]
Solids, Total Suspended (TSS)	160.2	5	6	ND	1[illegible]
Sulfate	300.0	0.2	2210	272	264

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3S30EPA/102094

07177WET.LJ1 - Mixed (6) 11/6/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/98
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10149815 ✓	Method Blank
		Lab Code:	K9807177-019	K9807177-MB
Analyte	**EPA Method**	**MRL**	Land St. Creek	
pH (units)	150.1	--	8.03	-
Conductivity (µmhos/cm)	120.1	2	1900	ND
Alkalinity, Total as $CaCO_3$	310.1	2	167	ND
Bromide	300.0	0.2	< 0.5 (D)	ND
Chloride	300.0	0.2	2.5	ND
Fluoride	300.0	0.2	1.4	ND
Nitrate as Nitrogen	300.0	0.2	< 0.5 (D)	ND
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01	0.02	ND
Phosphorus, Total	365.3	0.01	0.03	ND
Solids, Total Dissolved (TDS)	160.1	10	1490	ND
Solids, Total Suspended (TSS)	160.2	5	24	ND
Sulfate	300.0	0.2	1020	ND

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3S30EPA/102094

07177WET.LJ1 - Mixed (7) 11/6/98

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17714

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149810

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	18.5	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	10.2	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	16.8	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	23600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	35.2	B		P
7439-92-1	Lead	1.0	U	W	F
7439-95-4	Magnesium	5300			P
7439-96-5	Manganese	3.7	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	432	B	E	P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10600			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	4.1	B		P
7440-66-6	Zinc	6.9	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17715

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149811

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	44000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	8.3	B		P
7440-41-7	Beryllium	3.6	B		P
	Boron	59.9			P
7440-43-9	Cadmium	2.4	B		P
7440-70-2	Calcium	154000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	161			P
7440-50-8	Copper	1050			P
7439-89-6	Iron	236			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	49500			P
7439-96-5	Manganese	3450			P
7439-97-6	Mercury	7.5			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	347			P
7440-09-7	Potassium	7040		E	P
7782-49-2	Selenium	53.3		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10100			P
7440-28-0	Thallium	17.4			F
7440-62-2	Vanadium	3.4	B		P
7440-66-6	Zinc	406			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D17716

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149812

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	6.0	B		P
7440-41-7	Beryllium	10.3			P
	Boron	322			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	375000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	366			P
7440-50-8	Copper	1220			P
7439-89-6	Iron	95700			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	94700			P
7439-96-5	Manganese	21300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	557			P
7440-09-7	Potassium	22600		E	P
7782-49-2	Selenium	2.2	B	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	18000			P
7440-28-0	Thallium	9.9	B		F
7440-62-2	Vanadium	10.3	B		P
7440-66-6	Zinc	836			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D17717

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149813

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2700			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.4	B		F
7440-39-3	Barium	25.8	B		P
7440-41-7	Beryllium	0.91	B		P
	Boron	53.3			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	51600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	24.7	B		P
7440-50-8	Copper	63.7			P
7439-89-6	Iron	253			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	12300			P
7439-96-5	Manganese	1650			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	56.1			P
7440-09-7	Potassium	3990	B	E	P
7782-49-2	Selenium	7.3			F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9130			P
7440-28-0	Thallium	3.1	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	70.2			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17718

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149814

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	299			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	32.3	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	53.3			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	68900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	19.6	B		P
7440-50-8	Copper	42.0			P
7439-89-6	Iron	66.1	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	17000			P
7439-96-5	Manganese	1400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	49.2			P
7440-09-7	Potassium	3930	B	E	P
7782-49-2	Selenium	9.2		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10400			P
7440-28-0	Thallium	1.6	B		F
7440-62-2	Vanadium	2.9	B		P
7440-66-6	Zinc	61.3			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17719

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10149815

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51.4	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.1	B		F
7440-39-3	Barium	22.5	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	88.1			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	328000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	19.3	B		P
7439-89-6	Iron	83.7	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	87900			P
7439-96-5	Manganese	20.2			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	4410	B	E	P
7782-49-2	Selenium	13.8		S	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21400			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.8	B		P
7440-66-6	Zinc	19.9	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T17714

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149810

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	113	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	11.8	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	23.7	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	23000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	180			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5130			P
7439-96-5	Manganese	13.3	B		P
7439-97-6	Mercury	0.10	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	656	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9510			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.3	B		P
7440-66-6	Zinc	5.0	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17715

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149811

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	44800			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	14.1	B		P
7440-41-7	Beryllium	3.7	B		P
	Boron	64.3			P
7440-43-9	Cadmium	2.6	B		P
7440-70-2	Calcium	153000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	169			P
7440-50-8	Copper	1060			P
7439-89-6	Iron	362			P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	49700			P
7439-96-5	Manganese	3450			P
7439-97-6	Mercury	7.5			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	342			P
7440-09-7	Potassium	7000			P
7782-49-2	Selenium	39.1		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10000			P
7440-28-0	Thallium	17.3			F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	396			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17716

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149812

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51900			P
7440-36-0	Antimony	23.7	B		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	6.9	B		P
7440-41-7	Beryllium	10.6			P
	Boron	323			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	374000			P
7440-47-3	Chromium	4.1	B		P
7440-48-4	Cobalt	381			P
7440-50-8	Copper	1220			P
7439-89-6	Iron	96900			P
7439-92-1	Lead	1.0	U	W	F
7439-95-4	Magnesium	95300			P
7439-96-5	Manganese	21400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	581			P
7440-09-7	Potassium	22400			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	17900			P
7440-28-0	Thallium	8.6	B	S	F
7440-62-2	Vanadium	5.0	B		P
7440-66-6	Zinc	825			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17717

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149813

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2940			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.1	B		F
7440-39-3	Barium	27.0	B		P
7440-41-7	Beryllium	1.1	B		P
	Boron	50.8			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	53000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	28.1	B		P
7440-50-8	Copper	72.0			P
7439-89-6	Iron	831			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	12700			P
7439-96-5	Manganese	1710			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	46.3			P
7440-09-7	Potassium	4180	B		P
7782-49-2	Selenium	6.8		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9380			P
7440-28-0	Thallium	3.1	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	70.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

SAMPLE NO.

T17718

1

INORGANIC ANALYSIS DATA SHEET

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149814

Level (low/med): LOW Date Received: 10/16/98 St 16

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2110			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	35.5	B		P
7440-41-7	Beryllium	1.1	B		P
	Boron	49.1	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	67700			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	21.6	B		P
7440-50-8	Copper	54.8			P
7439-89-6	Iron	342			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	16700			P
7439-96-5	Manganese	1400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	44.5			P
7440-09-7	Potassium	4230	B		P
7782-49-2	Selenium	6.8		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10200			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	58.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T17719

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10149815

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	460			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.0	B		F
7440-39-3	Barium	26.6	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	93.1			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	331000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	14.9	B		P
7439-89-6	Iron	315			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	88400			P
7439-96-5	Manganese	215			P
7439-97-6	Mercury	0.25			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	4940	B		P
7782-49-2	Selenium	11.9		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21100			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.9	B		P
7440-66-6	Zinc	9.5	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte	EPA Method	MRL	10129800	10129801	10129802
Sample Name:			10129800	10129801	10129802
Lab Code:			K9807177-001	K9807177-002	K9807177-0
			Method Blank - Bugpartick comp.	Alen Cham	Chan Und
pH (units)	150.1	--	7.65	8.19	4.57
Conductivity (µmhos/cm)	120.1	2	310	145	2660
Alkalinity, Total as $CaCO_3$	310.1	2	49	74	ND
Bromide	300.0	0.2	ND	ND	< 0.5 (D)
Chloride	300.0	0.2	0.9	1.3	2.7
Fluoride	300.0	0.2	ND	ND	4.5
Nitrate as Nitrogen	300.0	0.2	0.2	ND	< 0.5 (D)
Nitrite as Nitrogen	300.0	0.2	ND	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.01	0.08	0.08
Phosphorus, Total	365.3	0.01	0.05	0.12	0.04
Solids, Total Dissolved (TDS)	160.1	10	251	126	3[illegible]
Solids, Total Suspended (TSS)	160.2	5	8	ND	2
Sulfate	300.0	0.2	115	8.5	1880

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3530EPA/102094

07177WET.LJ1 - Mixed 11/6/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14/98
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	10129803	10129804	10129805
		Lab Code:	K9807177-004	K9807177-005	K9807177-006
			Bay Outlet Comp	St 15	Zev Below Div
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	7.16	3.69	5.03
Conductivity (µmhos/cm)	120.1	2	306	1190	1260
Alkalinity, Total as $CaCO_3$	310.1	2	48	ND	ND
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	0.9	1.4	0.9
Fluoride	300.0	0.2	0.2	1.1	0.6
Nitrate as Nitrogen	300.0	0.2	0.2	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.02	ND	0.12
Phosphorus, Total	365.3	0.01	0.05	0.03	0.14
Solids, Total Dissolved (TDS)	160.1	10	237	938	1120
Solids, Total Suspended (TSS)	160.2	5	8	91	66
Sulfate	300.0	0.2	112	509	727

Approved By: _____ Date: 11/6/98

3530EPA/102094

07177WET.LJ1 - Mixed (2) 11/6/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9807177
Date Collected: 10/12-14
Date Received: 10/16/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte	EPA Method	MRL	10129806	10139801	10139802
Sample Name:			10129806	10139801	10139802
Lab Code:			K9807177-007	K9807177-008	K9807177-00
			OK 2 Fallen-down	St 1	Pond 4 over
pH (units)	150.1	--	5.67	7.68	2.31
Conductivity (µmhos/cm)	120.1	2	3	138	10200
Alkalinity, Total as $CaCO_3$	310.1	2	ND	69	ND
Bromide	300.0	0.2	ND	ND	< 4.0 (D)
Chloride	300.0	0.2	ND	ND	6.9
Fluoride	300.0	0.2	ND	ND	15.8
Nitrate as Nitrogen	300.0	0.2	ND	ND	< 4.0 (D)
Nitrite as Nitrogen	300.0	0.2	ND	ND	< 4.0 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.05	0.14	0.03
Phosphorus, Total	365.3	0.01	ND	0.11	0.04
Solids, Total Dissolved (TDS)	160.1	10	< 10	119	24
Solids, Total Suspended (TSS)	160.2	5	ND	ND	N
Sulfate	300.0	0.2	ND	7.5	15300

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/6/98

3S30EPA/102094

07177WET.LJ1 - Mixed (3) 11/6/98

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D17701	10129800
D17701D	10129800
D17701S	10129800
D17702	10129801
D17703	10129802
D17704	10129803
D17705	10129804
D17706	10129805
D17707	10129806
D17708	10139801
D17709	10139802
D17710	10139803
D17711	10139804
D17712	10149801
D17713	10149802
D17714	10149810
D17715	10149811
D17716	10149812
D17717	10149813
D17718	10149814

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Jeff Coronado Name: JEFF CORONADO

Date: 11/4/98 Title: METALS LAB MANAGER

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D17719	10149815

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES

If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CARONAD

Date: 11/4/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D17701

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129800

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	81.5	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.2	B		F
7440-39-3	Barium	32.4	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	32.6	B		P
7440-43-9	Cadmium	2.2	B		P
7440-70-2	Calcium	37400			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	26.3	B		P
7440-50-8	Copper	6.4	B		P
7439-89-6	Iron	1160			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	11100			P
7439-96-5	Manganese	836			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	8.5	B		P
7440-02-0	Nickel	63.1			P
7440-09-7	Potassium	2810	B	E	P
7782-49-2	Selenium	1.5	B	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9190			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	28.7			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17702

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129801

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	78.8	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.2	B		F
7440-39-3	Barium	74.8	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	25.7	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	16100			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	5.2	B		P
7439-89-6	Iron	157			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4980	B		P
7439-96-5	Manganese	10.2	B		P
7439-97-6	Mercury	0.51			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2860	B	E	P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9200			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.9	B		P
7440-66-6	Zinc	12.2	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17703

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129802 ✓

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	43400			P
7440-36-0	Antimony	28.9	B		P
7440-38-2	Arsenic	452			F
7440-39-3	Barium	17.5	B		P
7440-41-7	Beryllium	6.7			P
	Boron	352			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	317000			P
7440-47-3	Chromium	20.8			P
7440-48-4	Cobalt	862			P
7440-50-8	Copper	11.1	B		P
7439-89-6	Iron	352000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	77600			P
7439-96-5	Manganese	17600			P
7439-97-6	Mercury	0.18	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1910			P
7440-09-7	Potassium	16500		E	P
7782-49-2	Selenium	1.5	B	W	F
7440-22-4	Silver	5.1	B		P
7440-23-5	Sodium	25200			P
7440-28-0	Thallium	36.4		S	F
7440-62-2	Vanadium	85.9			P
7440-66-6	Zinc	390			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D17704

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129803

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	84.6	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.9	B		F
7440-39-3	Barium	31.4	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	29.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	38000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	27.7	B		P
7440-50-8	Copper	1.7	B		P
7439-89-6	Iron	1200			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	11500			P
7439-96-5	Manganese	852			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	71.7			P
7440-09-7	Potassium	2420	B	E	P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9620			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	27.7			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17705

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129804

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6350			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	40.0			F
7440-39-3	Barium	55.6	B		P
7440-41-7	Beryllium	1.7	B		P
	Boron	99.6			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	132000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	229			P
7440-50-8	Copper	10.1	B		P
7439-89-6	Iron	53300			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	35000			P
7439-96-5	Manganese	5730			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	524			P
7440-09-7	Potassium	5810		E	P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	16700			P
7440-28-0	Thallium	6.8	B		F
7440-62-2	Vanadium	5.0	B		P
7440-66-6	Zinc	105			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

SAMPLE NO.

D17706

1

INORGANIC ANALYSIS DATA SHEET

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129805

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4940			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	154			F
7440-39-3	Barium	53.2	B		P
7440-41-7	Beryllium	1.8	B		P
	Boron	134			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	123000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	315			P
7440-50-8	Copper	5.0	B		P
7439-89-6	Iron	128000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	31200			P
7439-96-5	Manganese	6360			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	704			P
7440-09-7	Potassium	7480		E	P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15600			P
7440-28-0	Thallium	9.2	B		F
7440-62-2	Vanadium	15.0	B		P
7440-66-6	Zinc	147			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17707

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10129806

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	1.8	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	36.0	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	55.6	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	78.7	B		P
7439-96-5	Manganese	0.80	U		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U	E	P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	129	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	10.4	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D17708

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10139801

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	37.5	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.1	B		F
7440-39-3	Barium	69.5	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	14100			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	93.4	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4720	B		P
7439-96-5	Manganese	6.0	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3020	B	E	P
7782-49-2	Selenium	1.0	U	W	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8530			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	4.0	B		P
7440-66-6	Zinc	5.9	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D17709

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: D17701

Matrix (soil/water): WATER Lab Sample ID: 10139802

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1600000			P
7440-36-0	Antimony	169			P
7440-38-2	Arsenic	20500			F
7440-39-3	Barium	16.5	B		P
7440-41-7	Beryllium	58.0			P
	Boron	1170			P
7440-43-9	Cadmium	287			P
7440-70-2	Calcium	480000			P
7440-47-3	Chromium	5020			P
7440-48-4	Cobalt	9700			P
7440-50-8	Copper	14000			P
7439-89-6	Iron	2210000			P
7439-92-1	Lead	2.8	B		F
7439-95-4	Magnesium	251000			P
7439-96-5	Manganese	47900			P
7439-97-6	Mercury	0.73			CV
	Molybdenum	8.8	U		P
7440-02-0	Nickel	24600			P
7440-09-7	Potassium	757	U	E	P
7782-49-2	Selenium	45.0	B	W	F
7440-22-4	Silver	6.3	B		P
7440-23-5	Sodium	20700			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	1480			P
7440-66-6	Zinc	4730			P

Color Before: YELLOW Clarity Before: CLEAR Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
T17701	10129800
T17701D	10129800
T17701S	10129800
T17702	10129801
T17703	10129802
T17704	10129803
T17705	10129804
T17706	10129805
T17707	10129806
T17708	10139801
T17709	10139802
T17714	10149810
T17715	10149811
T17716	10149812
T17717	10149813
T17718	10149814
T17719	10149815

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Jeff Corona Name: JEFF CORONA

Date: 11/4/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17701

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129800

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1420			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	5.2	B		F
7440-39-3	Barium	35.2	B		P
7440-41-7	Beryllium	0.72	B		P
	Boron	33.6	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	37900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	29.9	B		P
7440-50-8	Copper	1.6	B		P
7439-89-6	Iron	2570			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	11300			P
7439-96-5	Manganese	862			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.8	B		P
7440-02-0	Nickel	59.9			P
7440-09-7	Potassium	2860	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8830			P
7440-28-0	Thallium	3.2	B		F
7440-62-2	Vanadium	4.9	B		P
7440-66-6	Zinc	22.7			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17702

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129801

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	78.5	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.1	B		F
7440-39-3	Barium	75.9	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	21.9	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	15500			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.7	B		P
7440-50-8	Copper	1.9	B		P
7439-89-6	Iron	126			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4840	B		P
7439-96-5	Manganese	12.0	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	8.3	B		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2500	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8860			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	4.5	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17703

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129802

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	43200			P
7440-36-0	Antimony	46.6	B		P
7440-38-2	Arsenic	550			F
7440-39-3	Barium	18.1	B		P
7440-41-7	Beryllium	6.9			P
	Boron	328			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	310000			P
7440-47-3	Chromium	20.1			P
7440-48-4	Cobalt	854			P
7440-50-8	Copper	11.0	B		P
7439-89-6	Iron	348000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	76500			P
7439-96-5	Manganese	17400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1880			P
7440-09-7	Potassium	16400			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	B		P
7440-23-5	Sodium	24700			P
7440-28-0	Thallium	31.4			F
7440-62-2	Vanadium	78.9			P
7440-66-6	Zinc	376			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T17704

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129803

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1400			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	5.7	B		F
7440-39-3	Barium	33.2	B		P
7440-41-7	Beryllium	0.73	B		P
	Boron	28.6	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	37900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	29.9	B		P
7440-50-8	Copper	1.1	B		P
7439-89-6	Iron	2790			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	11300			P
7439-96-5	Manganese	870			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	61.7			P
7440-09-7	Potassium	2900	B		P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8800			P
7440-28-0	Thallium	1.8	B		F
7440-62-2	Vanadium	2.6	B		P
7440-66-6	Zinc	22.7			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17705

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129804

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10600			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	59.4			F
7440-39-3	Barium	54.9	B		P
7440-41-7	Beryllium	2.2	B		P
	Boron	100			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	129000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	231			P
7440-50-8	Copper	13.3	B		P
7439-89-6	Iron	54500			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	34200			P
7439-96-5	Manganese	5640			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	500			P
7440-09-7	Potassium	6180			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15900			P
7440-28-0	Thallium	10.2			F
7440-62-2	Vanadium	13.0	B		P
7440-66-6	Zinc	101			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T17706

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129805

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11100			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	110			F
7440-39-3	Barium	38.0	B		P
7440-41-7	Beryllium	2.2	B		P
	Boron	112			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	88100			P
7440-47-3	Chromium	6.3	B		P
7440-48-4	Cobalt	233			P
7440-50-8	Copper	3.9	B		P
7439-89-6	Iron	92500			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	22000			P
7439-96-5	Manganese	4650			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	487			P
7440-09-7	Potassium	5650			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10700			P
7440-28-0	Thallium	8.6	B		F
7440-62-2	Vanadium	20.8	B		P
7440-66-6	Zinc	99.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17707

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10129806

Filter blank

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	19.0	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	2.4	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	47.3	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.3	B		P
7439-89-6	Iron	41.1	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5.6	U		P
7439-96-5	Manganese	1.5	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U		P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15.1	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	6.6	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T17708

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10139801

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	118	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	6.6	B		F
7440-39-3	Barium	74.0	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	26.6	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	13900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	180			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4740	B		P
7439-96-5	Manganese	11.7	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3190	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8570			P
7440-28-0	Thallium	2.4	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	4.6	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T17709

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807177

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T17701

Matrix (soil/water): WATER Lab Sample ID: 10139802

Level (low/med): LOW Date Received: 10/16/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1570000			P
7440-36-0	Antimony	176			P
7440-38-2	Arsenic	42200			F
7440-39-3	Barium	18.0	B		P
7440-41-7	Beryllium	55.4			P
	Boron	129			P
7440-43-9	Cadmium	297			P
7440-70-2	Calcium	465000			P
7440-47-3	Chromium	4950			P
7440-48-4	Cobalt	9550			P
7440-50-8	Copper	13900			P
7439-89-6	Iron	2130000			P
7439-92-1	Lead	1.7	B		F
7439-95-4	Magnesium	249000			P
7439-96-5	Manganese	46800			P
7439-97-6	Mercury	0.16	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	24500			P
7440-09-7	Potassium	757	U		P
7782-49-2	Selenium	6.5	B	NW	F
7440-22-4	Silver	3.6	U		P
7440-23-5	Sodium	20200			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	1440			P
7440-66-6	Zinc	4640			P

Color Before: YELLOW Clarity Before: CLEAR Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

LEVIATHAN MINE

Surface Water Lab Results
Date Collected
10/2/98

Sample Name	**Lab Code**
Lower Tributary	QA/QC K9806967-003

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9806967
Date Collected: 10/2/98
Date Received: 10/7/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	QA/QC-1	QA/QC-2	Lower Tributa
		Lab Code:	K9806967-001	K9806967-002	K9806967-00:
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	7.84	4.55	7.71
Conductivity (µmhos/cm)	120.1	2	482	ND	375
Alkalinity, Total as $CaCO_3$	310.1	2	270	3	194
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	1.0	ND	0.7
Fluoride	300.0	0.2	ND	ND	ND
Nitrate as Nitrogen	300.0	0.2	ND	ND	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.08	ND	0.08
Phosphorus, Total	365.3	0.01	0.08	ND	0.08
Solids, Total Dissolved (TDS)	160.1	10	326	ND	224
Solids, Total Suspended (TSS)	160.2	5	7	ND	70
Sulfate	300.0	0.2	30.2	ND	15.1

Approved By: _____ Date: 10/28/98

3S30EPA/102094

06967WET.LJ1 - Mixed 10/28/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/19333
Sample Matrix: Water

Service Request: K9806967
Date Collected: NA
Date Received: NA
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name: **Method Blank**
Lab Code: K9806967-MB

Analyte	EPA Method	MRL	
pH (units)	150.1	--	-
Conductivity (µmhos/cm)	120.1	2	ND
Alkalinity, Total as $CaCO_3$	310.1	2	ND
Chloride	300.0	0.2	ND
Fluoride	300.0	0.2	ND
Nitrate as Nitrogen	300.0	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND
Orthophosphate as Phosphorus	365.3	0.01	ND
Phosphorus, Total	365.3	0.01	ND
Solids, Total Dissolved (TDS)	160.1	5	ND
Solids, Total Suspended (TSS)	160.2	5	ND
Sulfate	300.0	0.2	ND

Approved By: _____ Date: 10/28/98

3S30EPA/102094

06967WET.LJ1 - Mixed (2) 10/28/98

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D96701	QA/QC-1
D96702	QA/QC-2
D96703	LTributary
T96701	QA/QC-1
T96702	QA/QC-2
T96703	LTributary
T96703D	LTributary
T96703S	LTributary

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CORONADO

Date: 10/27/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D96701

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: QA/QC-1

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	22.0	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.8	B		F
7440-39-3	Barium	168	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	33.4	B		P
7440-43-9	Cadmium	2.4	B		P
7440-70-2	Calcium	72200			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	6.1	B		P
7439-89-6	Iron	22.5	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	14800			P
7439-96-5	Manganese	40.8			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	817	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	24100			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	10.2	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D96702

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: QA/QC-2

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	1.9	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	72.4	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	3.5	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5.6	U		P
7439-96-5	Manganese	0.80	U		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	438	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D96703

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: LTributary

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20.0	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.9	B		F
7440-39-3	Barium	164	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	43.5	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	71300			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	23.1	B		P
7439-89-6	Iron	26.7	B		P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	14700			P
7439-96-5	Manganese	40.5			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	676	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	23900			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	25.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T96701

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: QA/QC-1

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	104	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.8	B		F
7440-39-3	Barium	169	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	45.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	71300			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	2.1	B		P
7439-89-6	Iron	89.5	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	14700			P
7439-96-5	Manganese	44.6			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	5.8	B		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	770	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	23500			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.2	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T96702

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: QA/QC-2

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20.0	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	3.2	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	3.1	B		P
7440-70-2	Calcium	82.8	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.6	B		P
7439-89-6	Iron	12.7	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	13.5	B		P
7439-96-5	Manganese	0.80	U		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	14.7	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T96703

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806967

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W96701

Matrix (soil/water): WATER Lab Sample ID: LTributary

Level (low/med): LOW Date Received: 10/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	57.2	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.9	B		F
7440-39-3	Barium	166	B		P
7440-41-7	Beryllium	0.70	U		P
	Boron	33.4	B		P
7440-43-9	Cadmium	2.5	B		P
7440-70-2	Calcium	71500			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.6	B		P
7439-89-6	Iron	57.8	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	14700			P
7439-96-5	Manganese	43.3			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	890	B		P
7782-49-2	Selenium	1.0	U		F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	23400			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.6	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
TOTAL

Appendix C.3
Water Quality Data
November 1998

Columbia Analytical Services INC.
An Employee-Owned Company

December 8, 1998

Service Request No: K9807706

Tony Schwartz
Atlantic Richfield Company
444 South Flower Street
Los Angeles, CA 90071

Re: ARCO-Leviathan/WO 27/19333.2301

Dear Tony:

Enclosed are the results of the sample(s) submitted to our laboratory on November 7, 1998. For your reference, these analyses have been assigned our service request number K9807706.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 260.

Respectfully submitted,

Columbia Analytical Services, Inc.

Diane Wagel for

Teena Jones
Project Chemist

TJ/br

November
groundwater

M-11	11059800
M-10S	11059801
M-10D	11059802
M-2S	11059804
M-2D	11059805
M-6	11059806
M-7	11059801
M-8	11059802
	11059803 blank

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Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
J	Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but gr[illegible]r than or equal to the MDL.

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Atlantic Richfield Company	**Service Request No.:**	K9807706
Project:	ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301	**Date Received:**	11/7/98
Sample Matrix:	Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for sample(s) designated for Tier III/CLP data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Laboratory Control Sample (LCS), Initial/Continuing Calibration Verification Standards (ICV/CCV), and Initial/Continuing Calibration Blanks (ICB/CCB).

All EPA recommended holding times have been met for analyses in this sample delivery group.

The following difficulties were experienced during analysis of this batch:

Samples 11059800, 11059801, 11059802, 11059803, 11059804 and 11059805 for pH were received past the recommended holding time. The samples were analyzed as soon as possible after receipt by the laboratory. No bottle was received for Total Phosphorus so the analysis was done using unpreserved sample. The method recommends preservation to pH<2 using H2SO4.

The Matrix Spike (MS) recovery of selenium for the Batch QC was outside the CLP control limits because of matrix interference. Based on the this, the post-spike recovery and the concentrations found in the samples, no further corrective action is required by CLP protocol.

The Initial Calibration Blank (ICB) was inadvertently omitted during the ICP analysis. Since the Continuing Calibration Blank was analyzed prior to sample analysis and found to be in control, no corrective action was taken.

The serial dilution test for barium was out of control, generating E flags on the Form I's. The barium concentrations, while greater than 50X the IDL, are much less than the CRDL for this element so no corrective action was taken.

Approved by Diane Wiegel **Date** 12/7/98

LEVIATHAN MINE

Groundwater Lab Results
Date Collected
11-5,6/98

Sample Name	Lab Code
MW-11	11059800
MW-10s	11059801
MW-10d	11059802
MW-2s	11059804
MW-2d	1159805
BLANK	11059803
MW-6	11069800
MW-7	11069801
MW-8	11069802

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: 11/5/98
Date Received: 11/7/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11059800	11059801	11059802
		Lab Code:	K9807706-001	K9807706-002	K9807706-00
			MW-11	MW-10S	MW-15
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	7.10 (H)	3.72 (H)	6.36 (H)
Conductivity (µmhos/cm)	120.1	2	471	3090	1670
Alkalinity, Total as $CaCO_3$	310.1	2	261	ND	214
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	1.1	3.7	4.9
Fluoride	300.0	0.2	ND	5.1	< 1.0 (D)
Nitrate as Nitrogen	300.0	0.2	ND	ND	0.3
Nitrite as Nitrogen	300.0	0.2	ND	< 0.5 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01	0.03	0.02	0.03
Phosphorus, Total	365.3	0.01	0.12	0.10	0.20
Solids, Total Dissolved (TDS)	160.1	5	329	3930	1700
Solids, Total Suspended (TSS)	160.2	5	56	135	71
Sulfate	300.0	0.2	25.0	2320	771

H The Sample was received past the recommended hold time.
D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 12/4/98

3S30EPA/102094

07706WET.LJ1 - Mixed 12/4/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: 11/5/98
Date Received: 11/7/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11059803	11059804	11059805
		Lab Code:	K9807706-004	K9807706-005	K9807706-006
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.15 (H)	3.48 (H)	3.62 (H)
Conductivity (µmhos/cm)	120.1	2	3	3640	4540
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	ND	< 1.0 (D)	< 1.0 (D)
Chloride	300.0	0.2	0.2	2.0	2.6
Fluoride	300.0	0.2	ND	6.9	11.8
Nitrate as Nitrogen	300.0	0.2	ND	< 1.0 (D)	< 1.0 (D)
Nitrite as Nitrogen	300.0	0.2	ND	1.1	1.3
Orthophosphate as Phosphorus	365.3	0.01	ND	0.43	0.15
Phosphorus, Total	365.3	0.01	0.03	0.16	0.[illegible]
Solids, Total Dissolved (TDS)	160.1	5	21	5890	7[illegible]
Solids, Total Suspended (TSS)	160.2	5	ND	62	16
Sulfate	300.0	0.2	ND	6820	9900

H The Sample was received past the recommended hold time.
D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 12/4/98

00005

3S30EPA/102094

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: 11/6/98
Date Received: 11/7/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11069800	11069801	11069802
		Lab Code:	K9807706-007	K9807706-008	K9807706-009
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	4.62	6.03	3.88
Conductivity (µmhos/cm)	120.1	2	2650	277	1670
Alkalinity, Total as $CaCO_3$	310.1	2	ND	61	ND
Bromide	300.0	0.2	ND	ND	< 0.5 (D)
Chloride	300.0	0.2	5.0	1.3	2.9
Fluoride	300.0	0.2	5.0	ND	2.1
Nitrate as Nitrogen	300.0	0.2	ND	ND	< 0.5 (D)
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.02	0.04	0.09
Phosphorus, Total	365.3	0.01	0.09	0.31	0.04
Solids, Total Dissolved (TDS)	160.1	5	3330	246	1860
Solids, Total Suspended (TSS)	160.2	5	91	317	16
Sulfate	300.0	0.2	3230	90.1	1550

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 12/4/98

00006

3S30EPA/102094

07706WET.LJ1 - Mixed (3) 12/4/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: NA
Date Received: NA
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	**Method Blank 1**	**Method Blank 2**	**Method Blank 3**
		Lab Code:	K9807706-MB1	K9807706-MB2	K9807706-MB3
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	–	-	-	-
Conductivity (µmhos/cm)	120.1	2	ND	-	-
Alkalinity, Total as $CaCO_3$	310.1	2	ND	-	-
Bromide	300.0	0.2	ND	ND	-
Chloride	300.0	0.2	ND	ND	ND
Fluoride	300.0	0.2	ND	ND	ND
Nitrate as Nitrogen	300.0	0.2	ND	ND	-
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	ND	-	-
Phosphorus, Total	365.3	0.01	ND	-	-
Solids, Total Dissolved (TDS)	160.1	5	ND	-	-
Solids, Total Suspended (TSS)	160.2	5	ND	-	-
Sulfate	300.0	0.2	ND	ND	-

Approved By: _____ Date: 12/4/98

3S30EPA/102094

07706WET.LJ1 - MB 12/4/98

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70607

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11069800

mw-4

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20600			P
7440-36-0	Antimony	40.6	B		P
7440-38-2	Arsenic	306			F
7440-39-3	Barium	12.4	B	E	P
7440-41-7	Beryllium	6.1			P
	Boron	351			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	430000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	602			P
7440-50-8	Copper	3.1	B		P
7439-89-6	Iron	340000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	76300			P
7439-96-5	Manganese	21500			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1350			P
7440-09-7	Potassium	21600			P
7782-49-2	Selenium	2.5	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	23700			P
7440-28-0	Thallium	31.6		S	F
7440-62-2	Vanadium	25.7	B		P
7440-66-6	Zinc	262			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70608

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11069801

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	103	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	26.4			F
7440-39-3	Barium	28.2	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	23.8	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	35600			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	10.2	B		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	4120			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	6660			P
7439-96-5	Manganese	405			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	23.2	B		P
7440-09-7	Potassium	2670	B		P
7782-49-2	Selenium	3.6	B	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	13000			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	22.2			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70609

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11069802

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	29200			P
7440-36-0	Antimony	29.8	B		P
7440-38-2	Arsenic	336			F
7440-39-3	Barium	9.7	B	E	P
7440-41-7	Beryllium	3.6	B		P
	Boron	303			P
7440-43-9	Cadmium	7.8			P
7440-70-2	Calcium	185000			P
7440-47-3	Chromium	18.5			P
7440-48-4	Cobalt	108			P
7440-50-8	Copper	17.9	B		P
7439-89-6	Iron	227000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	33700			P
7439-96-5	Manganese	10200			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	313			P
7440-09-7	Potassium	17500			P
7782-49-2	Selenium	3.1	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	17300			P
7440-28-0	Thallium	176			F
7440-62-2	Vanadium	52.4			P
7440-66-6	Zinc	298			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: 11/6/98
Date Received: 11/7/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11069800	11069801	11069802
		Lab Code:	K9807706-007	K9807706-008	K9807706-008
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	–	4.62	6.03	3.88
Conductivity (µmhos/cm)	120.1	2	2650	277	1670
Alkalinity, Total as $CaCO_3$	310.1	2	ND	61	ND
Bromide	300.0	0.2	ND	ND	< 0.5 (D)
Chloride	300.0	0.2	5.0	1.3	2.9
Fluoride	300.0	0.2	5.0	ND	2.1
Nitrate as Nitrogen	300.0	0.2	ND	ND	< 0.5 (D)
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	ND	< 0.5 (D)
Orthophosphate as Phosphorus	365.3	0.01	0.02	0.04	0.09
Phosphorus, Total	365.3	0.01	0.09	0.31	[illegible]
Solids, Total Dissolved (TDS)	160.1	5	3330	246	[illegible]
Solids, Total Suspended (TSS)	160.2	5	91	317	[illegible]
Sulfate	300.0	0.2	3230	90.1	1550

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 12/4/98

00000

3S30EPA/102094

07706WET.LJ1 - Mixed (3) 12/4/98

Page No.:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/Monitoring Wells/WO 27/19333.2301
Sample Matrix: Water

Service Request: K9807706
Date Collected: NA
Date Received: NA
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name:			Method Blank 1	Method Blank 2	Method Blank
Lab Code:			K9807706-MB1	K9807706-MB2	K9807706-MB1
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	-	-	-
Conductivity (µmhos/cm)	120.1	2	ND	-	-
Alkalinity, Total as $CaCO_3$	310.1	2	ND	-	-
Bromide	300.0	0.2	ND	ND	-
Chloride	300.0	0.2	ND	ND	ND
Fluoride	300.0	0.2	ND	ND	ND
Nitrate as Nitrogen	300.0	0.2	ND	ND	-
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	ND	-	-
Phosphorus, Total	365.3	0.01	ND	-	-
Solids, Total Dissolved (TDS)	160.1	5	ND	-	-
Solids, Total Suspended (TSS)	160.2	5	ND	-	-
Sulfate	300.0	0.2	ND	ND	-

Approved By: _____ Date: 12/4/98

00007

3S30EPA/102094

07706WET.LJ1 - MB 12/4/98

Page No.:

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D35401D	10209800
D35401S	10209800
D70601	11059800
D70602	11059801
D70603	11059802
D70604	11059803
D70605	11059804
D70606	11059805
D70607	11069800
D70608	11069801
D70609	11069802

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Jeff Cor Name: JEFF CORNADO

Date: 11/19/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D70601

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059800

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.1	B		F
7440-39-3	Barium	114	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	33.7	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	77200			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	43.6	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	15800			P
7439-96-5	Manganese	9.8	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	1120	B		P
7782-49-2	Selenium	2.0	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	22900			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.6	B		P
7440-66-6	Zinc	10.2	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70602

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059801

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	23400			P
7440-36-0	Antimony	43.9	B		P
7440-38-2	Arsenic	420			F
7440-39-3	Barium	12.4	B	E	P
7440-41-7	Beryllium	5.6			P
	Boron	584			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	344000			P
7440-47-3	Chromium	4.9	B		P
7440-48-4	Cobalt	496			P
7440-50-8	Copper	4.9	B		P
7439-89-6	Iron	573000			P
7439-92-1	Lead	1.9	B		F
7439-95-4	Magnesium	121000			P
7439-96-5	Manganese	22800			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	1660			P
7440-09-7	Potassium	28100			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	29900			P
7440-28-0	Thallium	12.2		S	F
7440-62-2	Vanadium	36.3	B		P
7440-66-6	Zinc	360			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D70603

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059802

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	17.2	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	123			F
7440-39-3	Barium	27.6	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	113			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	302000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	6.0	B		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	37000			P
7439-92-1	Lead	1.2	B		F
7439-95-4	Magnesium	84600			P
7439-96-5	Manganese	3050			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	4170	B		P
7782-49-2	Selenium	2.1	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	32900			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.5	B		P
7440-66-6	Zinc	6.4	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70604

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059803

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.9	B		F
7440-39-3	Barium	0.97	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	86.6	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	32.0	B		P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	5.6	U		P
7439-96-5	Manganese	2.1	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	831	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	350	B		P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	12.2	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D70605

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059804

mw-25

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	319000			P
7440-36-0	Antimony	66.7			P
7440-38-2	Arsenic	17.0	B		F
7440-39-3	Barium	13.8	B	E	P
7440-41-7	Beryllium	10.7			P
	Boron	447			P
7440-43-9	Cadmium	48.8			P
7440-70-2	Calcium	169000			P
7440-47-3	Chromium	64.5			P
7440-48-4	Cobalt	2300			P
7440-50-8	Copper	1750			P
7439-89-6	Iron	904000			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	36900			P
7439-96-5	Manganese	7320			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	6230			P
7440-09-7	Potassium	15600			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	22300			P
7440-28-0	Thallium	303			F
7440-62-2	Vanadium	558			P
7440-66-6	Zinc	976			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D70606

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807706

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W70601

Matrix (soil/water): WATER Lab Sample ID: 11059805

Level (low/med): LOW Date Received: 11/07/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	310000			P
7440-36-0	Antimony	66.7			P
7440-38-2	Arsenic	5.0	U		F
7440-39-3	Barium	18.4	B	E	P
7440-41-7	Beryllium	94.1			P
	Boron	477			P
7440-43-9	Cadmium	166			P
7440-70-2	Calcium	428000			P
7440-47-3	Chromium	4.0	B		P
7440-48-4	Cobalt	7190			P
7440-50-8	Copper	9300			P
7439-89-6	Iron	889000			P
7439-92-1	Lead	2.5	B		F
7439-95-4	Magnesium	92600			P
7439-96-5	Manganese	73000			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	10500			P
7440-09-7	Potassium	21800			P
7782-49-2	Selenium	1.9	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	67500			P
7440-28-0	Thallium	41.6		S	F
7440-62-2	Vanadium	115			P
7440-66-6	Zinc	2190			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

LEVIATHAN MINE

Surface Water Lab Results
Date Collected
11-4,5/98

Sample Name	Lab Code
Aspen Creek/ Landslide	K9807679-002
Slide Creek above Aspen	K9807679-003
Leviathan above Aspen	K9807679-004
Upper Aspen	K9807679-005
Station 16	K9807679-006
Adit Drain	K9807679-007
Channel under drain	K9807679-008
Upper Tributary	K9807679-009
Underdrain	K9807679-010
Upper Leviathan	K9807679-011
BLANK	K9807679-012
Wetlands Seep	K9807679-013
Lower Aspen Seep	K9807679-014
Leviathan below Delta Seep	K9807679-015
Leviathan below Underdrain	K9807679-016
Diversion Channel	K9807679-017
Delta Seep	K9807679-018

COLUMBIA ANA...

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/4/98
Date Received: #REF!
Date Extracted: NA

WHITE OUT

Analyte	EPA Method	MRL		Aspen Above Slide - Below Dumps K9807679-002	Slide Creek Above Aspen K9807679-003
pH (units)	150.1	--	7.54 (H)	4.87 (H)	8.12 (H)
Conductivity (µmhos/cm)	120.1	2	265	379	1610
Alkalinity, Total as $CaCO_3$	310.1	2	44	ND	168
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	1.0	1.1	2.1
Fluoride	300.0	0.2	ND	0.8	1.8
Nitrate as Nitrogen	300.0	0.2	0.2	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.01	ND	0.0[illegible]
Phosphorus, Total	365.3	0.01	0.02	ND	0.02
Solids, Total Dissolved (TDS)	160.1	5	237	334	1780
Solids, Total Suspended (TSS)	160.2	5	13	ND	18
Sulfate	300.0	0.2	94.6	212	1020

H The Sample was received past the recommended hold time.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/4/98
Date Received: #REF!
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name:			Leviathan Above Aspen	Aspen Above Mine	Aspen Above Leviathan
Lab Code:			K9807679-004	K9807679-005	K9807679-006
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	5.34 (H)	7.77 (H)	6.53 (H)
Conductivity (µmhos/cm)	120.1	2	1140	161	467
Alkalinity, Total as $CaCO_3$	310.1	2	ND	97	6
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	1.6	0.7	1.1
Fluoride	300.0	0.2	1.7	ND	0.5
Nitrate as Nitrogen	300.0	0.2	ND	0.5	0.2
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.01	0.02	0.01
Phosphorus, Total	365.3	0.01	0.06	0.06	ND
Solids, Total Dissolved (TDS)	160.1	5	1100	116	414
Solids, Total Suspended (TSS)	160.2	5	62	31	23
Sulfate	300.0	0.2	663	1.2	241

H The Sample was received past the recommended hold time.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/4,5/98
Date Received: #REF!
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

			Sample Name:	#5 Adit Drain	Seep #1	Upper Tributary
			Lab Code:	K9807679-007	K9807679-008	K9807679-009
Analyte	**EPA Method**	**MRL**				
pH (units)	150.1	--		2.70 (H)	4.64	7.87 (H)
Conductivity (µmhos/cm)	120.1	2		3700	2440	178
Alkalinity, Total as $CaCO_3$	310.1	2		ND	ND	97
Bromide	300.0	0.2		< 1.0 (D)	< 1.0 (D)	ND
Chloride	300.0	0.2		< 2.0 (D)	4.5	1.1
Fluoride	300.0	0.2		< 2.0 (D)	4.5	ND
Nitrate as Nitrogen	300.0	0.2		< 1.0 (D)	< 1.0 (D)	ND
Nitrite as Nitrogen	300.0	0.2		< 1.0 (D)	< 1.0 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01		3.56	0.10	0.13
Phosphorus, Total	365.3	0.01		6.91	0.02	0.1[illegible]
Solids, Total Dissolved (TDS)	160.1	5		5000	3210	156
Solids, Total Suspended (TSS)	160.2	5		ND	18	6
Sulfate	300.0	0.2		4250	3380	11.3

H The Sample was received past the recommended hold time.
D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/4,5/98
Date Received: #REF!
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	Under Drain	Leviathan Above Mine	Method Blank
		Lab Code:	K9807679-010	K9807679-011	K9807679-012
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	4.69	7.54 (H)	6.05
Conductivity (µmhos/cm)	120.1	2	2430	120	ND
Alkalinity, Total as $CaCO_3$	310.1	2	ND	66	ND
Bromide	300.0	0.2	< 1.0 (D)	ND	ND
Chloride	300.0	0.2	4.9	0.9	ND
Fluoride	300.0	0.2	5.2	ND	ND
Nitrate as Nitrogen	300.0	0.2	< 1.0 (D)	ND	ND
Nitrite as Nitrogen	300.0	0.2	< 1.0 (D)	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.10	0.09	ND
Phosphorus, Total	365.3	0.01	ND	0.08	ND
Solids, Total Dissolved (TDS)	160.1	5	3220	114	< 10
Solids, Total Suspended (TSS)	160.2	5	14	6	ND
Sulfate	300.0	0.2	1810	6.1	ND

H The Sample was received past the recommended hold time.
D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/5/98
Date Received: #REF!
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	**Wetlands Seep**	**Bioreactor Outlet**	**Leviathan Below Delta**
		Lab Code:	K9807679-013	K9807679-014	K9807679-015
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	–	3.84	3.00	5.79
Conductivity (µmhos/cm)	120.1	2	1220	6880	873
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	ND
Bromide	300.0	0.2	ND	< 1.0 (D)	ND
Chloride	300.0	0.2	2.6	3.8	1.6
Fluoride	300.0	0.2	1.3	6.2	1.4
Nitrate as Nitrogen	300.0	0.2	2.2	< 1.0 (D)	ND
Nitrite as Nitrogen	300.0	0.2	< 0.5 (D)	< 1.0 (D)	ND
Orthophosphate as Phosphorus	365.3	0.01	0.01	ND	0.02
Phosphorus, Total	365.3	0.01	0.03	ND	0.1[illegible]
Solids, Total Dissolved (TDS)	160.1	5	1260	2860	776
Solids, Total Suspended (TSS)	160.2	5	23	12	62
Sulfate	300.0	0.2	1010	3130	836

D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: #REF!
Project: #REF!
Sample Matrix: #REF!

Service Request: K9807679
Date Collected: 11/5/98
Date Received: #REF!
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Sample Name:			Lvthn Below Drains	Diversion Channel Outlets	Delta Seep
Lab Code:			K9807679-016	K9807679-017	K9807679-018
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	5.70	8.40	6.00
Conductivity (µmhos/cm)	120.1	2	886	136	1620
Alkalinity, Total as $CaCO_3$	310.1	2	ND	70	32
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	1.6	0.9	2.7
Fluoride	300.0	0.2	1.5	ND	2.2
Nitrate as Nitrogen	300.0	0.2	ND	ND	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.03	0.03	0.01
Phosphorus, Total	365.3	0.01	0.14	0.09	ND
Solids, Total Dissolved (TDS)	160.1	5	824	120	1740
Solids, Total Suspended (TSS)	160.2	5	52	ND	8
Sulfate	300.0	0.2	645	8.8	1080

Approved By: _____ Date: _____

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D62504

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

Matrix (soil/water): WATER Lab Sample ID: 11039800

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

TAW-12

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	203			P
7440-36-0	Antimony	25.5	B		P
7440-38-2	Arsenic	56.8			F
7440-39-3	Barium	21.9	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	179			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	302000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	81.2			P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	117000			P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	92100			P
7439-96-5	Manganese	21700			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	81.0			P
7440-09-7	Potassium	13600			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	25700			P
7440-28-0	Thallium	1.2	B		F
7440-62-2	Vanadium	3.7	B		P
7440-66-6	Zinc	45.6			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

SAMPLE NO.

D62505

INORGANIC ANALYSIS DATA SHEET

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W625(

Matrix (soil/water): WATER Lab Sample ID: 11039801

Level (low/med): LOW Date Received: MW-1 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.2	B		F
7440-39-3	Barium	28.1	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	59.1			P
7440-43-9	Cadmium	2.7	B		P
7440-70-2	Calcium	272000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	81.9	B		P
7439-92-1	Lead	1.3	B		F
7439-95-4	Magnesium	115000			P
7439-96-5	Manganese	147			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	13600			P
7782-49-2	Selenium	10.0		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	41000			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	6.2	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D62506

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: V 5(

Matrix (soil/water): WATER Lab Sample ID: 110~~8~~29802

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	299000			P
7440-36-0	Antimony	65.8			P
7440-38-2	Arsenic	6520			F
7440-39-3	Barium	15.1	B	E	P
7440-41-7	Beryllium	5.6			P
	Boron	63.3			P
7440-43-9	Cadmium	11.3			P
7440-70-2	Calcium	209000			P
7440-47-3	Chromium	1350			P
7440-48-4	Cobalt	512			P
7440-50-8	Copper	13.5	B		P
7439-89-6	Iron	936000			P
7439-92-1	Lead	13.8			F
7439-95-4	Magnesium	63000			P
7439-96-5	Manganese	6400			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	2550			P
7440-09-7	Potassium	27500			P
7782-49-2	Selenium	5.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	29200			P
7440-28-0	Thallium	89.6			F
7440-62-2	Vanadium	659			P
7440-66-6	Zinc	791			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D62507

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

Matrix (soil/water): WATER Lab Sample ID: 11039803

Level (low/med): LOW Date Received: 11/05/98 mlw-cl

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	99800			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	7.2	B	W	F
7440-39-3	Barium	14.0	B	E	P
7440-41-7	Beryllium	9.4			P
	Boron	113			P
7440-43-9	Cadmium	12.2			P
7440-70-2	Calcium	412000			P
7440-47-3	Chromium	9.0	B		P
7440-48-4	Cobalt	445			P
7440-50-8	Copper	3370			P
7439-89-6	Iron	643			P
7439-92-1	Lead	4.6			F
7439-95-4	Magnesium	94800			P
7439-96-5	Manganese	13900			P
7439-97-6	Mercury	20.7			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	701			P
7440-09-7	Potassium	16900			P
7782-49-2	Selenium	37.3		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9340			P
7440-28-0	Thallium	14.9			F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	1140			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D62508

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

Matrix (soil/water): WATER Lab Sample ID: 11039804

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	184	B		P
7440-36-0	Antimony	19.3	B		P
7440-38-2	Arsenic	60.8			F
7440-39-3	Barium	23.0	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	178			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	292000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	68.4			P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	108000			P
7439-92-1	Lead	2.1	B		F
7439-95-4	Magnesium	95200			P
7439-96-5	Manganese	21300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	70.2			P
7440-09-7	Potassium	12600			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	26200			P
7440-28-0	Thallium	2.2	B		F
7440-62-2	Vanadium	2.8	B		P
7440-66-6	Zinc	38.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

		Sample Name:	Compliance	Aspen Above Slide - Below Dumps	Slide Creek Above Aspen
		Lab Code:	K9807679-001	K9807679-002	K9807679-003
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	1020	2890	764
Antimony	200.8	0.02	0.07	0.07	0.07
Arsenic	200.8	0.5	3.4	6.2	4.6
Barium	200.8	0.05	30.4	21.5	22.2
Beryllium	200.8	0.02	0.15	0.68	0.04
Boron	6010B	50	ND	51	65
Cadmium	200.8	0.02	0.07	0.25	0.08
Calcium	6010B	50	36800	53100	351000
Chromium	200.8	0.2	0.3	0.3	0.5
Cobalt	200.8	0.02	20.4	21.8	2.88
Copper	200.8	0.1	5.9	64.9	9.3
Iron	6010B	20	3290	1460	629
Lead	200.8	0.02	0.03	0.03	0.17
Magnesium	6010B	10	10800	12200	90500
Manganese	6010B	5	747	1680	218
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.08	0.02	0.08
Nickel	200.8	0.2	48.4	46.1	33.2
Potassium	6010B	2000	3900	6800	7500
Selenium	7740	5	ND	6	9
Silver	200.8	0.02	ND	ND	ND
Sodium	6010B	100	9070	9020	21000
Thallium	200.8	0.02	0.81	2.10	0.59
Vanadium	200.8	0.2	1.8	ND	1.3
Zinc	200.8	0.5	14.1	54.9	7.5

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

		Sample Name:	Leviathan Above Aspen	Aspen Above Mine	Aspen Above Leviathan
		Lab Code:	K9807679-004	K9807679-005	K9807679-006
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	10100	267	2400
Antimony	200.8	0.02	0.14	0.04	0.05
Arsenic	200.8	0.5	45.2	0.9	4.4
Barium	200.8	0.05	38.7	12.0	32.1
Beryllium	200.8	0.02	1.28	ND	0.55
Boron	6010B	50	77	ND	51
Cadmium	200.8	0.02	0.19	ND	0.25
Calcium	6010B	50	153000	24500	73300
Chromium	200.8	0.2	3.2	0.3	0.5
Cobalt	200.8	0.02	169	0.32	17.1
Copper	200.8	0.1	7.8	0.8	45.2
Iron	6010B	20	63000	441	1040
Lead	200.8	0.02	0.14	0.24	0.18
Magnesium	6010B	10	39500	5400	17500
Manganese	6010B	5	6370	24	1390
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.04	0.04	0.02
Nickel	200.8	0.2	363	1.8	39.1
Potassium	6010B	2000	7900	3100	6800
Selenium	7740	5	ND	ND	6
Silver	200.8	0.02	ND	ND	0.03
Sodium	6010B	100	17200	9700	10200
Thallium	200.8	0.02	6.00	ND	1.44
Vanadium	200.8	0.2	7.2	2.9	1.0
Zinc	200.8	0.5	69.1	1.9	51.4

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

		Sample Name:	#5 Adit Drain	Seep #1	Upper Tributary
		Lab Code:	K9807679-007	K9807679-008	K9807679-009
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	267000	42700	343
Antimony	200.8	0.02	<0.4(C)	<0.1(C)	0.09
Arsenic	200.8	0.5	11200	441	1.7
Barium	200.8	0.05	7.10	11.8	113
Beryllium	200.8	0.02	6.57	6.16	<0.04
Boron	6010B	50	114	184	ND
Cadmium	200.8	0.02	39.0	0.16	<0.04(C)
Calcium	6010B	50	126000	331000	26100
Chromium	200.8	0.2	903	20.8	0.8
Cobalt	200.8	0.02	1840	788	0.40
Copper	200.8	0.1	1150	14.1	1.7
Iron	6010B	20	711000	357000	447
Lead	200.8	0.02	6.84	<0.1(C)	0.22
Magnesium	6010B	10	37900	78800	4890
Manganese	6010B	5	7320	18200	30
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	<0.4(C)	<0.1(C)	0.05
Nickel	200.8	0.2	4550	1650	2.4
Potassium	6010B	2000	15000	17400	5700
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.4(C)	<0.3(C)	<0.04(C)
Sodium	6010B	100	23400	25000	10200
Thallium	200.8	0.02	463	29.2	0.07
Vanadium	200.8	0.2	411	65.8	1.9
Zinc	200.8	0.5	657	329	1.2

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

		Sample Name:	Upper Drain	Leviathan Above Mine	Method Blank
		Lab Code:	K9807679-010	K9807679-011	K9807679-012
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	41100	114	ND
Antimony	200.8	0.02	<0.1(C)	0.08	ND
Arsenic	200.8	0.5	425	1.9	ND
Barium	200.8	0.05	11.5	60.3	ND
Beryllium	200.8	0.02	6.51	<0.04(C)	ND
Boron	6010B	50	176	ND	ND
Cadmium	200.8	0.02	0.17	<0.04(C)	ND
Calcium	6010B	50	313000	12900	ND
Chromium	200.8	0.2	20.4	<0.4(C)	ND
Cobalt	200.8	0.02	801	0.10	ND
Copper	200.8	0.1	6.1	0.5	ND
Iron	6010B	20	340000	197	ND
Lead	200.8	0.02	<0.1(C)	0.05	ND
Magnesium	6010B	10	76400	4230	ND
Manganese	6010B	5	17300	12	ND
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.12	0.30	ND
Nickel	200.8	0.2	1730	1.1	ND
Potassium	6010B	2000	16200	3700	ND
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.04(C)	ND
Sodium	6010B	100	24900	8480	ND
Thallium	200.8	0.02	26.3	<0.04(C)	ND
Vanadium	200.8	0.2	66.3	2.4	ND
Zinc	200.8	0.5	324	<1(C)	ND

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

Analyte	EPA Method	MRL	Wetlands Seep	Bioreactor Outlet	Leviathan Below Delta A
Sample Name:			Wetlands Seep	Bioreactor Outlet	Leviathan Below Delta A
Lab Code:			K9807679-013	K9807679-014	K9807679-015
Date Analyzed:			11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Aluminum	6010B	50	44400	50200	9900
Antimony	200.8	0.02	<0.1(C)	<0.1(C)	0.09
Arsenic	200.8	0.5	5.4	15.4	103
Barium	200.8	0.05	7.20	1.87	54.2
Beryllium	200.8	0.02	3.34	9.30	1.01
Boron	6010B	50	52	273	65
Cadmium	200.8	0.02	3.74	2.39	0.10
Calcium	6010B	50	152000	356000	102000
Chromium	200.8	0.2	4.6	6.1	5.2
Cobalt	200.8	0.02	166	322	133
Copper	200.8	0.1	986	1030	4.3
Iron	6010B	20	238	138000	79500
Lead	200.8	0.02	0.50	<0.1(C)	0.37
Magnesium	6010B	10	49900	89600	26600
Manganese	6010B	5	3460	20800	4770
Mercury	7470A	0.5	7.9	ND	ND
Molybdenum	200.8	0.02	<.1(C)	<.1(C)	0.19
Nickel	200.8	0.2	339	508	288
Potassium	6010B	2000	7700	23700	6500
Selenium	7740	5	36	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.1(C)	ND
Sodium	6010B	100	10200	15800	13900
Thallium	200.8	0.02	19.8	12.4	5.48
Vanadium	200.8	0.2	<1(C)	4.7	12.3
Zinc	200.8	0.5	367	728	61.2

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

Analyte	EPA Method	MRL	Lvthn Below Drains	Diversion Channel Outlets	Delta Seeps
Sample Name:			Lvthn Below Drains	Diversion Channel Outlets	Delta Seeps
Lab Code:			K9807679-016	K9807679-017	K9807679-018
Date Analyzed:			11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Aluminum	6010B	50	11600	89	2360
Antimony	200.8	0.02	0.07	0.09	0.02
Arsenic	200.8	0.5	108	2.2	63.4
Barium	200.8	0.05	54.8	71.3	9.44
Beryllium	200.8	0.02	1.53	ND	1.57
Boron	6010B	50	61	ND	128
Cadmium	200.8	0.02	0.04	ND	0.24
Calcium	6010B	50	96300	15300	286000
Chromium	200.8	0.2	5.4	ND	0.4
Cobalt	200.8	0.02	185	0.07	205
Copper	200.8	0.1	2.4	0.8	16.8
Iron	6010B	20	94500	193	22000
Lead	200.8	0.02	0.11	0.06	0.03
Magnesium	6010B	10	23400	4680	82700
Manganese	6010B	5	4730	12	13900
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.16	0.25	0.03
Nickel	200.8	0.2	418	0.4	492
Potassium	6010B	2000	6700	4100	6300
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	ND	ND	ND
Sodium	6010B	100	14000	8960	24600
Thallium	200.8	0.02	7.26	0.04	1.79
Vanadium	200.8	0.2	17.5	2.2	1.4
Zinc	200.8	0.5	78.6	ND	75.4

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: NA
Date Received: NA
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

		Sample Name:	Method Blank #2	Method Blank #2
		Lab Code:	K9807679-MB1	K9807679-MB2
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**		
Aluminum	6010B	50	ND	ND
Antimony	200.8	0.02	ND	ND
Arsenic	200.8	0.5	ND	ND
Barium	200.8	0.05	ND	ND
Beryllium	200.8	0.02	ND	ND
Boron	6010B	50	ND	ND
Cadmium	200.8	0.02	ND	ND
Calcium	6010B	50	ND	ND
Chromium	200.8	0.2	ND	ND
Cobalt	200.8	0.02	ND	ND
Copper	200.8	0.1	ND	ND
Iron	6010B	20	ND	ND
Lead	200.8	0.02	ND	ND
Magnesium	6010B	10	ND	ND
Manganese	6010B	5	ND	ND
Mercury	7470A	0.5	ND	ND
Molybdenum	200.8	0.02	ND	ND
Nickel	200.8	0.2	ND	ND
Potassium	6010B	2000	ND	ND
Selenium	7740	5	ND	ND
Silver	200.8	0.02	ND	ND
Sodium	6010B	100	ND	ND
Thallium	200.8	0.02	ND	ND
Vanadium	200.8	0.2	ND	ND
Zinc	200.8	0.5	ND	ND

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

		Sample Name:	Compliance	Aspen Above Slide - Below Dumps	Slide Creek Above Aspen
		Lab Code:	K9807679-001	K9807679-002	K9807679-003
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	133	2750	ND
Antimony	200.8	0.02	0.07	0.04	0.08
Arsenic	200.8	0.5	1.7	1.0	3.2
Barium	200.8	0.05	29.7	21.2	16.2
Beryllium	200.8	0.02	0.04	0.64	ND
Boron	6010B	50	ND	53	66
Cadmium	200.8	0.02	0.08	0.26	0.04
Calcium	6010B	50	35800	54700	35100
Chromium	200.8	0.2	0.05	ND	0.[illegible]
Cobalt	200.8	0.02	20.4	21.5	1.67
Copper	200.8	0.1	3.4	61.8	5.4
Iron	6010B	20	2240	236	76
Lead	200.8	0.02	0.03	0.03	ND
Magnesium	6010B	10	10600	12600	93200
Manganese	6010B	5	711	1730	17
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.11	ND	0.08
Nickel	200.8	0.2	47.0	44.7	29.4
Potassium	6010B	2000	3000	5000	4400
Selenium	7740	5	ND	5	12
Silver	200.8	0.02	ND	0.03	ND
Sodium	6010B	100	8650	9440	21900
Thallium	200.8	0.02	0.77	2.10	0.55
Vanadium	200.8	0.2	0.7	ND	0.9
Zinc	200.8	0.5	11.8	56.2	3.0

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

		Sample Name:	Leviathan Above Aspen	Aspen Above Mine	Aspen Above Leviathan
		Lab Code:	K9807679-004	K9807679-005	K9807679-006
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	897	ND	317
Antimony	200.8	0.02	0.03	0.04	0.02
Arsenic	200.8	0.5	36.4	0.8	1.3
Barium	200.8	0.05	42.9	9.52	27.9
Beryllium	200.8	0.02	0.35	ND	0.36
Boron	6010B	50	73	ND	ND
Cadmium	200.8	0.02	0.22	0.03	0.23
Calcium	6010B	50	153000	24800	75600
Chromium	200.8	0.2	ND	ND	0.4
Cobalt	200.8	0.02	175	0.16	16.4
Copper	200.8	0.1	5.6	0.6	31.5
Iron	6010B	20	62300	38	61
Lead	200.8	0.02	0.04	ND	0.03
Magnesium	6010B	10	40400	5540	18200
Manganese	6010B	5	6410	ND	1430
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.04	0.06	0.02
Nickel	200.8	0.2	375	1.9	39.6
Potassium	6010B	2000	5300	ND	3200
Selenium	7740	5	ND	ND	6
Silver	200.8	0.02	ND	ND	0.02
Sodium	6010B	100	17800	10400	11300
Thallium	200.8	0.02	5.67	ND	1.44
Vanadium	200.8	0.2	0.3	2.0	0.3
Zinc	200.8	0.5	78.1	0.5	50.4

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

		Sample Name:	#5 Adit Drain	Seep #1	Upper Tributary
		Lab Code:	K9807679-007	K9807679-008	K9807679-009
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	262000	42800	ND
Antimony	200.8	0.02	<0.4(C)	<0.1(C)	<0.04(C)
Arsenic	200.8	0.5	12700	436	1.3
Barium	200.8	0.05	7.35	11.5	110
Beryllium	200.8	0.02	6.01	6.18	<0.04(C)
Boron	6010B	50	116	178	ND
Cadmium	200.8	0.02	37.5	0.21	<0.04(C)
Calcium	6010B	50	124000	334000	26600
Chromium	200.8	0.2	870	21.0	0.6
Cobalt	200.8	0.02	1790	781	0.4
Copper	200.8	0.1	1110	8.0	1.7
Iron	6010B	20	697000	360000	29
Lead	200.8	0.02	6.44	<0.1(C)	<0.04(C)
Magnesium	6010B	10	37100	80000	5090
Manganese	6010B	5	7170	18400	18
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.48	<0.1(C)	0.09
Nickel	200.8	0.2	4400	1640	2.2
Potassium	6010B	2000	12600	16000	3200
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.4(C)	<0.2(C)	<0.04(C)
Sodium	6010B	100	23400	25500	11600
Thallium	200.8	0.02	461	26.9	<0.04(C)
Vanadium	200.8	0.2	402	63.8	1.6
Zinc	200.8	0.5	624	321	<1(C)

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

				Leviathan Above	
		Sample Name:	Upper Drain	Mine	Method Blank
		Lab Code:	K9807679-010	K9807679-011	K9807679-012
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	43400	51	ND
Antimony	200.8	0.02	<0.1(C)	<0.6(C)	ND
Arsenic	200.8	0.5	418	1.6	ND
Barium	200.8	0.05	10.6	61.9	0.55
Beryllium	200.8	0.02	6.55	<0.04(C)	ND
Boron	6010B	50	196	ND	ND
Cadmium	200.8	0.02	0.17	0.06	ND
Calcium	6010B	50	326000	13100	ND
Chromium	200.8	0.2	19.6	<0.4(C)	0.3
Cobalt	200.8	0.02	800	0.11	ND
Copper	200.8	0.1	7.7	0.2	0.3
Iron	6010B	20	355000	96	ND
Lead	200.8	0.02	<0.1(C)	<0.04(C)	0.04
Magnesium	6010B	10	80200	4310	ND
Manganese	6010B	5	18100	9	ND
Mercury	7470A	0.5	ND	1.4	ND
Molybdenum	200.8	0.02	0.12	0.25	ND
Nickel	200.8	0.2	1730	1.0	ND
Potassium	6010B	2000	17000	3900	ND
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.06(C)	ND
Sodium	6010B	100	25800	8610	ND
Thallium	200.8	0.02	26.8	<0.04(C)	ND
Vanadium	200.8	0.2	67.0	2.2	ND
Zinc	200.8	0.5	328	<1(C)	ND

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-[redacted] Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

		Sample Name:	Wetlands Seep	Bioreactor Outlet	Leviathan Below Delta A
		Lab Code:	K9807679-013	K9807679-014	K9807679-015
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	44400	50200	503
Antimony	200.8	0.02	0.20	<0.1(C)	0.05
Arsenic	200.8	0.5	6.3	16.4	87.5
Barium	200.8	0.05	6.78	1.71	46.4
Beryllium	200.8	0.02	3.19	9.04	0.37
Boron	6010B	50	ND	256	63
Cadmium	200.8	0.02	3.41	2.24	0.11
Calcium	6010B	50	154000	360000	105000
Chromium	200.8	0.2	4.5	6.2	0.5
Cobalt	200.8	0.02	158	319	152
Copper	200.8	0.1	949	1050	1.4
Iron	6010B	20	220	139000	72200
Lead	200.8	0.02	0.53	<0.1(C)	0.04
Magnesium	6010B	10	50800	91200	27100
Manganese	6010B	5	3480	20900	4880
Mercury	7470A	0.5	7.5	ND	ND
Molybdenum	200.8	0.02	<0.1(C)	<0.1(C)	0.15
Nickel	200.8	0.2	331	511	319
Potassium	6010B	2000	8000	23900	7310
Selenium	7740	5	41	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.1(C)	ND
Sodium	6010B	100	10300	16000	13500
Thallium	200.8	0.02	19.5	12.6	5.59
Vanadium	200.8	0.2	<1(C)	4.4	ND
Zinc	200.8	0.5	358	746	68.1

C The MRL is elevated because the sample required diluting.

Approved By: _____ Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

Analyte	EPA Method	MRL	Lvthn Below Drains	Diversion Channel Outlets	Leviathan Below Delta B
Sample Name:			Lvthn Below Drains	Diversion Channel Outlets	Leviathan Below Delta B
Lab Code:			K9807679-016	K9807679-017	K9807679-019
Date Analyzed:			11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/98
Aluminum	6010B	50	1870	53	2150
Antimony	200.8	0.02	0.06	0.09	ND
Arsenic	200.8	0.5	97.6	2.2	62.1
Barium	200.8	0.05	53.3	69.6	10.3
Beryllium	200.8	0.02	0.66	ND	1.53
Boron	6010B	50	62	ND	126
Cadmium	200.8	0.02	0.03	ND	0.26
Calcium	6010B	50	93800	15800	288000
Chromium	200.8	0.2	1.7	ND	0.4
Cobalt	200.8	0.02	187	0.06	205
Copper	200.8	0.1	1.3	0.7	3.7
Iron	6010B	20	90300	124	21700
Lead	200.8	0.02	0.04	0.05	0.03
Magnesium	6010B	10	22600	4800	83800
Manganese	6010B	5	4570	12	14000
Mercury	7470A	0.5	ND	ND	0.4
Molybdenum	200.8	0.02	0.16	0.25	0.04
Nickel	200.8	0.2	414	0.4	483
Potassium	6010B	2000	6900	4400	6300
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	ND	ND	ND
Sodium	6010B	100	13400	9230	24800
Thallium	200.8	0.02	6.84	0.03	1.82
Vanadium	200.8	0.2	5.4	2.1	1.1
Zinc	200.8	0.5	79.5	0.7	76.9

Columbia Analytical Services INC.
An Employee-Owned Company

December 12, 1998 Service Request No: K9807679

Gene Mancini
ARCO
515 South Flower Street
Los Angeles, CA 90071

Re: ARCO-Leviathan/19333

Dear Gene:

Enclosed are the amended report pages for the sample(s) submitted to our laboratory on November 6, 1998. For your reference, these analyses have been assigned our service request number K9807679.

Corrected sample name from "Upper Drain" to"Under Drain" on apropriate pages. We apologize for any inconvenience this may have created.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 260.

Respectfully submitted,

Columbia Analytical Services, Inc.

Diane Wiegel for
Teena Jones
Project Chemist

TJ/br

Page 1 of _____

cc: Mark Hanneman - SRK, Inc./Reno
Terry Braun

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 360/ 577-7222 • Fax 360/636-1(

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Atlantic Richfield Company	**Service Request No.:**	K9807679
Project:	ARCO-Leviathan/19333	**Date Received:**	11/6/98
Sample Matrix:	Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for sample(s) designated for Tier III data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Laboratory Control Sample (LCS), Initial/Continuing Calibration Verification Standards (ICV/CCV), and Initial/Continuing Calibration Blanks (ICB/CCB).

The following difficulties were experienced during analysis of this batch:

Samples were received past the recommended holding time for pH determination. The samples were analyzed as soon as possible after receipt by the laboratory.

The Matrix Spike (MS) recovery of Selenium for sample Under Drain was outside the normal CAS control limits because of suspected matrix interference. No further corrective action was taken.

The Matrix Spike (MS) recoveries of Al, As, Co, Fe, Mn, Ni, V, and Zn for sample Under Drain were not calculated. The analyte concentrations in the sample were significantly higher than the added spike concentration, preventing accurate evaluation of the spike recoveries.

Several samples that required dilutions for analysis by ICP-MS had elevated Method Reporting Limits. Due to matrix interference with the ICP-MS analysis, Selenium was analyzed by GFAA.

Approved by Diane Wiegel **Date** 12/11/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Dissolved Metals
Units: µg/L (ppb)

		Sample Name:	Under Drain	Leviathan Above Mine	Method Blank
		Lab Code:	K9807679-010	K9807679-011	K9807679-012
		Date Analyzed:	11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/9
Analyte	**EPA Method**	**MRL**			
Aluminum	6010B	50	43400	51	ND
Antimony	200.8	0.02	<0.1(C)	<0.6(C)	ND
Arsenic	200.8	0.5	418	1.6	ND
Barium	200.8	0.05	10.6	61.9	0.55
Beryllium	200.8	0.02	6.55	<0.04(C)	ND
Boron	6010B	50	196	ND	ND
Cadmium	200.8	0.02	0.17	0.06	ND
Calcium	6010B	50	326000	13100	ND
Chromium	200.8	0.2	19.6	<0.4(C)	0.3
Cobalt	200.8	0.02	800	0.11	N
Copper	200.8	0.1	7.7	0.2	0
Iron	6010B	20	355000	96	Nl
Lead	200.8	0.02	<0.1(C)	<0.04(C)	0.04
Magnesium	6010B	10	80200	4310	ND
Manganese	6010B	5	18100	9	ND
Mercury	7470A	0.5	ND	1.4	ND
Molybdenum	200.8	0.02	0.12	0.25	ND
Nickel	200.8	0.2	1730	1.0	ND
Potassium	6010B	2000	17000	3900	ND
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.06(C)	ND
Sodium	6010B	100	25800	8610	ND
Thallium	200.8	0.02	26.8	<0.04(C)	ND
Vanadium	200.8	0.2	67.0	2.2	ND
Zinc	200.8	0.5	328	<1(C)	ND

C The MRL is elevated because the sample required diluting.

Approved By: DRV Date: 12/11/98

3S30EPA/102094
07679ICP.EM2 - Sample (4) 12/11/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/4/98
Date Received: 11/6/98
Date Extracted: 11/21/98

Total Metals
Units: µg/L (ppb)

Analyte	EPA Method	MRL	Under Drain	Leviathan Above Mine	Method Blank
Sample Name:			Under Drain	Leviathan Above Mine	Method Blank
Lab Code:			K9807679-010	K9807679-011	K9807679-012
Date Analyzed:			11/23/98-12/3/98	11/23/98-12/3/98	11/23/98-12/3/9
Aluminum	6010B	50	41100	114	ND
Antimony	200.8	0.02	<0.1(C)	0.08	ND
Arsenic	200.8	0.5	425	1.9	ND
Barium	200.8	0.05	11.5	60.3	ND
Beryllium	200.8	0.02	6.51	<0.04(C)	ND
Boron	6010B	50	176	ND	ND
Cadmium	200.8	0.02	0.17	<0.04(C)	ND
Calcium	6010B	50	313000	12900	ND
Chromium	200.8	0.2	20.4	<0.4(C)	ND
Cobalt	200.8	0.02	801	0.10	ND
Copper	200.8	0.1	6.1	0.5	ND
Iron	6010B	20	340000	197	ND
Lead	200.8	0.02	<0.1(C)	0.05	ND
Magnesium	6010B	10	76400	4230	ND
Manganese	6010B	5	17300	12	ND
Mercury	7470A	0.5	ND	ND	ND
Molybdenum	200.8	0.02	0.12	0.30	ND
Nickel	200.8	0.2	1730	1.1	ND
Potassium	6010B	2000	16200	3700	ND
Selenium	7740	5	ND	ND	ND
Silver	200.8	0.02	<0.1(C)	<0.04(C)	ND
Sodium	6010B	100	24900	8480	ND
Thallium	200.8	0.02	26.3	<0.04(C)	ND
Vanadium	200.8	0.2	66.3	2.4	ND
Zinc	200.8	0.5	324	<1(C)	ND

C The MRL is elevated because the sample required diluting.

Approved By: DW Date: 12/11/98

3S30EPA/102094
076791CP.EM1 - Sample (4) 12/11/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98
Date Analyzed: 11/23/98-12/3/98

Duplicate Summary
Total Metals
Units: µg/L (ppb)

Sample Name: Under Drain
Lab Code: K9807679-010

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Aluminum	6010B	50	41100	40500	40800	1
Antimony	200.8	0.02	<0.1 (C)	<0.1 (C)	NC	NC
Arsenic	200.8	0.5	425	408	416	4
Barium	200.8	0.05	11.5	11.3	11.4	2
Beryllium	200.8	0.02	6.51	6.40	6.46	2
Boron	6010B	50	176	167	172	5
Cadmium	200.8	0.02	0.17	0.17	0.17	<1
Calcium	6010B	50	313000	312000	312000	<1
Chromium	200.8	0.2	20.4	19.6	20.0	4
Cobalt	200.8	0.02	801	782	792	2
Copper	200.8	0.1	6.1	5.9	6.0	3
Iron	6010B	20	340000	336000	338000	1
Lead	200.8	0.02	<0.1 (C)	<0.1 (C)	NC	NC
Magnesium	6010B	10	76400	75500	76000	1
Manganese	6010B	5	17300	17200	17200	<1
Mercury (L)	7470A	0.5	ND	ND	ND	-
Molybdenum	200.8	0.02	0.12	ND	NC	NC
Nickel	200.8	0.2	1730	1710	1720	1
Potassium	6010B	2000	16200	16400	16300	1
Selenium	7750	5	ND	ND	ND	-
Silver	200.8	0.02	<0.1 (C)	<0.1 (C)	NC	NC
Sodium	6010B	100	24900	24400	24600	2
Thallium	200.8	0.02	26.3	25.4	25.8	3
Vanadium	200.8	0.2	66.3	64.7	65.5	2
Zinc	200.8	0.5	324	319	322	2

L Duplicate analysis was performed on Dissolved Sample Compliance; Lab Code K9807679-001.
C The MRL is elevated because the sample required diluting.

Approved By: DW Date: 12/11/98

DUP1SEPA/102194

076791CP.EM1 - DUP (2) 12/11/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: ARCO-Leviathan/W0 27/19333
Sample Matrix: Water

Service Request: K9807679
Date Collected: 11/5/98
Date Received: 11/6/98
Date Extracted: 11/21/98
Date Analyzed: 11/23/98-12/3/98

Matrix Spike Summary
Total Metals
Units: µg/L (ppb)

Sample Name: Under Drain
Lab Code: K9807679-010

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Aluminum	50	2000	41100	40400	NA	75-125
Antimony	0.02	20.0	<0.1 (C)	16.3	82	75-125
Arsenic	0.2	20.0	425	424	NA	75-125
Barium	0.05	20.0	11.5	26.9	77	75-125
Beryllium	0.02	20.0	6.51	26.6	100	75-125
Boron	0.5	1000	176	1070	89	75-125
Cadmium	0.02	20.0	0.17	15.6	77	75-125
Chromium	0.2	20.0	20.4	36.9	82	75-125
Cobalt	0.02	20.0	801	778	NA	75-125
Copper	0.1	20.0	6.1	22.5	82	75-125
Iron	20	1000	340000	323000	NA	75-125
Lead	0.02	20.0	<0.1 (C)	18.6	93	75-125
Manganese	5	500	17300	16900	NA	75-125
Mercury	0.5	1	ND	1.1	110	60-130
Molybdenum	0.02	20.0	0.12	15.6	77	75-125
Nickel	0.2	20.0	1730	1640	NA	75-125
Selenium	5	20	ND	11	55 (A)	75-125
Silver	0.02	20.0	<0.1 (C)	15.4	77	75-125
Thallium	0.02	20.0	26.3	43.4	86	75-125
Vanadium	0.2	20.0	66.3	78.9	NA	75-125
Zinc	0.5	20.0	324	323	NA	75-125

M — Matrix spike analysis was performed on Dissolved Sample Compliance; Lab Code K9807679-001.
NA — Not Applicable; see case narrative.
C — The MRL is elevated because the sample required diluting.
A — Outside acceptance limits; see case narrative.

Approved By: DW Date: 12/11/98

MS1S/102194
07679ICP.EM1 - Spike (2) 12/11/98

Columbia Analytical Services INC.
An Employee-Owned Company

December 8, 1998

Service Request No: K9807625

Tony Schwartz
Atlantic Richfield Company
444 South Flower Street
Los Angeles, CA 90071

Re: Leviathan/WO 2719333.2301

Dear Tony:

Enclosed are the results of the sample(s) submitted to our laboratory on November 5, 1998. For your reference, these analyses have been assigned our service request number K9807625.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 260.

Respectfully submitted,

Columbia Analytical Services, Inc.

Diane Weigel for

Teena Jones
Project Chemist

TJ/br

Corrections

USB-25 11029800
USB-33 11029802
MW-12 11039800
MW-1 11039801
MW-4 11039803
MW-12 11039804

11029801
11039802

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Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
J	Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Atlantic Richfield Company	**Service Request No.:**	K9807625
Project:	Leviathan/Monitor Wells/WO 2719333.2301	**Date Received:**	11/5/98
Sample Matrix:	Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for sample(s) designated for Tier III/CLP data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Laboratory Control Sample (LCS), Initial/Continuing Calibration Verification Standards (ICV/CCV), and Initial/Continuing Calibration Blanks (ICB/CCB).

All EPA recommended holding times have been met for analyses in this sample delivery group.

The following difficulties were experienced during analysis of this batch:

Samples 11029800, 11029801 and 11029802 for NO2, NO3 and O-phosphate and all samples for pH were received past the recommended holding time. The samples were analyzed as soon as possible after receipt by the laboratory. No bottle was received for Total Phosphorus so the analysis was done using unpreserved sample. The method recommends preservation to pH<2 using H2SO4.

The Matrix Spike (MS) recovery of selenium for the Batch QC was outside the CLP control limits because of matrix interference. Based on the this, the post-spike recovery and the concentrations found in the samples, no further corrective action is required by CLP protocol.

The Initial Calibration Blank (ICB) was inadvertently omitted during the ICP analysis. Since the Continuing Calibration Blank was analyzed prior to sample analysis and found to be in control, no corrective action was taken.

The serial dilution test for barium was out of control, generating E flags on the Form I's. The barium concentrations, while greater than 50X the IDL, are much less than the CRDL for this element so no corrective action was taken.

Approved by Diane Nagel **Date** 12/6/98

LEVIATHAN MINE

Groundwater Lab Results
Date Collected
11-2,3/98

Sample Name	Lab Code
USGS-25	11029800
MW-3	11029802
MW-12	11039800
MW-12	11039801
USGS-33	11039802
MW-4	11039803
MW-12	11039804

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/Monitor Wells/WO 2719333.2301
Sample Matrix: Water

Service Request: K9807625
Date Collected: 11/2/98
Date Received: 11/5/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	**11029800**	**11029801**	**11029802**
		Lab Code:	K9807625-001	K9807625-002	K9807625-003
					4S635
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	5.07 (H)	5.84 (H)	5.91 (H)
Conductivity (µmhos/cm)	120.1	2	79	ND	327
Alkalinity, Total as $CaCO_3$	310.1	2	ND	ND	17
Bromide	300.0	0.2	ND	ND	ND
Chloride	300.0	0.2	3.0	ND	1.0
Fluoride	300.0	0.2	ND	ND	ND
Nitrate as Nitrogen	300.0	0.2	1.9	ND	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	0.01 (H)	ND (H)	0.21 (H)
Phosphorus, Total	365.3	0.01	0.44	0.01	0.22
Solids, Total Dissolved (TDS)	160.1	10	107	ND	3[illegible]
Solids, Total Suspended (TSS)	160.2	5	241	ND	[illegible]
Sulfate	300.0	0.2	22.3	ND	1[illegible]

H The Sample was received past the recommended hold time.

Approved By: _____ Date: 11/24/98

3S30EPA/102094

07625WET.LJ1 - Mixed 11/24/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/Monitor Wells/WO 2719333.2301
Sample Matrix: Water

Service Request: K9807625
Date Collected: 11/3/98
Date Received: 11/5/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11039800	11039801	11039802
		Lab Code:	K9807625-004	K9807625-005	K9807625-00(
			7110-12	7110-1	
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	6.24 (H)	7.15 (H)	2.25 (H)
Conductivity (µmhos/cm)	120.1	2	1760	1630	6170
Alkalinity, Total as $CaCO_3$	310.1	2	209	373	ND
Bromide	300.0	0.2	0.4	ND	< 0.5 (D)
Chloride	300.0	0.2	3.5	4.5	2.2
Fluoride	300.0	0.2	1.2	< 1.0 (D)	2.7
Nitrate as Nitrogen	300.0	0.2	ND	0.2	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	0.9
Orthophosphate as Phosphorus	365.3	0.01	0.06	0.08	5.03
Phosphorus, Total	365.3	0.01	0.41	0.22	6.85
Solids, Total Dissolved (TDS)	160.1	10	1960	1580	6440
Solids, Total Suspended (TSS)	160.2	5	420	183	21
Sulfate	300.0	0.2	1010	873	6260

H The Sample was received past the recommended hold time.
D The MRL is elevated because of matrix interferences and because the sample required diluting.

Approved By: _____ Date: 11/24/98

3S30EPA/102094

07625WET.LJ1 - Mixed (2) 11/24/98

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/Monitor Wells/WO 2719333.2301
Sample Matrix: Water

Service Request: K9807625
Date Collected: 11/3/98
Date Received: 11/5/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

		Sample Name:	11039803	11039804	Method Blank
		Lab Code:	K9807625-007	K9807625-008	K9807625-MB
Analyte	**EPA Method**	**MRL**			
pH (units)	150.1	--	3.86 (H)	6.00 (H)	-
Conductivity (µmhos/cm)	120.1	2	2280	1790	ND
Alkalinity, Total as $CaCO_3$	310.1	2	ND	192	ND
Bromide	300.0	0.2	ND	0.4	ND
Chloride	300.0	0.2	2.6	3.9	ND
Fluoride	300.0	0.2	6.3	1.4	ND
Nitrate as Nitrogen	300.0	0.2	0.4	ND	ND
Nitrite as Nitrogen	300.0	0.2	ND	ND	ND
Orthophosphate as Phosphorus	365.3	0.01	ND	0.46	ND
Phosphorus, Total	365.3	0.01	0.10	0.99	ND
Solids, Total Dissolved (TDS)	160.1	10	3000	1930	N
Solids, Total Suspended (TSS)	160.2	5	95	1360	N
Sulfate	300.0	0.2	3380	1310	ND

H The Sample was received past the recommended hold time.

Approved By: _____ Date: 11/24/98

3S30EPA/102094

07625WET.LJ1 - Mixed (3) 11/24/98

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
D35401	10209800
D35401D	10209800
D35401S	10209800
D62501	11029800
D62502	11029801
D62503	11029802
D62504	11039800
D62505	11039801
D62506	11039802
D62507	11039803
D62508	11039804

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES

If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name: JEFF CORONADO

Date: 11/19/98 Title: METALS LAB MANAGER

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

D62501

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

Matrix (soil/water): WATER Lab Sample ID: 11029800

USB-25

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	408			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.5	B		F
7440-39-3	Barium	307		E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	25.2	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	5270			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	8.9	B		P
7439-89-6	Iron	152			P
7439-92-1	Lead	1.5	B		F
7439-95-4	Magnesium	1350	B		P
7439-96-5	Manganese	33.5			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2780	B		P
7782-49-2	Selenium	5.7		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	6880			P
7440-28-0	Thallium	2.5	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	19.7	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

D62502

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: SAS No.: SDG No.: W62501

Matrix (soil/water): WATER Lab Sample ID: 11029801

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	0.47	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	15.6	U		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	45.2	B		P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	90.5	B		P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5.6	U		P
7439-96-5	Manganese	0.80	U		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	378	U		P
7782-49-2	Selenium	1.0	U	N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	21.7	B		P
7440-28-0	Thallium	1.0	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	4.8	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

SAMPLE NO.

D62503

INORGANIC ANALYSIS DATA SHEET

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9807625

Lab Code: COLUMB Case No.: - SAS No.: SDG No.: 5(

Matrix (soil/water): WATER Lab Sample ID: 11079802

Level (low/med): LOW Date Received: 11/05/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	13.5	U		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.8	B		F
7440-39-3	Barium	35.2	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	52.0			P
7440-43-9	Cadmium	2.2	B		P
7440-70-2	Calcium	31100			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.2	B		P
7439-89-6	Iron	25.5	B		P
7439-92-1	Lead	1.0	B		F
7439-95-4	Magnesium	10700			P
7439-96-5	Manganese	26.3			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	7680			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	24200			P
7440-28-0	Thallium	1.2	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	20.7			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:
DISSOLVED METALS

FORM I - IN

Appendix D
Laboratory Quality Assurance Data

Columbia Analytical Services INC.
An Employee-Owned Company

November 3, 1998

Service Request No: K9806762

Tony Schwartz
Atlantic Richfield Company
444 South Flower Street
Los Angeles, CA 90071

Re: Leviathan/WO 27

Dear Tony:

Enclosed are the results of the sample(s) submitted to our laboratory on September 30, 1998. For your reference, these analyses have been assigned our service request number K9806762.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 260.

Respectfully submitted,

Columbia Analytical Services, Inc.

Teena Jones

Teena Jones
Project Chemist

TJ/clb

cc: Chris tenBraak [SRK/Lakewood], Dana Brown [SRK/Reno], Terry Braun [SRK/Tucson]

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Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
J	Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Atlantic Richfield Company	**Service Request No.:**	K9806762
Project:	Leviathan	**Date Received:**	9/30/98
Sample Matrix:	Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for samples designated for Tier III and CLP data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Laboratory Control Sample (LCS), Initial/Continuing Calibration Verification Standards (ICV/CCV), and Initial/Continuing Calibration Blanks (ICB/CCB).

All EPA recommended holding times have been met for analyses in this sample delivery group.

The following difficulties were experienced during analysis of this batch:

The Matrix Spike (MS) recovery of sulfate for sample Pond 2 Surface Drainage was outside control limits. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

The Matrix Spike (MS) recovery of selenium for the total and dissolved samples was outside the normal CAS control limits because of suspected matrix interference. The Lab Control Sample was acceptable. No further corrective action was taken.

In several cases, antimony, arsenic and cadmium required manual interelement correction due to elevated analyte concentration. Sb and As required correction for the high iron concentration and Cd required correction for the high iron and arsenic concentrations.

Approved by TG **Date** 11/2/98

NON-CLP PARAMETERS

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/23-25/98
Date Received: 9/30/98
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte:		Alkalinity, Total as $CaCO_3$	Solids, Total Dissolved (TDS)	Solids, Total Suspended (TSS)	Sulfate
EPA Method:		310.1	160.1	160.2	300.0
Method Reporting Limit:		2	5	5	0.2
Date Analyzed:		10/6,8/98	10/1,2/98	10/1,2/98	10/2/98
Sample Name	**Lab Code**				
Pond 2 Surface Drainage	K9806762-001	ND	208	1820	208
Pit Under Drain	K9806762-002	ND	5430	ND	7640
Adit Drainage	K9806762-003	ND	5160	ND	5240
Leviathan Creek Below Delta Seep	K9806762-004	ND	1070	74	667
Lower Aspen Creek	K9806762-005	ND	358	ND	342
Lower Aspen Seep	K9806762-006	ND	2840	ND	1649
Underdrain (Channel Underdrain)	K9806762-007	ND	3170	10	2306
Leviathan Creek Below Diversion Ch	K9806762-008	ND	1150	82	672
Delta Seep	K9806762-009	23	1860	24	1175
Aspen Creek Above Leviathan Creek	K9806762-010	ND	430 (H)	6 (H)	273
Aspen Wetland Spring/Seep	K9806762-011	ND	1260 (H)	ND (H)	795
Aspen Creek Station #22	K9806762-012	98	106 (H)	6 (H)	1.2
Diversion Channel	K9806762-013	ND	72 (H)	31 (H)	8.6
Leviathan Creek Above Aspen Creek	K9806762-014	ND	964 (H)	66 (H)	695
Station #1 Leviathan Creek	K9806762-015	68	114 (H)	6 (H)	6.9
Pond 4 Discharge	K9806762-016	ND	23500	6	6068
Upper Tributary	K9806762-017	96	202	ND	11.1
Method Blank	K9806762-MB	ND	ND	ND	ND

H The Sample was received past the recommended hold time.

Approved By: _____ Date: 10/19/98

4A4M_DA/102194

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98

Hardness, Total as CaCO3

Prep Method: CLAA
Analysis Method: 6010B/SM 2340B
Test Notes:

Units: mg/L (ppm)
Basis: NA

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
Pond 2 Surface Drainage	K9806762-001	0.2	1	10/22/98	10/27/98	265	
Pit Under Drain	K9806762-002	0.2	1	10/22/98	10/27/98	551	
Adit Drainage	K9806762-003	0.2	1	10/22/98	10/27/98	457	
Leviathan Creek Below Delta Seep	K9806762-004	0.2	1	10/22/98	10/27/98	495	
Lower Aspen Creek	K9806762-005	0.2	1	10/22/98	10/27/98	197	
Lower Aspen Seep	K9806762-006	0.2	1	10/22/98	10/27/98	1380	
Underdrain (Channel Underdrain)	K9806762-007	0.2	1	10/22/98	10/27/98	1150	
Leviathan Creek Below Diversion C	K9806762-008	0.2	1	10/22/98	10/27/98	468	
Delta Seep	K9806762-009	0.2	1	10/22/98	10/27/98	1140	
Aspen Creek Above Leviathan Creel	K9806762-010	0.2	1	10/22/98	10/27/98	264	
Aspen Wetland Spring/Seep	K9806762-011	0.2	1	10/22/98	10/27/98	603	
Aspen Creek Station #22	K9806762-012	0.2	1	10/22/98	10/27/98	80.5	
Diversion Channel	K9806762-013	0.2	1	10/22/98	10/27/98	55.7	
Leviathan Creek Above Aspen Creel	K9806762-014	0.2	1	10/22/98	10/27/98	470	
Station #1 Leviathan Creek	K9806762-015	0.2	1	10/22/98	10/27/98	54.8	
Pond 4 Discharge	K9806762-016	0.2	2	10/22/98	10/27/98	1150	
Upper Tributary	K9806762-017	0.2	1	10/22/98	10/27/98	94.6	
Method Blank	K9806762-MB	0.2	1	10/22/98	10/27/98	ND	

Approved By: _____ Date: 10/29/98

LA/052595

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/6,8/98

Alkalinity, Total as $CaCO_3$
EPA Method 310.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	ERA Lot#9980	211	183	87
	ERA Lot#9980	211	218	103

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
pH Buffer Check 1	4.00	3.99	100
pH Buffer Check 2	4.00	4.00	100
pH Buffer Check 3	4.00	4.01	100
pH Buffer Check 4	4.00	4.01	100
pH Buffer Check 5	4.00	4.00	100
pH Buffer Check 6	4.00	4.00	100

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Underdrain (Channel Underdrain)	K9806762-007D	2	ND	ND	ND	-

Approved By: _____ Date: 10/19/98

COMBOQCP/042695

06762WET.LJ1 - alk 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1,2/98

Solids, Total Dissolved (TDS)
EPA Method 160.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #48370	616	641	104
	APG 3664 Lot #48370	616	643	104

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	5	208	220	214	6

Approved By: _____ Date: 10/19/98

COMBOQCG (2)/060695

06762WET.LJ1 - tds 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1,2/98

Solids, Total Suspended (TSS)
EPA Method 160.2
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot#48370	316	301	95
	APG 3664 Lot#48370	312	304	97

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	5	1820	1840	1830	1

Approved By: _____ Date: 10/19/98

COMBOQCG (3)/060695

06762WET.LJI - tss 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/2/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	150	104

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	5.0	5.0	100
CCV 2 Result	5.0	5.0	100
CCV 3 Result	5.0	5.0	100
CCV 4 Result	5.0	5.0	100
CCV 5 Result	5.0	4.9	98
CCV 6 Result	5.0	4.9	98

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Pond 2 Surface Drainage	K9806762-001D	0.2	208	209	208	< 1

MATRIX SPIKE ANALYSIS

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
Pond 2 Surface Drainage	K9806762-001MS	0.2	100	208	357	149 (A)

A Outside acceptanee limits: see case narrative.

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

06762WET.LJ1 - so4 10/19/98

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/1/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	145	100

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	5.0	4.8	96
CCV 2 Result	5.0	4.9	98
CCV 3 Result	5.0	4.8	96
CCV 4 Result	5.0	4.9	98
CCV 5 Result	5.0	4.8	96
CCV 6 Result	5.0	4.8	96

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Analyzed: 10/5/98

Sulfate
EPA Method 300.0
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

		True Value	Measured Value	Percent Recovery
Source:	CAS STD ID#AN1-15FF	144	146	101

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	144	4.9	98
CCV 2 Result	144	4.9	98
CCV 3 Result	144	5.3	106
CCV 4 Result	144	5.5	110
CCV 5 Result	144	5.1	102
CCV 6 Result	144	5.0	100

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND

Approved By: _____ Date: 10/19/98

COMBOQCD/042695

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: Atlantic Richfield Company
Project: Leviathan/WO 27
Sample Matrix: Water

Service Request: K9806762
Date Collected: 9/24/98
Date Received: 9/30/98
Date Extracted: 10/22/98
Date Analyzed: 10/27/98

Duplicate Summary
Total Metals

Sample Name: Pit Under Drain
Lab Code: K9806762-002
Test Notes:

Units: mg/L (ppm)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
Hardness, Total as CaCO3	EPA 3010A	6010B/SM 2340B	0.2	551	561	556	2	

Approved By: JC Date: 10/29/98

DUP/052595
06762ICP.JC1 - DUP 10/29/98

TOTAL CLP METALS

Sample Identification Summary

Client Sample No. :	CAS Lab Code:	Metals CLP ID. (Dissolved) :	Metals CLP ID. (Total) :
Pond 2 Surface Drainage	K9806762-001	D76201	T76201
Pit Under Drain	K9806762-002	D76202	T76202
Adit Drainage	K9806762-003	D76203	T76203
Leviathan Creek Below Delta Seep	K9806762-004	D76204	T76204
Lower Aspen Creek	K9806762-005	D76205	T76205
Lower Aspen Seep	K9806762-006	D76206	T76206
Underdrain (Channel Underdrain)	K9806762-007	D76207	T76207
Leviathan Creek Below Diversion Channel	K9806762-008	D76208	T76208
Delta Seep	K9806762-009	D76209	T76209
Aspen Creek Above Leviathan Creek	K9806762-010	D76210	T76210
Aspen Wetland Spring/Seep	K9806762-011	D76211	T76211
Aspen Creek Station #22	K9806762-012	D76212	T76212
Diversion Channel	K9806762-013	D76213	T76213
Leviathan Creek Above Aspen Creek	K9806762-014	D76214	T76214
Station #1 Leviathan Creek	K9806762-015	D76215	T76215
Pond 4 Discharge	K9806762-016	D76216	T76216
Upper Tributary	K9806762-017	D76217	T76217

ENVIROFORMS/INORGANIC CLP

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

SOW No.: ILM04.0

Sample No.	Lab Sample ID.
T76201	Pond 2 Sur
T76202	Pit u Drai
T76202D	Pit u Drai
T76202S	Pit u Drai
T76203	Adit Drain
T76204	LCreeK/Del
T76205	LAspenCree
T76206	LAspenSeep
T76207	ChannUnder
T76208	LCrK/DivCh
T76209	Delta Seep
T76210	ACreek ab
T76211	Aspen Seep
T76212	Aspen St22
T76213	DiverChann
T76214	LCreek/Asp
T76215	Sta1 LCree
T76216	Pond 4 Dis
T76217	Upper Trib

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES
If yes, were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: _____ Name: _____

Date: _____ Title: _____

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76201

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pond 2 Sur

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	59200			P
7440-36-0	Antimony	21.2	B		P
7440-38-2	Arsenic	102		*	F
7440-39-3	Barium	333		E	P
7440-41-7	Beryllium	6.9			P
	Boron	53.7			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	76800			P
7440-47-3	Chromium	113			P
7440-48-4	Cobalt	94.0			P
7440-50-8	Copper	302			P
7439-89-6	Iron	37100			P
7439-92-1	Lead	9.4			F
7439-95-4	Magnesium	17800			P
7439-96-5	Manganese	2720			P
7439-97-6	Mercury	4.8			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	178			P
7440-09-7	Potassium	7430			P
7782-49-2	Selenium	5.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	1900	B		P
7440-28-0	Thallium	10.6			F
7440-62-2	Vanadium	123			P
7440-66-6	Zinc	222			P

Color Before: BROWN Clarity Before: CLOUDY Texture:

Color After: BROWN Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76202

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pit u Drai

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	253000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	10800		*	F
7440-39-3	Barium	14.6	B	E	P
7440-41-7	Beryllium	10.5			P
	Boron	393			P
7440-43-9	Cadmium	26.4			P
7440-70-2	Calcium	146000			P
7440-47-3	Chromium	956			P
7440-48-4	Cobalt	1740			P
7440-50-8	Copper	1140			P
7439-89-6	Iron	729000			P
7439-92-1	Lead	7.0		W	F
7439-95-4	Magnesium	45200			P
7439-96-5	Manganese	8970			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	4690			P
7440-09-7	Potassium	15300			P
7782-49-2	Selenium	5.0	U	NW	F
7440-22-4	Silver	6.0	B		P
7440-23-5	Sodium	25100			P
7440-28-0	Thallium	470			F
7440-62-2	Vanadium	458			P
7440-66-6	Zinc	835			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76203

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Adit Drain

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	256000			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	12800		*	F
7440-39-3	Barium	13.9	B	E	P
7440-41-7	Beryllium	8.0			P
	Boron	391			P
7440-43-9	Cadmium	26.3			P
7440-70-2	Calcium	122000			P
7440-47-3	Chromium	1050			P
7440-48-4	Cobalt	2040			P
7440-50-8	Copper	1420			P
7439-89-6	Iron	696000			P
7439-92-1	Lead	10.5		S	F
7439-95-4	Magnesium	37000			P
7439-96-5	Manganese	7100			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	5430			P
7440-09-7	Potassium	14300			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	4.8	B		P
7440-23-5	Sodium	22500			P
7440-28-0	Thallium	562			F
7440-62-2	Vanadium	475			P
7440-66-6	Zinc	732			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76204

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCreeK/Del

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14200			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	156		*	F
7440-39-3	Barium	76.4	B	E	P
7440-41-7	Beryllium	2.1	B		P
	Boron	143			P
7440-43-9	Cadmium	3.6	B		P
7440-70-2	Calcium	140000			P
7440-47-3	Chromium	8.6	B		P
7440-48-4	Cobalt	272			P
7440-50-8	Copper	20.0	B		P
7439-89-6	Iron	104000			P
7439-92-1	Lead	1.3	B		F
7439-95-4	Magnesium	35400			P
7439-96-5	Manganese	6700			P
7439-97-6	Mercury	0.17	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	606			P
7440-09-7	Potassium	8040			P
7782-49-2	Selenium	1.3	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	14800			P
7440-28-0	Thallium	10.3			F
7440-62-2	Vanadium	26.7	B		P
7440-66-6	Zinc	119			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76205

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LAspenCree

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3040			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.5	B	*	F
7440-39-3	Barium	26.9	B	E	P
7440-41-7	Beryllium	1.1	B		P
	Boron	51.6			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	57100			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	29.4	B		P
7440-50-8	Copper	78.7			P
7439-89-6	Iron	602			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	13300			P
7439-96-5	Manganese	1850			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	54.0			P
7440-09-7	Potassium	6060			P
7782-49-2	Selenium	8.3		N	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9320			P
7440-28-0	Thallium	3.0	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	69.0			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76206

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LAspenSeep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	51500			P
7440-36-0	Antimony	32.0	B		P
7440-38-2	Arsenic	1.8	B	*	F
7440-39-3	Barium	8.3	B	E	P
7440-41-7	Beryllium	10.8			P
	Boron	314			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	396000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	394			P
7440-50-8	Copper	1290			P
7439-89-6	Iron	96900			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	95900			P
7439-96-5	Manganese	22300			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	631			P
7440-09-7	Potassium	23600			P
7782-49-2	Selenium	1.2	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	15800			P
7440-28-0	Thallium	11.3			F
7440-62-2	Vanadium	7.0	B		P
7440-66-6	Zinc	900			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76207

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: ChannUnder

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	43500			P
7440-36-0	Antimony	49.7	B		P
7440-38-2	Arsenic	544		*	F
7440-39-3	Barium	18.3	B	E	P
7440-41-7	Beryllium	6.9			P
	Boron	345			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	330000			P
7440-47-3	Chromium	21.0			P
7440-48-4	Cobalt	904			P
7440-50-8	Copper	15.7	B		P
7439-89-6	Iron	365000			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	78000			P
7439-96-5	Manganese	18000			P
7439-97-6	Mercury	0.50			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	2030			P
7440-09-7	Potassium	17500			P
7782-49-2	Selenium	1.6	B	NW	F
7440-22-4	Silver	5.5	B		P
7440-23-5	Sodium	24000			P
7440-28-0	Thallium	31.3			F
7440-62-2	Vanadium	86.7			P
7440-66-6	Zinc	399			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76208

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCrK/DivCh

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	16400			P
7440-36-0	Antimony	31.6	B		P
7440-38-2	Arsenic	202		*	F
7440-39-3	Barium	60.8	B	E	P
7440-41-7	Beryllium	2.5	B		P
	Boron	140			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	135000			P
7440-47-3	Chromium	8.1	B		P
7440-48-4	Cobalt	339			P
7440-50-8	Copper	10.1	B		P
7439-89-6	Iron	137000			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	31800			P
7439-96-5	Manganese	6770			P
7439-97-6	Mercury	0.13	B		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	766			P
7440-09-7	Potassium	10100			P
7782-49-2	Selenium	1.2	B	NW	F
7440-22-4	Silver	2.0	B		P
7440-23-5	Sodium	13900			P
7440-28-0	Thallium	13.6			F
7440-62-2	Vanadium	33.5	B		P
7440-66-6	Zinc	152			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76209

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Delta Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3510			P
7440-36-0	Antimony	23.9	B		P
7440-38-2	Arsenic	72.2		*	F
7440-39-3	Barium	18.6	B	E	P
7440-41-7	Beryllium	2.2	B		P
	Boron	176			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	321000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	255			P
7440-50-8	Copper	35.0			P
7439-89-6	Iron	24300			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	87200			P
7439-96-5	Manganese	15000			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	576			P
7440-09-7	Potassium	7730			P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	2.1	B		P
7440-23-5	Sodium	23800			P
7440-28-0	Thallium	3.0	B		F
7440-62-2	Vanadium	6.0	B		P
7440-66-6	Zinc	109			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76210

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: ACreek ab

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1990			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.2	B	*	F
7440-39-3	Barium	33.1	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	53.5			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	75000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	23.7	B		P
7440-50-8	Copper	58.6			P
7439-89-6	Iron	233			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	18600			P
7439-96-5	Manganese	1770			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	45.2			P
7440-09-7	Potassium	3630	B		P
7782-49-2	Selenium	7.3		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10400			P
7440-28-0	Thallium	2.2	B		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	58.4			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76211

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Aspen Seep

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	45600			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	1.3	B	*	F
7440-39-3	Barium	10.2	B	E	P
7440-41-7	Beryllium	3.0	B		P
	Boron	61.5			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	159000			P
7440-47-3	Chromium	4.9	B		P
7440-48-4	Cobalt	171			P
7440-50-8	Copper	1060			P
7439-89-6	Iron	306			P
7439-92-1	Lead	1.1	B		F
7439-95-4	Magnesium	49900			P
7439-96-5	Manganese	3570			P
7439-97-6	Mercury	7.7			CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	347			P
7440-09-7	Potassium	7400			P
7782-49-2	Selenium	26.2		NS	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9740			P
7440-28-0	Thallium	18.8			F
7440-62-2	Vanadium	2.5	B		P
7440-66-6	Zinc	410			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76212

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Aspen St22

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	210			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	2.2	B	*	F
7440-39-3	Barium	12.2	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	24.6	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	23700			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.6	B		P
7439-89-6	Iron	228			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5120			P
7439-96-5	Manganese	13.4	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	1260	B		P
7782-49-2	Selenium	1.8	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	9230			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.6	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76213

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: DiverChann

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	93.4	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	4.1	B	*	F
7440-39-3	Barium	65.0	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	21.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	15000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.1	B		P
7439-89-6	Iron	182			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4400	B		P
7439-96-5	Manganese	9.3	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3150	B		P
7782-49-2	Selenium	1.1	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8230			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

T76214

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: LCreek/Asp

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10300			P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	44.4		*	F
7440-39-3	Barium	38.9	B	E	P
7440-41-7	Beryllium	1.5	B		P
	Boron	98.4			P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	135000			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	237			P
7440-50-8	Copper	6.6	B		P
7439-89-6	Iron	51100			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	32200			P
7439-96-5	Manganese	5730			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	511			P
7440-09-7	Potassium	6020			P
7782-49-2	Selenium	1.0	U	NW -	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	13400			P
7440-28-0	Thallium	7.6	B		F
7440-62-2	Vanadium	8.8	B		P
7440-66-6	Zinc	96.3			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76215

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Sta1 LCree

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	120	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.3	B	*	F
7440-39-3	Barium	70.4	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	21.4	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	14300			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	1.1	U		P
7439-89-6	Iron	215			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	4640	B		P
7439-96-5	Manganese	10.7	B		P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	3440	B		P
7782-49-2	Selenium	1.6	B	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	8410			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	2.5	U		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76216

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Pond 4 Dis

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1550000			P
7440-36-0	Antimony	37.4	U		P
7440-38-2	Arsenic	41200		*	F
7440-39-3	Barium	20.5	B	E	P
7440-41-7	Beryllium	53.7			P
	Boron	1220			P
7440-43-9	Cadmium	324			P
7440-70-2	Calcium	519000			P
7440-47-3	Chromium	5080			P
7440-48-4	Cobalt	9810			P
7440-50-8	Copper	13000			P
7439-89-6	Iron	2410000			P
7439-92-1	Lead	4.3			F
7439-95-4	Magnesium	244000			P
7439-96-5	Manganese	47600			P
7439-97-6	Mercury	0.17	B		CV
	Molybdenum	8.8	U		P
7440-02-0	Nickel	25100			P
7440-09-7	Potassium	757	U		P
7782-49-2	Selenium	25.0	U	NW	F
7440-22-4	Silver	3.6	U		P
7440-23-5	Sodium	18500			P
7440-28-0	Thallium	1.5	B		F
7440-62-2	Vanadium	1700			P
7440-66-6	Zinc	4750			P

Color Before: YELLOW Clarity Before: CLEAR Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

T76217

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Lab Sample ID: Upper Trib

Level (low/med): LOW Date Received: 09/30/98

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	122	B		P
7440-36-0	Antimony	18.7	U		P
7440-38-2	Arsenic	3.4	B	*	F
7440-39-3	Barium	135	B	E	P
7440-41-7	Beryllium	0.70	U		P
	Boron	19.8	B		P
7440-43-9	Cadmium	2.2	U		P
7440-70-2	Calcium	28900			P
7440-47-3	Chromium	3.9	U		P
7440-48-4	Cobalt	3.6	U		P
7440-50-8	Copper	3.1	B		P
7439-89-6	Iron	178			P
7439-92-1	Lead	1.0	U		F
7439-95-4	Magnesium	5470			P
7439-96-5	Manganese	29.2			P
7439-97-6	Mercury	0.10	U		CV
	Molybdenum	4.4	U		P
7440-02-0	Nickel	15.1	U		P
7440-09-7	Potassium	2990	B		P
7782-49-2	Selenium	1.0	U	NW	F
7440-22-4	Silver	1.8	U		P
7440-23-5	Sodium	10600			P
7440-28-0	Thallium	1.0	U		F
7440-62-2	Vanadium	3.7	B		P
7440-66-6	Zinc	2.0	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum	5000.0	5090.44	101.8	5000.0	4914.51	98.3	5141.44	102.8	P
Antimony	2500.0	2548.30	101.9	5000.0	5000.10	100.0	5022.23	100.4	P
Arsenic	25.0	26.00	104.0	40.0	41.20	103.0	41.70	104.2	F
Barium	5000.0	5178.28	103.6	500.0	505.31	101.1	510.62	102.1	P
Beryllium	125.0	124.19	99.4	500.0	486.20	97.2	492.11	98.4	P
Boron	5000.0	5122.85	102.5	10000.0	10124.53	101.2	9975.06	99.8	P
Cadmium	1250.0	1275.24	102.0	500.0	505.22	101.0	507.45	101.5	P
Calcium	12500.0	12556.60	100.5	5000.0	4913.30	98.3	5158.68	103.2	P
Chromium	500.0	505.14	101.0	5000.0	5059.30	101.2	5106.97	102.1	P
Cobalt	1250.0	1240.00	99.2	500.0	489.48	97.9	495.03	99.0	P
Copper	625.0	625.00	100.0	500.0	483.68	96.7	493.61	98.7	P
Iron	2500.0	2506.88	100.3	5000.0	4917.80	98.4	5031.45	100.6	P
Lead	25.0	26.70	106.8	40.0	40.30	100.8	38.30	95.8	F
Magnesium	12500.0	12588.26	100.7	5000.0	4963.30	99.3	5178.83	103.6	P
Manganese	1250.0	1250.99	100.1	500.0	488.10	97.6	491.62	98.3	P
Mercury	5.0	5.14	102.8	5.0	4.98	99.6	5.09	101.8	CV
Molybdenum	5000.0	5014.26	100.3	500.0	488.45	97.7	486.84	97.4	P
Nickel	1250.0	1309.48	104.8	500.0	510.09	102.0	513.11	102.6	P
Potassium	12500.0	12813.50	102.5	25000.0	25150.00	100.6	25263.69	101.1	P
Selenium	25.0	26.30	105.2	40.0	39.10	97.8	38.70	96.8	F
Silver	625.0	628.90	100.6	500.0	501.58	100.3	506.47	101.3	P
Sodium	12500.0	12638.61	101.1	25000.0	25259.00	101.0	25603.69	102.4	P
Thallium	25.0	26.10	104.4	40.0	40.70	101.8	41.80	104.5	F
Vanadium	1250.0	1247.66	99.8	500.0	491.63	98.3	494.71	98.9	P
Zinc	1250.0	1274.37	101.9	2500.0	2468.50	98.7	2500.29	100.0	P

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum				5000.0	4918.94	98.4	4913.34	98.3	P
Antimony				5000.0	5004.55	100.1	5066.77	101.3	P
Arsenic				40.0	42.60	106.5	41.60	104.0	F
Barium				500.0	503.65	100.7	508.63	101.7	P
Beryllium				500.0	486.73	97.3	502.69	100.5	P
Boron				10000.0	10142.96	101.4	10224.57	102.2	P
Cadmium				500.0	518.05	103.6	542.48	108.5	P
Calcium				5000.0	5077.03	101.5	5293.48	105.9	P
Chromium				5000.0	5154.02	103.1	5322.07	106.4	P
Cobalt				500.0	494.09	98.8	501.94	100.4	P
Copper				500.0	482.27	96.5	488.89	97.8	P
Iron				5000.0	5097.63	102.0	5075.85	101.5	P
Lead				40.0	39.10	97.8	39.90	99.8	F
Magnesium				5000.0	5072.17	101.4	5240.80	104.8	P
Manganese				500.0	494.63	98.9	501.38	100.3	P
Mercury				5.0	5.14	102.8	5.13	102.6	CV
Molybdenum				500.0	486.85	97.4	495.54	99.1	P
Nickel				500.0	522.82	104.6	544.66	108.9	P
Potassium				25000.0	25400.42	101.6	26103.60	104.4	P
Selenium				40.0	39.20	98.0	37.80	94.5	F
Silver				500.0	510.35	102.1	520.11	104.0	P
Sodium				25000.0	25170.59	100.7	25340.69	101.4	P
Thallium				40.0	42.40	106.0	42.00	105.0	F
Vanadium				500.0	492.09	98.4	499.91	100.0	P
Zinc				2500.0	2548.45	101.9	2659.14	106.4	P

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum				5000.0	5023.53	100.5	4834.65	96.7	P
Antimony				5000.0	5029.24	100.6	4964.04	99.3	P
Arsenic				40.0	41.90	104.8	41.40	103.5	F
Barium				500.0	502.57	100.5	476.81	95.4	P
Beryllium				500.0	503.42	100.7	483.94	96.8	P
Boron				10000.0	10209.81	102.1	9757.51	97.6	P
Cadmium				500.0	504.59	100.9	522.15	104.4	P
Calcium				5000.0	5032.90	100.7	5197.54	104.0	P
Chromium				5000.0	5033.45	100.7	5058.09	101.2	P
Cobalt				500.0	506.19	101.2	503.11	100.6	P
Copper				500.0	502.39	100.5	471.78	94.4	P
Iron				5000.0	5034.73	100.7	5005.72	100.1	P
Lead				40.0	39.60	99.0	39.50	98.8	F
Magnesium				5000.0	4979.59	99.6	4875.26	97.5	P
Manganese				500.0	503.66	100.7	502.43	100.5	P
Mercury				5.0	5.19	103.8	5.13	102.6	CV
Molybdenum				500.0	501.55	100.3	491.71	98.3	P
Nickel				500.0	498.32	99.7	508.90	101.8	P
Potassium				25000.0	25172.50	100.7	24957.39	99.8	P
Selenium									
Silver				500.0	501.56	100.3	500.57	100.1	P
Sodium				25000.0	25097.65	100.4	23649.32	94.6	P
Thallium				40.0	42.10	105.2	40.70	101.8	F
Vanadium				500.0	503.06	100.6	492.42	98.5	P
Zinc				2500.0	2522.87	100.9	2582.69	103.3	P

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

FORM II (PART 1) - IN

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum				5000.0	5069.17	101.4			P
Antimony				5000.0	4895.65	97.9			P
Arsenic				40.0	41.40	103.5	41.30	103.2	F
Barium				500.0	490.56	98.1			P
Beryllium				500.0	488.27	97.7			P
Boron				10000.0	9675.62	96.8			P
Cadmium				500.0	493.83	98.8			P
Calcium				5000.0	5102.31	102.0			P
Chromium				5000.0	4900.89	98.0			P
Cobalt				500.0	490.78	98.2			P
Copper				500.0	489.60	97.9			P
Iron				5000.0	4962.77	99.3			P
Lead				40.0	43.00	107.5	38.70	96.8	F
Magnesium				5000.0	5190.43	103.8			P
Manganese				500.0	488.35	97.7			P
Mercury									
Molybdenum				500.0	490.51	98.1			P
Nickel				500.0	492.34	98.5			P
Potassium				25000.0	24716.05	98.9			P
Selenium									
Silver				500.0	493.47	98.7			P
Sodium				25000.0	24607.74	98.4			P
Thallium				40.0	39.90	99.8			F
Vanadium				500.0	490.51	98.1			P
Zinc				2500.0	2466.57	98.7			P

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

FORM II (PART 1) - IN

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead				40.0	39.00	97.5			F
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium									
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic	25.0	25.80	103.2	40.0	41.80	104.5	42.90	107.2	F
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium	25.0	26.20	104.8	40.0	40.10	100.2	42.20	105.5	F
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium				40.0	39.30	98.2	40.80	102.0	F
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium				40.0	38.90	97.2	39.40	98.5	F
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium				40.0	37.70	94.2	37.60	94.0	F
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

FORM II (PART 1) - IN

ENVIROFORMS/INORGANIC CLP

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Initial Calibration Source: INOR-VNT-ICV

Continuing Calibration Source: CAS-CCV

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	Continuing Calibration %R(1)	Continuing Calibration Found	Continuing Calibration %R(1)	M
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Boron									
Cadmium									
Calcium									
Chromium									
Cobalt									
Copper									
Iron									
Lead									
Magnesium									
Manganese									
Mercury									
Molybdenum									
Nickel									
Potassium									
Selenium				40.0	36.90	92.2			F
Silver									
Sodium									
Thallium									
Vanadium									
Zinc									

(1) Control Limits : Mercury 80-120; Other Metals 90-110; Cyanide 85-115

ENVIROFORMS/INORGANIC CLP

2B
CRDL STANDARD FOR AA AND ICP

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

AA CRDL Standard Source: CAS-AACRDL

ICP CRDL Standard Source: CAS-ICPCRDL

Concentration Units: ug/L

Analyte	CRDL Standard for AA			CRDL Standard for ICP				
					Initial		Final	
	True	Found	%R	True	Found	%R	Found	%R
Aluminum								
Antimony				100.0	127.18	127.2	125.47	125.5
Arsenic	10.0	11.20	112.0					
Barium								
Beryllium				10.0	10.36	103.6	10.72	107.2
Boron					3.83		2.46	
Cadmium				8.0	8.40	105.0	8.28	103.5
Calcium								
Chromium				20.0	20.66	103.3	21.93	109.6
Cobalt				100.0	103.23	103.2	104.62	104.6
Copper				50.0	50.59	101.2	49.88	99.8
Iron								
Lead	3.0	3.40	113.3					
Magnesium								
Manganese				30.0	29.28	97.6	31.03	103.4
Mercury	0.2	0.21	105.0					
Molybdenum					-2.14		-3.23	
Nickel				80.0	84.29	105.4	86.11	107.6
Potassium								
Selenium	5.0	5.50	110.0					
Silver				20.0	19.31	96.6	18.99	95.0
Sodium								
Thallium	10.0	10.70	107.0					
Vanadium				100.0	100.47	100.5	101.81	101.8
Zinc				40.0	38.68	96.7	41.23	103.1

ENVIROFORMS/INORGANIC CLP

2B
CRDL STANDARD FOR AA AND ICP

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

AA CRDL Standard Source: CAS-AACRDL

ICP CRDL Standard Source: CAS-ICPCRDL

Concentration Units: ug/L

Analyte	CRDL Standard for AA			CRDL Standard for ICP				
	True	Found	%R	True	Initial Found	%R	Final Found	%R
Aluminum								
Antimony							124.81	124.8
Arsenic	10.0	10.40	104.0					
Barium								
Beryllium							9.85	98.5
Boron							10.13	
Cadmium							7.15	89
Calcium								
Chromium							18.86	94.3
Cobalt							102.51	102.5
Copper							50.10	100.2
Iron								
Lead								
Magnesium								
Manganese							30.06	100.2
Mercury								
Molybdenum							-2.14	
Nickel							77.13	96.4
Potassium								
Selenium	5.0	5.10	102.0					
Silver							18.48	92.4
Sodium								
Thallium								
Vanadium							99.02	99.0
Zinc							37.47	93.7

ENVIROFORMS/INORGANIC CLP

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum	13.5	U	13.5	U	32.4	B	14.7	B	13.740	B	P
Antimony	18.7	U	18.7	U	18.7	U	18.7	U	18.700	U	P
Arsenic	1.0	U	1.0	U	1.0	U	1.0	U	1.700	B	F
Barium	0.7	B	0.2	U	0.2	U	0.7	B	0.200	U	P
Beryllium	0.7	U	0.7	U	0.7	U	0.7	U	0.700	U	P
Boron	15.6	U	15.6	U	22.1	B	23.8	B	15.600	U	P
Cadmium	2.2	U	2.2	U	2.2	U	2.2	U	2.200	U	P
Calcium	7.7	U	7.7	U	28.9	B	7.7	U	7.700	U	P
Chromium	3.9	U	3.9	U	3.9	U	3.9	U	3.900	U	P
Cobalt	3.6	U	3.6	U	3.6	U	3.7	B	3.600	U	P
Copper	1.1	U	1.1	U	1.1	U	1.1	U	1.100	U	P
Iron	2.9	U	2.9	U	12.5	B	33.0	B	3.080	B	P
Lead	1.0	U	1.0	U	1.0	U	1.0	U	1.000	U	F
Magnesium	5.6	U	-8.9	B	23.6	B	-23.8	B	-41.410	B	P
Manganese	0.8	U	-0.8	B	0.8	U	0.8	U	-1.000	B	P
Mercury	0.1	U	0.1	U	0.1	U	0.1	U	0.100	U	CV
Molybdenum	4.4	U	4.4	U	4.4	U	4.4	U	4.400	U	P
Nickel	15.1	U	15.1	U	15.1	U	15.1	U	15.100	U	P
Potassium	378.4	U	378.4	U	378.4	U	898.5	B	386.750	B	P
Selenium	1.0	U	1.1	B	1.6	B	-1.6	B	1.000	U	F
Silver	1.8	U	1.8	U	1.8	U	1.8	U	1.800	U	P
Sodium	14.5	B	9.4	U	21.1	B	44.2	B	10.660	B	P
Thallium	1.0	U	1.0	U	1.0	U	1.0	U	1.000	U	F
Vanadium	2.5	U	2.5	U	2.5	U	2.5	U	2.500	U	P
Zinc	2.0	U	2.0	U	-2.0	B	2.0	U	-4.060	B	P

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum			15.4	B	13.5	U	13.5	U			P
Antimony			18.7	U	18.7	U	18.7	U			P
Arsenic			1.0	B	1.1	B	1.0	U			F
Barium			1.0	B	0.2	U	3.0	B			P
Beryllium			0.7	U	0.7	U	0.7	U			P
Boron			28.7	B	15.6	U	16.6	B			P
Cadmium			2.2	U	2.2	U	-2.4	B			P
Calcium			13.9	B	7.7	U	7.7	U			P
Chromium			3.9	U	3.9	U	3.9	U			P
Cobalt			3.6	U	3.6	U	3.6	U			P
Copper			-1.6	B	-1.2	B	-1.1	B			P
Iron			13.6	B	3.4	B	18.3	B			P
Lead			1.0	U	1.0	U	1.0	U			F
Magnesium			11.8	B	5.6	U	-35.5	B			P
Manganese			0.8	U	0.8	U	0.8	U			P
Mercury			0.1	U	0.1	U	0.1	U			CV
Molybdenum			4.4	U	4.4	U	4.4	U			P
Nickel			15.1	U	15.1	U	15.1	U			P
Potassium			1328.2	B	-496.2	B	1661.3	B			P
Selenium			1.0	U							F
Silver			1.8	U	1.8	U	1.8	U			P
Sodium			56.1	B	29.0	B	99.8	B			P
Thallium			1.0	U	1.0	U	1.0	U			F
Vanadium			2.5	U	2.5	U	2.5	U			P
Zinc			2.0	U	2.0	U	2.0	U			P

ENVIROFORMS/INORGANIC CLP

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum			42.8	B							P
Antimony			18.7	U							P
Arsenic			1.0	U	1.0	U					F
Barium			3.0	B							P
Beryllium			0.7	U							P
Boron			35.8	B							P
Cadmium			2.2	U							P
Calcium			32.6	B							P
Chromium			3.9	U							P
Cobalt			3.6	U							P
Copper			1.1	U							P
Iron			29.5	B							P
Lead			1.0	U	1.0	U	1.0	U			F
Magnesium			12.0	B							P
Manganese			0.8	U							P
Mercury											
Molybdenum			4.4	U							P
Nickel			15.1	U							P
Potassium			1385.3	B							P
Selenium											
Silver			1.8	U							P
Sodium			97.7	B							P
Thallium			1.0	U							F
Vanadium			2.5	U							P
Zinc			2.0	U							P

FORM III - IN

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											
Antimony											
Arsenic	1.0	U	1.0	U	1.0	U					F
Barium											
Beryllium											
Boron											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Molybdenum											
Nickel											
Potassium											
Selenium	1.0	U	1.0	U	1.0	U	1.0	U			F
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											

ENVIROFORMS/INORGANIC CLP

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Boron											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Molybdenum											
Nickel											
Potassium											
Selenium			1.3	B	1.0	U	1.0	U			F
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											

FORM III - IN

3
BLANKS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Boron											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Molybdenum											
Nickel											
Potassium											
Selenium			1.0	U	1.0	U	1.0	U			F
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											

ENVIROFORMS/INORGANIC CLP

4

ICP INTERFERENCE CHECK SAMPLE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 ICS Source: INOR-VNT

Concentration Units: ug/L

Analyte	True Sol. A	True Sol. AB	Initial Found Sol. A	Initial Found Sol. AB	%R	Final Found Sol. A	Final Found Sol. AB	%R
Aluminum	500000	500000	497997	505723.9	101.1	498700	502253.8	100.5
Antimony		1000	18	1006.2	100.6	40	1046.2	104.6
Arsenic								
Barium		500	8	500.0	100.0	9	505.3	101.1
Beryllium		500	0	468.2	93.6	0	489.4	97.9
Boron			192	195.0		202	207.4	
Cadmium		1000	15	972.6	97.3	8	1068.5	106.8
Calcium	500000	500000	476281	483515.3	96.7	508561	528141.2	105.6
Chromium		500	-5	454.6	90.9	-2	491.6	98.3
Cobalt		500	2	443.1	88.6	2	462.5	92.5
Copper		500	3	491.9	98.4	5	488.8	97.8
Iron	200000	200000	175272	177852.4	88.9	182060	186556.0	93.3
Lead								
Magnesium	500000	500000	482835	490774.1	98.2	505286	511069.4	102.2
Manganese		500	10	459.8	92.0	16	489.5	97.9
Mercury								
Molybdenum			-7	-10.0		-5	-4.8	
Nickel		1000	-25	907.0	90.7	-19	979.8	98.0
Potassium			-539	-703.2		121	1140.7	
Selenium								
Silver		1000	0	957.5	95.8	4	1007.9	100.8
Sodium			43	145.7		61	187.4	
Thallium								
Vanadium		500	9	462.8	92.6	12	484.3	96.9
Zinc		1000	3	946.1	94.6	3	1039.1	103.9

4

ICP INTERFERENCE CHECK SAMPLE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 ICS Source: INOR-VNT

Concentration Units: ug/L

Analyte	True Sol. A	True Sol. AB	Initial Found Sol. A	Initial Found Sol. AB	Initial Found %R	Final Found Sol. A	Final Found Sol. AB	Final Found %R
Aluminum	500000	500000				488636	496473.0	99.3
Antimony		1000				40	996.0	99.6
Arsenic								
Barium		500				11	484.2	96.8
Beryllium		500				0	469.5	93.9
Boron						200	198.0	
Cadmium		1000				16	942.0	94.2
Calcium	500000	500000				468560	474652.6	94.9
Chromium		500				-4	439.1	87.8
Cobalt		500				1	441.3	88.3
Copper		500				-1	485.4	97.1
Iron	200000	200000				173873	176146.7	88.1
Lead								
Magnesium	500000	500000				478008	485706.4	97.1
Manganese		500				12	461.8	92.4
Mercury								
Molybdenum						-6	-2.9	
Nickel		1000				-21	882.6	88.3
Potassium						1109	959.4	
Selenium								
Silver		1000				1	935.4	93.5
Sodium						128	231.5	
Thallium								
Vanadium		500				10	461.3	92.3
Zinc		1000				2	932.9	93.3

ENVIROFORMS/INORGANIC CLP

5A
SPIKE SAMPLE RECOVERY

SAMPLE NO.

T76202S

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Level (low/med): LOW
% Solids for Sample: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Aluminum		261443.0500		252583.2500		2000.00	443.0		P
Antimony	75-125	515.8000		18.7000	U	500.00	103.2		P
Arsenic		9480.0000		10760.0000		40.00	-3200.0		F
Barium	75-125	2111.2200		14.6000	B	2000.00	104.8		P
Beryllium	75-125	63.8200		10.5100		50.00	106.6		P
Boron	75-125	1390.3000		392.8400		1000.00	99.7		P
Cadmium	75-125	73.1900		26.4300		50.00	93.5		P
Calcium									NR
Chromium		1185.9000		955.8800		200.00	115.0		P
Cobalt	75-125	2272.1100		1742.7700		500.00	105.9		P
Copper		1426.5800		1143.2900		250.00	113.3		P
Iron		743058.9000		728790.2000		1000.00	1426.9		P
Lead	75-125	22.8000		7.0000		20.00	79.0		F
Magnesium									NR
Manganese		9736.2800		8965.8700		500.00	154.1		P
Mercury	75-125	1.0300		0.1000	U	1.00	103.0		CV
Molybdenum	75-125	919.2100		4.4000	U	1000.00	91.9		P
Nickel		5379.3900		4692.1400		500.00	137.4		P
Potassium									NR
Selenium	75-125	5.0000	U	5.0000	U	10.00	0.0	N	F
Silver	75-125	53.5000		5.9800	B	50.00	95.0		P
Sodium									NR
Thallium		522.0000		470.0000		50.00	104.0		F
Vanadium	75-125	965.2800		458.0900		500.00	101.4		P
Zinc	75-125	1357.1300		835.1000		500.00	104.4		P

Comments:

ENVIROFORMS/INORGANIC CLP

5B
POST DIGEST SPIKE SAMPLE RECOVERY

SAMPLE NO.

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): Level (low/med):

Concentration Units: ug/L

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)		Spike Added (SA)	%R	Q	M
Aluminum									NR
Antimony									NR
Arsenic									NR
Barium									NR
Beryllium									NR
Boron									NR
Cadmium									NR
Calcium									NR
Chromium									NR
Cobalt									NR
Copper									NR
Iron									NR
Lead									NR
Magnesium									NR
Manganese									NR
Mercury									NR
Molybdenum									NR
Nickel									NR
Potassium									NR
Selenium									NR
Silver									NR
Sodium									NR
Thallium									NR
Vanadium									NR
Zinc									NR

Comments:

ENVIROFORMS/INORGANIC CLP

6
DUPLICATES

SAMPLE NO.

T76202D

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Level (low/med): LOW

% Solids for Sample: 0.0 % Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum		252583.2500		257179.8000		1.8		P
Antimony		18.7000	U	23.8700	B	200.0		P
Arsenic	10.0	10760.0000		10800.0000		0.4	*	F
Barium		14.6000	B	14.6000	B	0.0		P
Beryllium	5.0	10.5100		10.8500		3.2		P
Boron		392.8400		404.4800		2.9		P
Cadmium	5.0	26.4300		22.4900		16.1		P
Calcium		145973.1900		148834.3600		1.9		P
Chromium		955.8800		975.2800		2.0		P
Cobalt		1742.7700		1770.2700		1.6		P
Copper		1143.2900		1163.5800		1.8		P
Iron		728790.2000		722772.3000		0.8		P
Lead	3.0	7.0000		7.2000		2.8		F
Magnesium		45207.5500		46088.3100		1.9		P
Manganese		8965.8700		9138.0000		1.9		P
Mercury		0.1000	U	0.1000	U			CV
Molybdenum		4.4000	U	4.4000	U			P
Nickel		4692.1400		4821.3700		2.7		P
Potassium	5000.0	15286.3500		15438.7000		1.0		P
Selenium		5.0000	U	5.0000	U			F
Silver		5.9800	B	5.5800	B	6.9		P
Sodium		25136.5800		25647.3600		2.0		P
Thallium	10.0	470.0000		468.0000		0.4		F
Vanadium		458.0900		464.6500		1.4		P
Zinc		835.1000		851.1600		1.9		P

FORM VI - IN

ENVIROFORMS/INORGANIC CLP

7

LABORATORY CONTROL SAMPLE

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Solid LCS Source:

Aqueous LCS Source: INOR-VNT-ICV

Analyte	Aqueous (ug/L) True	Found	%R	Solid (mg/kg) True	Found	C	Limits		%R
Aluminum	5000.0	5222.43	104.4						
Antimony	2500.0	2539.85	101.6						
Arsenic	25.0	28.30	113.2						
Barium	5000.0	5412.35	108.2						
Beryllium	125.0	128.54	102.8						
Boron	1000.0	1009.60	101.0						
Cadmium	1250.0	1291.19	103.3						
Calcium	12500.0	12933.02	103.5						
Chromium	500.0	523.87	104.8						
Cobalt	1250.0	1270.70	101.7						
Copper	625.0	645.81	103.3						
Iron	2500.0	2588.37	103.5						
Lead	25.0	27.50	110.0						
Magnesium	12500.0	13081.91	104.7						
Manganese	1250.0	1290.76	103.3						
Mercury	5.0	5.39	107.8						
Molybdenum	1000.0	980.22	98.0						
Nickel	1250.0	1351.95	108.2						
Potassium	12500.0	12868.19	102.9						
Selenium	25.0	24.90	99.6						
Silver	625.0	641.69	102.7						
Sodium	12500.0	13098.36	104.8						
Thallium	25.0	26.80	107.2						
Vanadium	1250.0	1275.87	102.1						
Zinc	1250.0	1309.28	104.7						

FORM VII - IN

ENVIROFORMS/INORGANIC CLP

8

STANDARD ADDITION RESULTS

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Concentration Units: ug/L

EPA Sample No.	An	0 ADD ABS	1 ADD CON	1 ADD ABS	2 ADD CON	2 ADD ABS	3 ADD CON	3 ADD ABS	Final Conc.	r	Q
T76203	PB	0.022	10.00	0.046	20.00	0.067	30.00	0.088	10.5	0.9994	
T76210	SE	0.019	10.00	0.041	20.00	0.063	30.00	0.092	7.3	0.9975	
T76211	SE	0.056	10.00	0.080	20.00	0.098	30.00	0.122	26.2	0.9985	

FORM VIII - IN

ENVIROFORMS/INORGANIC CLP

9

ICP SERIAL DILUTIONS

SAMPLE NO.

T76214L

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Matrix (soil/water): WATER Level (low/med): LOW

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Aluminum	10322.67		10362.35		0.4		P
Antimony	18.70	U	93.50	U			P
Arsenic					0.0		
Barium	38.90	B	55.60	B	42.9	E	P
Beryllium	1.53	B	3.50	U	100.0		P
Boron	98.45		155.05	B	57.5		P
Cadmium	2.20	U	11.00	U			P
Calcium	135032.95		132228.65		2.1		P
Chromium	3.90	U	19.50	U			P
Cobalt	237.43		256.15		7.9		P
Copper	6.58	B	7.70	B	17.0		P
Iron	51091.35		51623.30		1.0		P
Lead							
Magnesium	32171.06		32671.40		1.6		P
Manganese	5733.73		5770.70		0.6		P
Mercury							
Molybdenum	4.40	U	22.00	U			P
Nickel	510.70		506.15		0.9		P
Potassium	6024.81		14419.35	B	139.3		P
Selenium							
Silver	1.80	U	9.00	U			P
Sodium	13390.90		13880.10	B	3.7		P
Thallium					0.0		
Vanadium	8.80	B	12.50	U	100.0		P
Zinc	96.28		91.05	B	5.4		P

FORM IX - IN

ENVIROFORMS/INORGANIC CLP

10

INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 Date: 08/01/98

Flame AA ID Number:

Furnace AA ID Number:

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum	308.20		200.0	13.5	P
Antimony	206.80		60.0	18.7	P
Arsenic	193.60		10.0		
Barium	493.60		200.0	0.2	P
Beryllium	313.00		5.0	0.7	P
Cadmium	228.80		5.0	2.2	P
Calcium	317.90		5000.0	7.7	P
Chromium	267.70		10.0	3.9	P
Cobalt	228.60		50.0	3.6	P
Copper	324.70		25.0	1.1	P
Cyanide			10.0		
Iron	259.90		100.0	2.9	P
Lead	220.30		3.0	29.0	P
Magnesium	383.20		5000.0	5.6	P
Manganese	257.60		15.0	0.8	P
Mercury			0.2		
Nickel	231.60		40.0	15.1	P
Potassium	766.50		5000.0	378.4	P
Selenium	196.00		5.0		
Silver	328.00		10.0	1.8	P
Sodium	588.90		5000.0	9.4	P
Thallium			10.0		
Vanadium	292.40		50.0	2.5	P
Zinc	213.80		20.0	2.0	P
Boron	249.60		50.0	15.6	P
Molybdenum	202.00		10.0	4.4	P

Comments:

ENVIROFORMS/INORGANIC CLP

10

INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: Date: 08/01/98

Flame AA ID Number:

Furnace AA ID Number: VARIAN-2

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum			200.0		
Antimony			60.0		
Arsenic			10.0		
Barium			200.0		
Beryllium			5.0		
Cadmium			5.0		
Calcium			5000.0		
Chromium			10.0		
Cobalt			50.0		
Copper			25.0		
Cyanide			10.0		
Iron			100.0		
Lead	283.30	BZ	3.0	1.0	F
Magnesium			5000.0		
Manganese			15.0		
Mercury			0.2		
Nickel			40.0		
Potassium			5000.0		
Selenium			5.0		
Silver			10.0		
Sodium			5000.0		
Thallium	276.80	BZ	10.0	1.0	F
Vanadium			50.0		
Zinc			20.0		

Comments:

ENVIROFORMS/INORGANIC CLP

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INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: Date: 08/01/98

Flame AA ID Number: VARIAN-3

Furnace AA ID Number:

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum			200.0		
Antimony			60.0		
Arsenic			10.0		
Barium			200.0		
Beryllium			5.0		
Cadmium			5.0		
Calcium			5000.0		
Chromium			10.0		
Cobalt			50.0		
Copper			25.0		
Cyanide			10.0		
Iron			100.0		
Lead			3.0		
Magnesium			5000.0		
Manganese			15.0		
Mercury	253.70	BD	0.2	0.1	CV
Nickel			40.0		
Potassium			5000.0		
Selenium			5.0		
Silver			10.0		
Sodium			5000.0		
Thallium			10.0		
Vanadium			50.0		
Zinc			20.0		

Comments:

ENVIROFORMS/INORGANIC CLP

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INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: Date: 08/01/98

Flame AA ID Number:

Furnace AA ID Number: VARIAN-4

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum			200.0		
Antimony			60.0		
Arsenic			10.0		
Barium			200.0		
Beryllium			5.0		
Cadmium			5.0		
Calcium			5000.0		
Chromium			10.0		
Cobalt			50.0		
Copper			25.0		
Cyanide			10.0		
Iron			100.0		
Lead			3.0		
Magnesium			5000.0		
Manganese			15.0		
Mercury			0.2		
Nickel			40.0		
Potassium			5000.0		
Selenium	196.00	BZ	5.0	1.0	F
Silver			10.0		
Sodium			5000.0		
Thallium			10.0		
Vanadium			50.0		
Zinc			20.0		

Comments:

ENVIROFORMS/INORGANIC CLP

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INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: Date: 08/01/98

Flame AA ID Number:

Furnace AA ID Number: VARIAN-5

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Aluminum			200.0		
Antimony			60.0		
Arsenic	193.70	BZ	10.0	1.0	F
Barium			200.0		
Beryllium			5.0		
Cadmium			5.0		
Calcium			5000.0		
Chromium			10.0		
Cobalt			50.0		
Copper			25.0		
Cyanide			10.0		
Iron			100.0		
Lead			3.0		
Magnesium			5000.0		
Manganese			15.0		
Mercury			0.2		
Nickel			40.0		
Potassium			5000.0		
Selenium			5.0		
Silver			10.0		
Sodium			5000.0		
Thallium			10.0		
Vanadium			50.0		
Zinc			20.0		

Comments:

ENVIROFORMS/INORGANIC CLP

11A

ICP INTERELEMENT CORRECTION FACTORS (Annually)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 Date: 08/24/98

Analyte	Wave-length (nm)	Interelement Correction Factors for: Al	Ca	Fe	Mg	AS
Aluminum	308.20	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Antimony	206.80	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Arsenic	193.60	0.0079000	0.0000000	0.0007540	0.0000000	0.0000000
Barium	493.40	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.00	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	228.60	0.0000000	0.0000000	-0.0000540	0.0000000	0.0111000
Calcium	317.90	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.70	0.0000000	0.0000000	-0.0000158	0.0000000	0.0000000
Cobalt	228.60	-0.0000150	0.0000000	0.0000166	0.0000000	0.0000000
Copper	324.70	0.0000000	0.0000000	-0.0000578	0.0000000	0.0000000
Iron	259.90	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Lead	220.30	0.0008100	0.0000000	0.0002360	0.0000000	0.0000000
Magnesium	383.20	0.0000000	0.0000000	0.0284000	0.0000000	0.0000000
Manganese	257.60	0.0000000	0.0000000	-0.0001990	0.0000000	0.0000000
Mercury						
Nickel	231.60	0.0000000	0.0000000	0.0000384	0.0000000	0.0000000
Potassium	766.50	0.0000000	0.0000000	0.0000000	-0.0000000	0.0000000
Selenium	196.00	0.0002900	0.0000000	-0.0022000	0.0000000	0.0000000
Silver	328.00	0.0000000	0.0000000	-0.0001800	0.0000000	0.0000000
Sodium	588.90	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	190.80	0.0000000	0.0000000	0.0038400	0.0000000	0.0000000
Vanadium	292.40	0.0000000	0.0000000	-0.0000150	0.0000000	0.0000000
Zinc	213.80	0.0000000	0.0000000	0.0001240	0.0000000	0.0000000

Comments:

ENVIROFORMS/INORGANIC CLP

11B
ICP INTERELEMENT CORRECTION FACTORS (Annually)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 Date: 08/24/98

Analyte	Wave-length (nm)	Interelement Correction Factors for: CR	CO	TI	MN	V
Aluminum	308.20	0.0000000	-0.0166000	0.0000000	0.0000000	0.0000000
Antimony	206.80	0.0084200	-0.0023200	0.0015800	0.0000000	-0.0083500
Arsenic	193.60	0.0012500	0.0007400	0.0000000	-0.0009020	0.0188000
Barium	493.40	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.00	0.0000000	0.0000000	0.0000420	0.0000000	0.0042500
Cadmium	228.80	0.0000000	-0.0065100	0.0000000	0.0000000	0.0001070
Calcium	317.90	0.0000000	0.0000000	0.0000000	0.0000000	0.0010600
Chromium	267.70	0.0000000	0.0000000	0.0001280	0.0000000	0.0009890
Cobalt	228.80	0.0003600	0.0000000	0.0017000	0.0000000	0.0000000
Copper	324.70	0.0000000	0.0000000	-0.0004020	0.0000000	-0.0000960
Iron	259.90	0.0000000	0.0000000	0.0000000	0.0016600	0.0005780
Lead	220.30	-0.0006150	-0.0211000	0.0007240	0.0000000	0.0000000
Magnesium	383.20	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.60	0.0000480	0.0000000	0.0000000	0.0000000	-0.0000930
Mercury						
Nickel	231.60	0.0000000	0.0004700	0.0000000	0.0000000	0.0000000
Potassium	766.50	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.00	0.0000000	0.0012700	0.0000000	0.0000000	0.0000000
Silver	328.00	0.0000000	0.0000000	0.0000000	0.0001630	-0.0051700
Sodium	588.90	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	292.40	0.0000000	0.0000000	0.0000000	-0.0136000	0.0000000
Vanadium	292.40	-0.0025100	0.0000000	0.0003060	-0.0001070	0.0000000
Zinc	213.80	0.0000000	0.0000000	-0.0000600	0.0000000	0.0000000

Comments:

ENVIROFORMS/INORGANIC CLP

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ICP LINEAR RANGES (QUARTERLY)

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

ICP ID Number: TJA-1 Date: 08/01/98

Analyte	Integ. Time (Sec.)	Concentration (ug/L)	M
Aluminum	5.00	1000000.0	P
Antimony	5.00	100000.0	P
Arsenic	5.00	100000.0	P
Barium	5.00	200000.0	P
Beryllium	5.00	20000.0	P
Cadmium	5.00	100000.0	P
Calcium	5.00	1000000.0	P
Chromium	5.00	200000.0	P
Cobalt	5.00	100000.0	P
Copper	5.00	100000.0	P
Iron	5.00	400000.0	P
Lead	5.00	200000.0	P
Magnesium	5.00	800000.0	P
Manganese	5.00	200000.0	P
Mercury			
Nickel	5.00	200000.0	P
Potassium	5.00	500000.0	P
Selenium	5.00	100000.0	P
Silver	5.00	5000.0	P
Sodium	5.00	500000.0	P
Thallium			
Vanadium	5.00	100000.0	P
Vanadium	5.00	200000.0	P

Comments:

ENVIROFORMS/INORGANIC CLP

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Preparation Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Method: CV

Sample No.	Preparation Date	Weight (gram)	Volume (ml)
ICV	10/19/98		100
LCSW	10/19/98		100
PBW	10/19/98		100
S0	10/19/98		100
S0.2	10/19/98		100
S0.5	10/19/98		100
S1	10/19/98		100
S10	10/19/98		100
S5	10/19/98		100
T76201	10/19/98		100
T76202	10/19/98		100
T76202D	10/19/98		100
T76202S	10/19/98		100
T76203	10/19/98		100
T76204	10/19/98		100
T76205	10/19/98		100
T76206	10/19/98		100
T76207	10/19/98		100
T76208	10/19/98		100
T76209	10/19/98		100
T76210	10/19/98		100
T76211	10/19/98		100
T76212	10/19/98		100
T76213	10/19/98		100
T76214	10/19/98		100
T76215	10/19/98		100
T76216	10/19/98		100
T76217	10/19/98		100

FORM XIII - IN

ENVIROFORMS/INORGANIC CLP

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Preparation Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Method: F

Sample No.	Preparation Date	Weight (gram)	Volume (ml)
LCSW	10/22/98		50
PBW	10/22/98		50
T76201	10/22/98		50
T76202	10/22/98		50
T76202D	10/22/98		50
T76202S	10/22/98		50
T76203	10/22/98		50
T76204	10/22/98		50
T76205	10/22/98		50
T76206	10/22/98		50
T76207	10/22/98		50
T76208	10/22/98		50
T76209	10/22/98		50
T76210	10/22/98		50
T76211	10/22/98		50
T76212	10/22/98		50
T76213	10/22/98		50
T76214	10/22/98		50
T76215	10/22/98		50
T76216	10/22/98		50
T76217	10/22/98		50

FORM XIII - IN

ENVIROFORMS/INORGANIC CLP

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Preparation Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762

Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201

Method: P

Sample No.	Preparation Date	Weight (gram)	Volume (ml)
LCSW	10/22/98		50
PBW	10/22/98		50
T76201	10/22/98		50
T76202	10/22/98		50
T76202D	10/22/98		50
T76202S	10/22/98		50
T76203	10/22/98		50
T76204	10/22/98		50
T76205	10/22/98		50
T76206	10/22/98		50
T76207	10/22/98		50
T76208	10/22/98		50
T76209	10/22/98		50
T76210	10/22/98		50
T76211	10/22/98		50
T76212	10/22/98		50
T76213	10/22/98		50
T76214	10/22/98		50
T76215	10/22/98		50
T76216	10/22/98		50
T76217	10/22/98		50

FORM XIII - IN

ENVIROFORMS/INORGANIC CLP

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: TJA-1 Method: P
Start Date: 10/27/98 End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	B_	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	MO
S0	1.00	0937		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
S	1.00	0939		_	X	_	X	_	X	_	X	X	_	_	_	_	_	_	X	X	_	X	X	_	_	_	_
S	1.00	0941		_	_	X	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
S	1.00	0944		X	_	_	_	X	_	X	_	X	X	X	_	X	X	_	_	_	_	_	_	_	X	X	X
ICV	1.00	0948		X	X	_	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
ICV	1.00	0951				X																					
ICB	1.00	0953		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV11	1.00	0956		X	X	_	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV11	1.00	1001				X																					
CCB11	1.00	1004		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CRII	1.00	1006		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
ICSAI	1.00	1008		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
ICSABI	1.00	1010		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV12	1.00	1012		X	X	_	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV12	1.00	1014				X																					
CCB12	1.00	1016		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	_
PBW	1.00	1022		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
LCSW	1.00	1024		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
T76201	1.00	1028		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
T76202	1.00	1030		X	X	X	X	X	X	X	X	X	X	_	_	X	X	_	X	X	_	X	X	_	X	X	X
T76202D	1.00	1033		X	X	X	X	X	X	X	X	X	X	_	_	X	X	_	X	X	_	X	X	_	X	X	X
T76202S	1.00	1035		X	X	X	X	X	X	_	X	X	X	_	_	_	X	_	X	_	_	X	_	_	X	X	X
T76202	10.00	1039		_	_	_	_	_	_	_	_	_	_	X	_	_	_	_	_	_	_	_	_	_	_	_	_
T76202D	10.00	1041		_	_	_	_	_	_	_	_	_	_	X	_	_	_	_	_	_	_	_	_	_	_	_	_
T76202S	10.00	1043												X													
T76203	1.00	1045		X	X	X	X	X	X	X	X	X	X	_	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV13	1.00	1047		X	X	_	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
CCV13	1.00	1050				X																					
CCB13	1.00	1052		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
T76203	10.00	1054												X													
T76204	1.00	1056		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X
T76205	1.00	1104		X	X	X	X	X	X	X	X	X	X	X	_	X	X	_	X	X	_	X	X	_	X	X	X

FORM XIV - IN

ENVIROFORMS/INORGANIC CLP

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: TJA-1 Method: P
Start Date: 10/27/98 End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	B	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	MO
T76206	1.00	1107		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76207	1.00	1109		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76208	1.00	1114		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76209	1.00	1117		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CRIF1	1.00	1129		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
ICSAF1	1.00	1131		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
ICSABF1	1.00	1133		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV14	1.00	1137		X	X		X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV14	1.00	1140				X																					
CCB14	1.00	1142		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV15	1.00	1148		X	X		X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV15	1.00	1149				X																					
CCB15	1.00	1152		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
6210	1.00	1154		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
6211	1.00	1157		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76212	1.00	1159		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76213	1.00	1201		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76214	1.00	1203		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76215	1.00	1205		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76216	1.00	1207																									
T76216	2.00	1209		X	X	X	X	X	X	X	X	X	X			X	X		X	X		X	X		X	X	X
T76216	10.00	1211												X													
T76217	1.00	1216		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV16	1.00	1218		X	X		X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV16	1.00	1220				X																					
CCB16	1.00	1222		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
T76214L	5.00	1226		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
ZZZZZZ	1.00	1228																									
ZZZZZZ	1.00	1230																									
CRIF2	1.00	1234		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
ICSAF2	1.00	1236		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
ICSABF2	1.00	1238		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X

FORM XIV - IN

ENVIROFORMS/INORGANIC CLP

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: TJA-1 Method: P
Start Date: 10/27/98 End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	B	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	MO
CCV17	1.00	1240		X	X		X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X
CCV17	1.00	1242				X																					
CCB17	1.00	1244		X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X	X	X

FORM XIV - IN

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-5 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	0704				X																					
S10	1.00	0708				X																					
S20	1.00	0712				X																					
S40	1.00	0716				X																					
S60	1.00	0720				X																					
ICV	1.00	0724				X																					
ICB	1.00	0728				X																					
CCV11	1.00	0732				X																					
CCB11	1.00	0736				X																					
CRA	1.00	0740				X																					
PBW	1.00	0744				X																					
PBWA	1.00	0748	102.5			X																					
LCSW	1.00	0752				X																					
LCSWA	1.00	0756	104.0			X																					
CCV12	1.00	0800				X																					
CCB12	1.00	0804				X																					
T76201	1.00	0808																									
T76201A	1.00	0812	0.0																								
T76202	400.00	0816				X																					
T76202A	400.00	0820	105.0			X																					
T76202D	400.00	0824				X																					
T76202DA	400.00	0828	100.0			X																					
T76202S	400.00	0832				X																					
T76203	400.00	0836				X																					
T76203A	400.00	0840	98.5			X																					
CCV13	1.00	0844				X																					
CCB13	1.00	0848				X																					
T76204	5.00	0852				X																					
T76204A	5.00	0856	101.5			X																					
T76205	1.00	0900				X																					
T76205A	1.00	0904	100.0			X																					
T76206	1.00	0908				X																					

FORM XIV - IN

ENVIROFORMS/INORGANIC CLP

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-5 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
T76206A	1.00	0912	95.0			X																					
T76207	20.00	0916				X																					
T76207A	20.00	0920	102.5			X																					
T76208	10.00	0924				X																					
T76208A	10.00	0928	106.5			X																					
CCV14	1.00	0932				X																					
CCB14	1.00	0936				X																					
T76209	2.00	0940				X																					
T76209A	2.00	0944	99.5			X																					
T76210	1.00	0948				X																					
T76210A	1.00	0952	99.5			X																					
T76211	1.00	0956				X																					
T76211A	1.00	1000	97.0			X																					
6212	1.00	1004				X																					
6212A	1.00	1008	101.0			X																					
CCV15	1.00	1012				X																					
CCB15	1.00	1016				X																					
ZZZZZZ	1.00	1020																									
ZZZZZZ	1.00	1024																									
CCV16	1.00	1028				X																					
CCB16	1.00	1032				X																					
T76213	1.00	1036				X																					
T76213A	1.00	1040	107.0			X																					
T76214	1.00	1044																									
T76214A	1.00	1048	-229.5																								
T76215	1.00	1052				X																					
T76215A	1.00	1056	107.5			X																					
T76216	1000.00	1100																									
T76216A	1000.00	1104	-304.0																								
T76217	1.00	1108				X																					
T76217A	1.00	1112	100.0			X																					
CCV17	1.00	1116				X																					

FORM XIV - IN

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-5 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
CCB17	1.00	1120		–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
ZZZZZZ	1.00	1124		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76214	2.00	1128		–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76214A	2.00	1132	99.5	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76216	4000.00	1136		–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76216A	4000.00	1140	97.0	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CCV18	1.00	1144		–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CCB18	1.00	1148		–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

FORM XIV - IN

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-5 Method: F
Start Date: 10/28/98 End Date: 10/28/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1804				X																					
S10	1.00	1808				X																					
S20	1.00	1812				X																					
S40	1.00	1816				X																					
S50	1.00	1820				X																					
ICV2	1.00	1824				X																					
ICB2	1.00	1828				X																					
CCV21	1.00	1832				X																					
CCB21	1.00	1836				X																					
CRA2	1.00	1840				X																					
T76201	4.00	1844				X																					
T76201A	4.00	1848	102.5			X																					
ZZZZZZ	1.00	1852																									
ZZZZZZ	1.00	1856																									
ZZZZZZ	1.00	1900																									
ZZZZZZ	1.00	1904																									
ZZZZZZ	1.00	1908																									
ZZZZZZ	1.00	1912																									
ZZZZZZ	1.00	1916																									
CCV22	1.00	1920				X																					
CCB22	1.00	1924				X																					

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-2 Method: F
Start Date: 10/27/98 End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	0104		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S3	1.00	0108		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S0	1.00	0112		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
S3	1.00	0116		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
S30	1.00	0120		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
S40	1.00	0124		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
S50	1.00	0128		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
ICV	1.00	0132		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
ICB	1.00	0136		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CCV11	1.00	0140		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CCB11	1.00	0144		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CRA	1.00	0148		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
PBW	1.00	0152		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
SWA	1.00	0156	109.5	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
SW	1.00	0200		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
LCSWA	1.00	0204	103.5	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76201	1.00	0208		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76201A	1.00	0212	89.5	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76202	1.00	0216		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76202A	1.00	0220	81.0	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CCV12	1.00	0224		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CCB12	1.00	0228		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76202D	1.00	0232		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76202DA	1.00	0236	80.5	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76202S	1.00	0240		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76203	1.00	0244		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76203A	1.00	0248	80.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T76204	1.00	0252		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76204A	1.00	0256	94.5	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76205	1.00	0300		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
T76205A	1.00	0304	96.0	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
CCV13	1.00	0308		–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-2 Method: F
Start Date: 10/27/98 End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
CCB13	1.00	0312		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76206	1.00	0316		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76206A	1.00	0320	90.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76207	1.00	0324		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76207A	1.00	0328	90.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76208	1.00	0332		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76208A	1.00	0336	95.5	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76209	1.00	0340		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76209A	1.00	0344	99.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76210	1.00	0348		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76210A	1.00	0352	96.5	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
CCV14	1.00	0356		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
CCB14	1.00	0400		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
[illegible]6211	1.00	0404		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
[illegible]6211A	1.00	0408	95.5	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76212	1.00	0412		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76212A	1.00	0416	104.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
CCV15	1.00	0420		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
CCB15	1.00	0424		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
ZZZZZZ	1.00	0428		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZZZZZZ	1.00	0432		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZZZZZZ	1.00	0436		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCV16	1.00	0440		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
CCB16	1.00	0444		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76213	1.00	0448		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76213A	1.00	0452	104.5	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76214	1.00	0456		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76214A	1.00	0500	105.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76215	1.00	0504		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76215A	1.00	0508	105.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76216	1.00	0512		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
T76216A	1.00	0516	100.0	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-

FORM XIV - IN

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS
Lab Code: COLUMB Case No.:
Instrument ID Number: VARIAN-2
Start Date: 10/27/98

Contract: K9806762
SAS No.: SDG No.: T76201
Method: F
End Date: 10/27/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
T76217	1.00	0520													X												
T76217A	1.00	0524	110.5												X												
CCV17	1.00	0528													X												
CCB17	1.00	0532													X												
ZZZZZZ	1.00	0534																									
ZZZZZZ	1.00	0536																									
CCV18	1.00	0538													X												
CCB18	1.00	0540													X												
T762030	1.00	0542													X												
T762031	1.00	0544													X												
T762032	1.00	0546													X												
T762033	1.00	0548													X												
CCV19	1.00	0550													X												
CCB19	1.00	0552													X												

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-4 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	0804																									
S5	1.00	0808																									
S0	1.00	0812																									
S0	1.00	0816																			X						
S5	1.00	0820																			X						
S30	1.00	0824																			X						
S40	1.00	0828																			X						
S50	1.00	0832																			X						
ICV	1.00	0836																			X						
ICB	1.00	0840																			X						
CCV11	1.00	0844																			X						
CCB11	1.00	0848																			X						
ZZZZZZ	1.00	0852																									
[illegible]A	1.00	0856																			X						
[illegible]W	1.00	0900																			X						
PBWA	1.00	0904	102.0																		X						
LCSW	1.00	0908																			X						
LCSWA	1.00	0912	100.0																		X						
CCV12	1.00	0916																			X						
CCB12	1.00	0920																			X						
ZZZZZZ	1.00	0924																									
ZZZZZZ	1.00	0928																									
CCV13	1.00	0932																			X						
CCB13	1.00	0936																			X						
ZZZZZZ	1.00	0940																									
T76201	1.00	0944																									
T76201A	1.00	0948	11.0																								
T76202	1.00	0952																									
T76202A	1.00	0956	38.0																								
T76202D	1.00	1000																									
T76202DA	1.00	1004	37.0																								
T76202S	1.00	1008																									

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS
Lab Code: COLUMB Case No.:
Instrument ID Number: VARIAN-4
Start Date: 10/26/98

Contract: K9806762
SAS No.: SDG No.: T76201
Method: F
End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
T76203	1.00	1012																			X						
T76203A	1.00	1016	42.0																		X						
CCV14	1.00	1020																			X						
CCB14	1.00	1024																			X						

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-4 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1112																			X						
S5	1.00	1116																			X						
S30	1.00	1120																			X						
S40	1.00	1124																			X						
S50	1.00	1128																			X						
ICV2	1.00	1132																			X						
ICB2	1.00	1136																			X						
CCV21	1.00	1140																			X						
CCB21	1.00	1144																			X						
CRA2	1.00	1148																			X						
T76204	1.00	1152																			X						
T76204A	1.00	1156	61.0																		X						
T76205	1.00	1200																			X						
T76205A	1.00	1204	92.0																		X						
T76206	1.00	1208																			X						
T76206A	1.00	1212	54.0																		X						
T76207	1.00	1216																			X						
T76207A	1.00	1220	48.0																		X						
CCV22	1.00	1224																			X						
CCB22	1.00	1228																			X						
T76208	1.00	1232																			X						
T76208A	1.00	1236	62.0																		X						
T76209	1.00	1240																			X						
T76209A	1.00	1244	84.0																		X						
T76210	1.00	1248																									
T76210A	1.00	1252	84.0																								
T76211	1.00	1256																									
T76211A	1.00	1300	134.0																								
T76212	1.00	1304																			X						
T76212A	1.00	1308	75.0																		X						
CCV23	1.00	1312																			X						
CCB23	1.00	1316																			X						

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-4 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
T76213	1.00	1320		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76213A	1.00	1324	68.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76214	1.00	1328		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76214A	1.00	1332	83.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76215	1.00	1336		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76215A	1.00	1340	67.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76216	1.00	1344		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T76216A	1.00	1348	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T76217	1.00	1352		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76217A	1.00	1356	73.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
CCV24	1.00	1400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
CCB24	1.00	1404		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
ZZZZZZ	1.00	1408		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZZZZ	1.00	1412		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V25	1.00	1416		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
CCB25	1.00	1420		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76201	5.00	1424		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76201A	5.00	1428	74.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76202	5.00	1432		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76202A	5.00	1436	64.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76202D	5.00	1440		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76202DA	5.00	1444	62.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76202S	5.00	1448		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76216	5.00	1452		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T76216A	5.00	1456	32.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCV26	1.00	1500		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
CCB26	1.00	1504		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76216	25.00	1508		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T76216A	25.00	1512	65.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
ZZZZZZ	1.00	1516		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T76211	2.00	1520		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T76211A	2.00	1524	80.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

FORM XIV - IN

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS
Lab Code: COLUMB Case No.:
Instrument ID Number: VARIAN-4
Start Date: 10/26/98

Contract: K9806762
SAS No.: SDG No.: T76201
Method: F
End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
CCV27	1.00	1528																			X						
CCB27	1.00	1532																			X						
ZZZZZZ	1.00	1534																									
ZZZZZZ	1.00	1536																									
CCV28	1.00	1538																			X						
CCB28	1.00	1540																			X						
T762100	1.00	1542																			X						
T762101	1.00	1544																			X						
T762102	1.00	1546																			X						
T762103	1.00	1548																			X						
T762110	1.00	1550																			X						
T762111	1.00	1552																			X						
T762112	1.00	1554																			X						
62113	1.00	1556																			X						
V29	1.00	1558																			X						
CCB29	1.00	1600																			X						

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-2 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1004		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
S10	1.00	1008		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
S20	1.00	1012		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
S40	1.00	1016		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
S60	1.00	1020		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
ICV	1.00	1024		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
ICB	1.00	1028		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CCV11	1.00	1032		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CCB11	1.00	1036		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CRA	1.00	1040		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
PBW	1.00	1044		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
PBWA	1.00	1048	109.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
LCSW	1.00	1052		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
[illegible]WA	1.00	1056	106.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
[illegible]V12	1.00	1100		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CCB12	1.00	1104		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76201	1.00	1108		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76201A	1.00	1112	95.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76202	20.00	1116		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76202A	20.00	1120	98.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76202D	20.00	1124		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76202DA	20.00	1128	96.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76202S	20.00	1132		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76203	20.00	1136		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76203A	20.00	1140	97.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CCV13	1.00	1144		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
CCB13	1.00	1148		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76204	1.00	1152		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76204A	1.00	1156	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76205	1.00	1200		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76205A	1.00	1204	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
T76206	1.00	1208		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-2 Method: F
Start Date: 10/26/98 End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
T76206A	1.00	1212	88.5																					X			
T76207	1.00	1216																						X			
T76207A	1.00	1220	85.0																					X			
T76208	1.00	1224																						X			
T76208A	1.00	1228	90.0																					X			
CCV14	1.00	1232																						X			
CCB14	1.00	1236																						X			
T76209	1.00	1240																						X			
T76209A	1.00	1244	98.0																					X			
T76210	1.00	1248																						X			
T76210A	1.00	1252	100.5																					X			
T76211	1.00	1256																						X			
T76211A	1.00	1300	96.0																					X			
T76212	1.00	1304																						X			
T76212A	1.00	1308	110.0																					X			
CCV15	1.00	1312																						X			
CCB15	1.00	1316																						X			
ZZZZZZ	1.00	1320																									
ZZZZZZ	1.00	1324																									
CCV16	1.00	1328																						X			
CCB16	1.00	1332																						X			
T76213	1.00	1336																						X			
T76213A	1.00	1340	94.0																					X			
T76214	1.00	1344																						X			
T76214A	1.00	1348	98.0																					X			
T76215	1.00	1352																						X			
T76215A	1.00	1356	98.5																					X			
T76216	1.00	1400																						X			
T76216A	1.00	1404	97.0																					X			
T76217	1.00	1408																						X			
T76217A	1.00	1412	103.0																					X			
CCV17	1.00	1416																						X			

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Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS
Lab Code: COLUMB Case No.:
Instrument ID Number: VARIAN-2
Start Date: 10/26/98

Contract: K9806762
SAS No.: SDG No.: T76201
Method: F
End Date: 10/26/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CCB17	1.00	1420		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–
				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
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FORM XIV - IN

ENVIROFORMS/INORGANIC CLP

14

Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-3 Method: CV
Start Date: 10/19/98 End Date: 10/19/98

Sample No.	D/F	Time	%R	Analytes																								
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1816		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
S0.2	1.00	1817		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
S0.5	1.00	1818		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
S1	1.00	1819		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
S5	1.00	1820		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
S10	1.00	1821		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
ICV	1.00	1822		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
ICB	1.00	1823		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
CCV11	1.00	1824		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
CCB11	1.00	1825		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
CRA	1.00	1827		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1828		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1830		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1831		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1833		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1835		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1836		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1837		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1838		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1840		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CCV12	1.00	1841		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
CCB12	1.00	1843		—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1844		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1845		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1846		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1848		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1849		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1851		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1853		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1854		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1855		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ZZZZZZ	1.00	1856		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

ENVIROFORMS/INORGANIC CLP

14

Analysis Run Log

Lab Name: COLUMBIA ANALYTICAL SVCS Contract: K9806762
Lab Code: COLUMB Case No.: SAS No.: SDG No.: T76201
Instrument ID Number: VARIAN-3 Method: CV
Start Date: 10/19/98 End Date: 10/19/98

Sample No.	D/F	Time	%R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
CCV13	1.00	1858																X									
CCB13	1.00	1900																X									
ZZZZZZ	1.00	1901																									
ZZZZZZ	1.00	1903																									
PBW	1.00	1904																X									
LCSW	1.00	1905																X									
T76201	1.00	1907																X									
T76202	1.00	1908																X									
T76202D	1.00	1910																X									
T76202S	1.00	1912																X									
T76203	1.00	1913																X									
T76204	1.00	1914																X									
CCV14	1.00	1916																X									
CCB14	1.00	1917																X									
T76205	1.00	1919																X									
T76206	1.00	1920																X									
T76207	1.00	1922																X									
T76208	1.00	1923																X									
T76209	1.00	1925																X									
T76210	1.00	1926																X									
T76211	1.00	1927																X									
T76212	1.00	1929																X									
T76213	1.00	1930																X									
T76214	1.00	1932																X									
CCV15	1.00	1933																X									
CCB15	1.00	1935																X									
T76215	1.00	1936																X									
T76216	1.00	1937																X									
T76217	1.00	1939																X									
CCV16	1.00	1940																X									
CCB16	1.00	1941																X									

FORM XIV - IN

Columbia Analytical Services, Inc

Daily Run Log — ICP Analysis

Batch Number	Date of Analysis	ICP Method	SR# : Sample#	Cal. Data w/SR#	CCV	STD4, CCV	Analyst	ICS, Lab QC	Comments
MET9815872	10/23	EPA6010	7255:1-3	7649	C		[illegible]	QC	Solid
			7119:1-12		C		[illegible]	QC	water
			7037:4,7		C		JC		Soil
			7050:1,2		C	98-10	JC	QC	TCLP Toxicity
			7134:1		C	98-10	JC	QC	Solid
			7166:1,2				JC		Soil
			7051:2				JC		Sludge
			7137:1		C	98-10	JC		Solid
			7232:1				JC		Solid
			7217:1				JC		Soil
Extr/Analysis Lot MET9815873			7166:3		C	98-10	JC	ICS/QC	water
	10/23	EPA6010	6743:1-20	6743	D		JC	III	solid
			7348:1-6		D		JC	III	water
Extr/Analysis Lot MET9815874	10/24	EPA6010	6762:1-17	D76244	D	98-10	[illegible]	III	Dissolved
	~~10/25~~	~~EPA6010~~	~~6762:1-17~~	~~D76201~~	~~D~~	~~98-10~~	~~[illegible]~~	~~III~~	~~Total~~
	10/24	10/24	D76324:1-4	6324	D	98-10	[illegible]	III	Sediment
Extr/Analysis Lot MET9815875		EPA6010	7326:1-4		D	98-10	[illegible]	QC	[illegible]
			7244:1				[illegible]	QC	water
			7207:1-6		D	98-10	[illegible]		water
			7172:1-3				[illegible]	QC	water
			7233:1-3		D		[illegible]	QC	water
			7284:1-3		D		[illegible]	ICS	water
Extr/Analysis Lot MET9815876	10/27	EPA6010	D76201	6762	D	98-10	[illegible]	III	water

00091

[5%HCL.XLS]STD2FORM.XLS

Solution: ICP STD2
Matrix: 5%HCl
Volume: 500 mls.

Analyst: JC
Date: 10/22/98
Time: 1720

WORKING SOLUTION

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	Em Science	K25402403827	OP 4/16/98	25.0	✓	5.0%
HNO3	J.T. Baker	M0425	OP 7/20/98	5.0	✓	1.0%
Ag	IV	M-AG01121	5/1/99	0.5	✓	1.0
CAS STOCK SOLUTION - soln listed below				50.0	✓	---

	DATE USED:				
		10/22/98 JC			
Sb		10/23 "			10.0
Ba		10/23/98 JC			1.0
Cd		10/24 "			1.0
Cr		10/27 "			10.0
Ni					1.0
Na					50.0
K					50.0

STOCK SOLUTION

Analyst: JC Date: 8/19/98 Time: 1500

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	EM SCIENCE	37280	OP 7/20/98	25.0	✓	5.0%
HNO3	J.T. BAKER	M0425	OP 7/20/98	5.0	✓	1.0%
Sb	CPI	710714	12/31/98	50.0	✓	100.0
Ba	High Purity	726008	12/31/98	5.0	✓	10.0
Cd	High Purity	805545	3/31/99	5.0	✓	10.0
Cr	IV	M-CR02081	2/1/99	50.0	✓	100.0
Ni	IV	M-NI02004	5/1/99	5.0	✓	10.0
Na	CPI	718220	3/9/99	25.0	✓	500.0
K	CPI	726104	7/31/99	25.0	✓	500.0

EARLIEST EXPIRATION DATE= 12/31/98

UPDATED 8/19/98

Solution: ICP STD3
Matrix: 5%HCl
Volume: 500 mls.

Analyst: JC
Date: 10/22/98
Time: 1720

WORKING SOLUTION

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	EM Science	K25402903827	OP 10/16/98	25.0	✓	5.0%
HNO3	J.T. Baker	M04025	OP 7/20/98	5.0	✓	1.0%
STOCK SOLUTION - soln listed below				50.0	✓	—
Al						10.0
Ca						10.0
Fe	DATE USED:	10/22/98 JC				10.0
Mg		10/27				10.0
Ph		10/23/98 JC				10.0
Zn		10/26				5.0
As		10/27				4.0
Se						4.0
Be						1.0
Co						1.0
Cu						1.0
Mn						1.0
Mo						1.0
Ti						1.0
V						1.0

STOCK SOLUTION

Analyst: JC Date: 10/22/98 Time: 1630

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	EM Science	K25402903827	OP 10/16/98	25.0	✓	5.0%
HNO3	J.T. BAKER	M04025	OP 7/20/98	5.0	✓	1.0%
Al	CPI	733013	6/9/99	50.0	✓	100.0
Ca	IN. VENT.	N-CA02093	9/1/99	50.0	✓	100.0
Fe	IN. VENT.	M-FE02124	2/1/99	50.0	✓	100.0
Mg	CPI	730321	6/9/99	50.0	✓	100.0
Pb	CPI	800712	7/31/99	50.0	✓	100.0
Zn	CPI	804807	10/31/99	25.0	✓	50.0
As	CPI	720620	2/25/99	20.0	✓	40.0
Se	CPI	8CB063	5/31/99	20.0	✓	40.0
Be	IN. VENT.	M-BE01081	5/1/99	5.0	✓	10.0
Co	CPI	731641	7/5/99	5.0	✓	10.0
Cu	CPI	802207	9/30/99	5.0	✓	10.0
Mn	CPI	803426	9/30/99	5.0	✓	10.0
Mo	CPI	728311	4/29/99	5.0	✓	10.0
Ti	IN. VENT.	M-TI02021	9/1/99	5.0	✓	10.0
V	IN. VENT.	722011	12/31/98	5.0	✓	10.0

EARLIEST EXPIRATION DATE= 2/1/99

UPDATED 10/22/98

Solution: ICP STD4
Matrix: 5% HCl
Volume: 500 mL

Analyst: JC
Date: 10/6/98
Time: 1600

WORKING SOLUTION

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	J.T. BAKER	M17024	OP 9/1/98	25.0	✓	5.0%
HNO3	J.T. BAKER	M04025	OP 7/20/98	5.0	✓	1.0%
B	CPI	735217	9/30/99	5.0	✓	10.0
P	.IN. VENT.	M-P01096	12/1/98	25.0	✓	50.0
Si	CPI	729411	6/9/99	5.0	✓	10.0
Sn	CPI	719906	2/11/99	10.0	✓	20.0
Tl	CPI	719209	2/11/99	5.0	✓	10.0
Li	CPI	803627	9/30/99	5.0	✓	10.0
Sr	CPI	707021	11/16/98	5.0	✓	10.0

DATE USED:

10/9 [illegible]				
10/9/98 JC				
10/12 [illegible]				
10/14 [illegible]				
10/15/98 JC				
10/16/98 JC				
10/17 [illegible]				
10/20 [illegible]				
10/21 [illegible]				
10/21/98 JC				
10/22/98 JC				
10/23 [illegible]				
10/23/98 JC				
10/26 [illegible]				
10/27 [illegible]				

EARLIEST EXPIRATION DATE= 11/16/98

98-10

[5%HCL.XLS] CCVFORM.XLS

Solution:	CCV	Analyst:	JC
Matrix:	5%HCl	Date:	10/23/98
Volume:	100 mls.	Time:	1915

ICP STD2

Element	Source	Lot #	Expiration Date	Aliquot per 100 mls.	Check Off	Concentration (ppm)
HCl	EM Science	K25402903827	OP 10/16/98			5.0%
HNO3	J.T. BAKER	M04025	OP 7/20/98			1.0%
Ag	IV	M-AG01121	5/1/99			0.5
Sb	CPI	710714	12/31/98			5.0
Ba	High Purity	726008	12/31/98	50.0 ✓		0.5
Cd	High Purity	805545	3/31/99			0.5
Cr	IN. VENT.	M-CR02081	2/1/99			5.0
Ni	IV	M-NI02004	5/1/99			0.5
Na	CPI	718220	3/9/99			25.0
K	CPI	726104	7/31/99			25.0

ICP STD3

Element	Source	Lot #	Expiration Date	Aliquot per 100 mls.	Check Off	Concentration (ppm)
HCl	EM Science	K25402903827	OP 10/16/98			5.0%
HNO3	J.T. BAKER	M04025	OP 7/20/98			1.0%
Al	CPI	733013	6/9/99			5.0
Ca	IN. VENT.	N-CA02093	9/1/99			5.0
Fe	IN. VENT.	M-FE02124	2/1/99			5.0
Mg	CPI	730321	6/9/99			5.0
Pb	CPI	800712	7/31/99			5.0
Zn	CPI	804807	10/31/99			2.5
As	CPI	720620	2/25/99	50.0 ✓		2.0
Se	CPI	8CB063	5/31/99			2.0
Be	IN. VENT.	M-BE01081	5/1/99			0.5
Co	CPI	731641	7/5/99			0.5
Cu	CPI	802207	9/30/99			0.5
Mn	CPI	803426	9/30/99			0.5
Mo	CPI	728311	4/29/99			0.5
Ti	IN. VENT.	M-TI02021	9/1/99			0.5
V	IN. VENT.	722011	12/31/98			0.5

CCV# D

Solution: ICV
Matrix: 5%HCl
Volume: 500 mL

Analyst: JC
Date: 9/25/98
Time: 1620

WORKING SOLUTION

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	J.T. BAKER	M17024	OP 9/1/98	25.0	✓	5.0%
HNO3	J.T. BAKER	M04025	OP 7/20/98	5.0	✓	1.0%
CLPP-CICV-1	IV	N-MEB58076	7/1/99	2.5	✓	
	Date Used					-
Ca	9/26/98JC	10/16/98JC				12.5
Mg	9/28 "	10/17 "				12.5
Na	9/29/98JC	10/20 "				12.5
K	9/30 "	10/21 "				12.5
Al	10/1 "	10/21/98JC				5.00
Ba	10/1/98JC	10/22/98JC				5.00
Fe	10/2/98JC	10/23 "				2.50
Co	10/5 "	10/23/98JC				1.25
Ni	10/6 "	10/24/98 "				1.25
Mn	10/6/98JC	10/27 "				1.25
V	10/7 "					1.25
Zn	10/7/98JC					1.25
Cu	10/8 "					0.625
Ag	10/9 "					0.625
Cr	10/9/98JC					0.500
Be	10/12 "					1.25
	10/13/98JC					
	10/14 "					
	10/14/98JC					
	10/15/98JC					
CLPP-CICV-2	IV	N-MEB58079	9/1/99	2.5	✓	-
Sb						2.50
CLPP-CICV-3	IV	M-MEB58063	7/1/99	2.5	✓	-
As						2.50
Se						2.50
Pb						2.50
Cd						1.25
Mo	IV	M-MO01111	9/1/99	2.5	✓	5.00

EARLIEST EXPIRATION DATE= 7/1/99

UPDATED: 9/25/98

Solution:	**STD4-ICV**	**Analyst:**	JC
Matrix:	**5% HCl**	**Date:**	9/14/98
Volume:	**500 mL**	**Time:**	1530

WORKING SOLUTION

Element	Source	Lot #	Expiration Date	Aliquot per 500 mls.	Check Off	Concentration (ppm)
HCl	J. T BAKER	M17024	OP 9/1/98	25.0	✓	5.0%
HNO3	J. T. BAKER	M04025	7/20/98	5.0	✓	1.0%
B	IN. VENT.	M-B02008	5/1/99	2.5	✓	5.0
Li	IN.VENT	M-LI02012	2/1/99	2.5	✓	5.0
P	CPI	701416	1/23/99	2.5	✓	5.0
Si	CPI	712002	3/22/99	2.5	✓	5.0
Sn	CPI	719906	3/22/99	2.5	✓	5.0
Sr	IN. VENT.	M-SR01108	2/1/99	2.5	✓	5.0
Ti	High Purity	804949	3/31/99	2.5	✓	5.0

DATE USED:

9/14/98 JC	10/6 [illegible]				
9/10 [illegible]	10/7 [illegible]				
9/14 [illegible]	10/7/98 JC				
9/14 [illegible]	10/7 [illegible]				
9/14/98 JC	10/7 [illegible]				
9/15 [illegible]	10/9/98 JC				
9/16/98 JC	10/12 [illegible]				
9/17 [illegible]	10/14 [illegible]				
9/17/98 JC	10/15/98 JC				
9/18/98 JC	10/16/98 JC				
9/21/98 JC	10/17 [illegible]				
9/22/98 JC	10/20 [illegible]				
9/23 [illegible]	10/21 [illegible]				
9/24 [illegible]	10/21/98 JC				
9/25 [illegible]	10/22/98 JC				
9/25/98 JC	10/23 [illegible]				
9/26/98 JC	10/23/98 JC				
9/29 [illegible]	10/26/98 [illegible]				
9/29 [illegible]	10/27 [illegible]				
9/30 [illegible]					
10/1 [illegible]					
10/2/98 JC					
10/5 [illegible]					

EARLIEST EXPIRATION DATE= 1/23/99

UPDATED: 9/4/98

Method: EPACLP2 Standard: STD3

Elem	Al3082	As1936	Be3130	Ca3179	Co2286	Cu3247	Fe2599
Avge	2.1499	.48886	.38636	2.0307	.15371	.30264	3.2798
SDev	.0093	.00222	.00212	.0036	.00000	.00192	.0047
%RSD	.43228	.45460	.54906	.17659	.00000	.63417	.14476
#1	2.1564	.48729	.38786	2.0281	.15371	.30400	3.2831
#2	2.1433	.49043	.38486	2.0332	.15371	.30129	3.2764

Elem	Pb2203	Mg2795	Mg3832	Mn2576	Mo2020	Se1960	V_2924
Avge	1.4743	3.0955	.24307	.28500	.13164	.44157	.25271
SDev	.0028	.0021	.00010	.00020	.00030	.00768	.00121
%RSD	.19185	.06852	.04156	.07089	.23020	1.7386	.47967
#1	1.4723	3.0970	.24314	.28514	.13186	.44700	.25357
#2	1.4763	3.0940	.24300	.28486	.13143	.43614	.25186

Elem	Zn2138	Ti3349
Avge	.69729	.34400
SDev	.00040	.00141
%RSD	.05795	.41111
#1	.69700	.34500
	.69757	.34300

Method: EPACLP2 Standard: STD4

Elem	B_2496
Avge	.42843
SDev	.00121
%RSD	.28294
#1	.42757
#2	.42929

Method: EPACLP2 Standard: STD2

Elem	Sb2068	Ba4934	Cd2288	Cr2677	Ni2316	K_7665	Ag3280
Avge	1.2369	.22014	.13014	3.3712	.11836	1.3006	.21993
SDev	.0004	.00020	.00141	.0100	.00030	.0058	.00030
%RSD	.03267	.09177	1.0867	.29664	.25604	.44270	.13779
#1	1.2371	.22000	.12914	3.3641	.11814	1.2966	.21971
#2	1.2366	.22029	.13114	3.3783	.11857	1.3047	.22014

Elem	Na5889
Avge	14.175
SDev	.002
%RSD	.01639
#1	14.174
#2	14.177

Method: EPACLP2 Standard: STD1-Blank

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Avge	.01043	-.00064	-.00029	.00500	.00071	.00021	.00107
SDev	.00040	.00010	.00141	.00000	.00000	.00030	.00051
%RSD	3.8746	15.713	494.97	.00000	.00000	141.42	47.140
#1	.01071	-.00071	.00071	.00500	.00071	.00000	.00143
#2	.01014	-.00057	-.00129	.00500	.00071	.00043	.00071

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Avge	.00064	-.00029	.00079	.03050	.00164	.00093	.00086
SDev	.00030	.00000	.00010	.00010	.00071	.00010	.00020
%RSD	47.140	.00000	12.856	.33120	43.041	10.879	23.570
#1	.00086	-.00029	.00086	.03043	.00214	.00100	.00071
#2	.00043	-.00029	.00071	.03057	.00114	.00086	.00100

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Avge	.00021	.00029	.00064	.38643	.00186	-.00043	.10736
SDev	.00010	.00000	.00010	.00000	.00040	.00061	.00091
%RSD	47.140	.00000	15.713	.00000	21.757	141.42	.84684
#1	.00029	.00029	.00071	.38643	.00157	.00000	.10800
#2	.00014	.00029	.00057	.38643	.00214	-.00086	.10671

Elem	V_2924	Zn2138	Ti3349	B_2496
Avge	.00021	.00071	.00114	.00400
SDev	.00010	.00000	.00000	.00000
%RSD	47.140	.00000	.00000	.00000
#1	.00029	.00071	.00114	.00400
#2	.00014	.00071	.00114	.00400

Method: CUMNCD Sample Name: CUMNCD Operator: WM
Run Time: 10/27/98 09:32:39
Comment: MET9815876
Mode: IR Corr. Factor: 1

Elem	Cd2288	Mn2576
Avge	717.5	.9078
SDev	4.0	.0054
%RSD	.5546	.5927
#1	714.0	.9100
#2	717.0	.9128
#3	721.0	.9127
#4	726.0	.9128
#5	719.0	.9120
#6	719.0	.9079
#7	716.0	.9038
#8	716.0	.8977
#9	712.0	.9010
#10	715.0	.9072

IntStd	1	2	3	4	5	6	7
Mode	*Counts	None	NOTUSED	NOTUSED	NOTUSED	NOTUSED	NOTUSED
Elem	Cu	--	--	--	--	--	--
Wlen	324.754	--	--	--	--	--	--
Avge	1654	1	--	--	--	--	--
SDev	6.033241	.0000000	--	--	--	--	--
%RSD	.3648108	.0000000	--	--	--	--	--
#1	1644	1	--	--	--	--	--
#2	1652	1	--	--	--	--	--
#3	1660	1	--	--	--	--	--
#4	1652	1	--	--	--	--	--
#5	1648	1	--	--	--	--	--
#6	1661	1	--	--	--	--	--
#7	1653	1	--	--	--	--	--
#8	1662	1	--	--	--	--	--
#9	1657	1	--	--	--	--	--
#10	1649	1	--	--	--	--	--

Method: EPACLP2 Sample Name: ICV Operator: WM
Run Time: 10/27/98 09:48:26
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0904	2.5483	2.5019	5.1783	.12420	1.2752	12.557
SDev	.0202	.0009	.0325	.0061	.00026	.0036	.001
%RSD	.39734	.03418	1.3001	.11787	.21290	.27872	.00595
#1	5.0761	2.5489	2.4789	5.1740	.12438	1.2727	12.556
#2	5.1048	2.5477	2.5249	5.1826	.12401	1.2778	12.557
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	2.5000	2.5000	5.0000	.12500	1.2500	12.500
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50515	1.2400	.62501	2.5069	2.4998	12.513	12.588
SDev	.00090	.0039	.00134	.0047	.0075	.013	.063
%RSD	.17923	.31828	.21398	.18600	.29889	.10434	.49826
[illegible]	.50451	1.2372	.62406	2.5036	2.5051	12.504	12.544
#2	.50579	1.2428	.62595	2.5102	2.4945	12.523	12.633
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	1.2500	.62500	2.5000	2.5000		12.500
Range	10.000	10.000	10.000	10.000	10.000		10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.2510	5.0143	1.3095	12.814	2.4832	.62891	12.639
SDev	.0007	.0169	.0034	.022	.0229	.00000	.011
%RSD	.05708	.33692	.26199	.17247	.92103	.00048	.08806
#1	1.2505	5.0023	1.3071	12.829	2.4994	.62891	12.631
#2	1.2515	5.0262	1.3119	12.798	2.4671	.62891	12.646
Errors	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	1.2500		1.2500	12.500	2.5000	.62500	12.500
Range	10.000		10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	1.2477	1.2744	.00188	.01515
SDev	.0005	.0029	.00030	.00238
%RSD	.04041	.22726	15.713	15.713
[illegible]	1.2473	1.2723	.00208	.01683
#2	1.2480	1.2764	.00167	.01346
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	1.2500	1.2500		
Range	10.000	10.000		

A-[illegible]sis Report QC Standard Tue 10-27-98 09:52:42 AM page 1

Method: EPACLP2 Sample Name: ICV Operator: WM
Run Time: 10/27/98 09:51:10
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00307	-.00306	-.00792	.00299	-.00003	.00036	.00563
SDev	.00049	.00000	.00951	.00047	.00026	.00145	.00249
%RSD	16.103	.10969	120.10	15.713	799.08	405.96	44.177
#1	-.00342	-.00306	-.01464	.00332	.00015	-.00067	.00739
#2	-.00272	-.00306	-.00119	.00266	-.00021	.00138	.00387
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00066	-.04218	-.00054	.00550	-.00557	.00554	.01181
SDev	.00090	.00002	.00000	.00124	.00069	.00229	.02509
%RSD	137.02	.03663	.79954	22.609	12.446	41.248	212.38
[illegible]	-.00129	-.04217	-.00054	.00637	-.00508	.00716	.02956
[illegible]	-.00002	-.04219	-.00054	.00462	-.00606	.00392	-.00593
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00050	.00434	-.00908	.14064	.00201	.00098	8.3876
SDev	.00036	.00307	.00343	.08840	.00275	.00045	.0323
%RSD	70.624	70.720	37.795	62.854	136.88	46.250	.38525
#1	.00075	.00651	-.01151	.20314	.00395	.00066	8.3647
#2	.00025	.00217	-.00665	.07813	.00006	.00130	8.4104
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00075	-.00376	5.1267	5.1229
SDev	.00126	.00001	.0112	.0000
%RSD	166.53	.32661	.21839	.00000
[illegible]	.00164	-.00375	5.1188	5.1229
#2	-.00013	-.00377	5.1346	5.1229
Errors	NOCHECK	NOCHECK	QC Pass	QC Pass
Value			5.0000	5.0000
Range			10.000	10.000

lethod: EPACLP2 Sample Name: ICB Operator: WM
:un Time: 10/27/98 09:53:10
:omment: SDG: T76201 MET9815876
lode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00239	L-.00290	L-.00672	L.00066	L-.00000	L-.00156	L-.00141
SDev	.00893	.00331	.03873	.00000	.00000	.00111	.00199
%RSD	373.80	113.91	576.00	.00000	1602.6	71.431	141.45
#1	L.00870	L-.00524	L.02066	L.00066	L.00000	L-.00077	L.00000
#2	L-.00393	L-.00056	L-.03411	L.00066	L-.00000	L-.00235	L-.00282
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00106	L.00277	L-.00047	L.00088	L-.00673	.00069	L.00295
SDev	.00120	.00132	.00033	.00031	.00346	.00065	.02091
%RSD	113.12	47.509	70.971	35.365	51.405	94.281	707.67
[illegible]	L-.00021	L.00184	L-.00023	L.00066	L-.00918	.00115	L-.01183
#2	L-.00191	L.00371	L-.00071	L.00110	L-.00428	.00023	L.01774
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00050	-.00109	L-.00546	L.11720	L.00970	L.00032	L.01447
SDev	.00035	.00153	.00343	.02210	.00092	.00046	.00574
%RSD	70.760	141.16	62.828	18.856	9.4468	140.85	39.697
#1	L-.00025	-.00000	L-.00789	L.13282	L.00905	L.00065	L.01853
#2	L-.00075	-.00217	L-.00304	L.10157	L.01035	L.00000	L.01041
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00004	L-.00101	.00479	.01178
SDev	.00034	.00001	.00030	.00714
%RSD	930.95	1.2339	6.1488	60.609
[illegible]	L-.00028	L-.00100	.00458	.01683
#2	L.00020	L-.00102	.00500	.00673
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Avge	4.9145	5.0001	1.9702	.50531	.48618	.50522	4.9133
#1	4.9252	4.9972	1.9860	.50531	.48637	.50339	4.9105
#2	4.9038	5.0029	1.9544	.50531	.48599	.50704	4.9162

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Avge	5.0593	.48948	.48368	4.9178	4.8947	4.9224	4.9633
#1	5.0601	.48855	.48392	4.9152	4.8976	4.9181	4.9781
#2	5.0585	.49040	.48345	4.9204	4.8918	4.9268	4.9485

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Avge	.48810	.48845	.51009	25.150	1.9695	.50158	25.259
#1	.48760	.48628	.51373	25.150	1.9455	.50223	25.287
#2	.48860	.49062	.50644	25.150	1.9934	.50094	25.231

Ignore
[illegible] 10/27/97
Accidental scan point

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Method: EPACLP2 Sample Name: CCV11 Operator: WM
Run Time: 10/27/98 09:56:18
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9145	5.0001	1.9702	.50531	.48618	.50522	4.9133
SDev	.0151	.0041	.0223	.00000	.00026	.00259	.0040
%RSD	.30716	.08115	1.1332	.00000	.05449	.51179	.08103
#1	4.9252	4.9972	1.9860	.50531	.48637	.50339	4.9105
#2	4.9038	5.0029	1.9544	.50531	.48599	.50704	4.9162
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0593	.48948	.48368	4.9178	4.8947	4.9224	4.9633
SDev	.0012	.00131	.00033	.0037	.0041	.0062	.0209
%RSD	.02367	.26751	.06910	.07584	.08321	.12600	.42154
#1	5.0601	.48855	.48392	4.9152	4.8976	4.9181	4.9781
#2	5.0585	.49040	.48345	4.9204	4.8918	4.9268	4.9485
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.48810	.48845	.51009	25.150	1.9695	.50158	25.259
SDev	.00071	.00307	.00515	.000	.0339	.00091	.039
%RSD	.14536	.62862	1.0095	.00000	1.7192	.18222	.15635
#1	.48760	.48628	.51373	25.150	1.9455	.50223	25.287
#2	.48860	.49062	.50644	25.150	1.9934	.50094	25.231
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49163	2.4685	.49208	.01010
SDev	.00048	.0058	.00059	.00000
%RSD	.09696	.23577	.11975	.00000
#1	.49129	2.4644	.49250	.01010
#2	.49197	2.4726	.49167	.01010
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

Analysis Report QC Standard Tue 10-27-98 10:03:41 AM page 1

Method: EPACLP2 Sample Name: CCV11 Operator: WM
Run Time: 10/27/98 10:01:09
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00185	-.02463	-.00172	-.00000	.00000	-.00329	.00018
SDev	.00102	.00897	.00257	.00000	.00000	.00079	.00075
%RSD	55.189	36.424	149.34	.00000	30.763	23.905	421.52
#1	.00257	-.03097	.00010	-.00000	.00001	-.00273	.00071
#2	.00113	-.01828	-.00354	-.00000	.00000	-.00385	-.00035
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00148	-.17097	-.00047	.00286	-.02251	.00069	-.08873
SDev	.00240	.00526	.00033	.00000	.00696	.00000	.05019
%RSD	161.65	3.0771	70.725	.02732	30.943	.00000	56.563
	.00318	-.16725	-.00024	.00286	-.01758	.00069	-.05324
	-.00021	-.17469	-.00071	.00286	-.02743	.00069	-.12422
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00050	-.00217	.00433	-.02344	-.01660	.00129	17.075
SDev	.00035	.00154	.00515	.02210	.02195	.00092	.069
%RSD	70.600	70.827	118.91	94.287	132.25	71.146	.40160
#1	-.00075	-.00108	.00797	-.00781	-.00108	.00064	17.027
#2	-.00025	-.00326	.00069	-.03906	-.03212	.00194	17.124
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00116	-.00207	-.00021	10.125
SDev	.00034	.00002	.00029	.010
%RSD	29.055	.81392	141.42	.09403
	-.00140	-.00208	-.00000	10.118
#2	-.00092	-.00206	-.00042	10.131
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB11 Operator: WM
Run Time: 10/27/98 10:04:02
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00372	L.00636	L.00791	L-.00000	L.00000	L-.00063	L-.00299
SDev	.00044	.01145	.01463	.00000	.00000	.00018	.00125
%RSD	11.798	180.04	184.91	.00000	220.58	28.277	41.628
#1	L.00341	L-.00174	L-.00243	L-.00000	L.00000	L-.00050	L-.00211
#2	L.00403	L.01445	L.01826	L-.00000	L-.00000	L-.00075	L-.00387
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00085	L.00186	L-.00047	L-.00088	L-.01256	-.00162	L-.00887
SDev	.00090	.00263	.00033	.00031	.00611	.00000	.01255
%RSD	105.79	141.46	70.641	35.366	48.652	.00000	141.45
[illegible]	L-.00148	L.00371	L-.00024	L-.00110	L-.01688	-.00162	L-.01774
#2	L-.00021	L-.00000	L-.00071	L-.00066	L-.00824	-.00162	L.00000
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00075	-.00326	L-.00303	L-.01953	L.00582	L.00097	L.00584
SDev	.00000	.00153	.00343	.03867	.00823	.00046	.00574
%RSD	.05315	47.097	113.15	198.00	141.49	47.628	98.380
#1	L-.00075	-.00217	L-.00546	L.00781	L.01164	L.00064	L.00990
#2	L-.00075	-.00434	L-.00061	L-.04688	L-.00000	L.00130	L.00178
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00037	L-.00153	-.00021	.01215
SDev	.00073	.00071	.00029	.00470
%RSD	196.30	46.603	141.42	38.697
[illegible]	L-.00089	L-.00203	-.00042	.01548
#2	L.00014	L-.00103	-.00000	.00883
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: CRII Operator: WM
Run Time: 10/27/98 10:06:42
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00373	.12719	.19846	L-.00000	.01036	.00841	L-.00222
SDev	.00192	.00241	.00428	.00000	.00000	.00081	.00149
%RSD	51.465	1.8966	2.1567	.00000	.01487	9.6594	67.332
#1	L.00509	.12548	.20148	L-.00000	.01036	.00783	L-.00327
#2	L.00237	.12889	.19543	L-.00000	.01036	.00898	L-.00116
Errors	LC Low	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02067	.10323	.05059	L.00011	.09474	-.00046	L-.00000
SDev	.00150	.00132	.00033	.00000	.00271	.00033	.00836
%RSD	7.2458	1.2800	.66065	.17598	2.8645	70.711	2607100.
	.02173	.10417	.05036	L.00011	.09282	-.00023	L-.00592
	.01961	.10230	.05083	L.00011	.09666	-.00069	L.00591
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02928	-.00215	.08430	L.16408	.19652	.01932	L.00457
SDev	.00000	.00153	.00686	.04420	.01647	.00092	.00108
%RSD	.00179	71.371	8.1433	26.937	8.3781	4.7559	23.570
#1	.02928	-.00323	.08915	L.19533	.20816	.01996	L.00533
#2	.02928	-.00106	.07944	L.13282	.18488	.01867	L.00381
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10047	.03868	-.00042	.00384
SDev	.00035	.00002	.00000	.00235
%RSD	.34483	.06233	.00000	61.245
	.10072	.03867	-.00042	.00550
#2	.10023	.03870	-.00042	.00218
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: ICSAI Operator: WM
Run Time: 10/27/98 10:08:43
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	498.00	.01790	-1.3493	.00764	-.00004	.01454	476.28
SDev	1.93	.00655	.0022	.00047	.00000	.00072	2.19
%RSD	.38656	36.613	.15994	6.1488	8.2051	4.9849	.45895
#1	496.64	.01327	-1.3478	.00730	-.00004	.01505	474.74
#2	499.36	.02254	-1.3508	.00797	-.00004	.01403	477.83
Errors	QC Pass	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value	500.00						500.00
Range	20.000						20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00505	.00172	.00284	175.27	-.03914	280.01	482.84
SDev	.00179	.00129	.00004	.67	.01134	1.07	.93
%RSD	35.401	74.980	1.3613	.38126	28.967	.38121	.19191
	-.00379	.00264	.00282	174.80	-.03113	279.25	482.18
	-.00631	.00081	.00287	175.74	-.04716	280.76	483.49
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass
Value				200.00			500.00
Range				20.000			20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01011	-.00740	-.02488	-.53910	-.16765	.00031	.04290
SDev	.00013	.00087	.00172	.00000	.03202	.00054	.00574
%RSD	1.3201	11.771	6.9015	.00000	19.100	176.04	13.389
#1	.01001	-.00801	-.02609	-.53910	-.14501	-.00008	.04697
#2	.01020	-.00678	-.02366	-.53910	-.19029	.00069	.03884
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00937	.00296	.01271	.19169
SDev	.00080	.00154	.00030	.00000
%RSD	8.5130	51.943	2.3184	.00000
	.00881	.00405	.01292	.19169
#2	.00994	.00187	.01250	.19169
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value				
Range				

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Method: EPACLP2 Sample Name: ICSABI Operator: WM
Run Time: 10/27/98 10:10:41
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	505.72	1.0062	-1.3660	.50000	.46826	.97265	483.52
SDev	.68	.0000	.0319	.00188	.00053	.00198	1.16
%RSD	.13366	.00002	2.3359	.37562	.11408	.20321	.24022
#1	506.20	1.0062	-1.3886	.50133	.46864	.97125	482.69
#2	505.25	1.0062	-1.3435	.49867	.46788	.97405	484.34
Errors	QC Pass	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass
Value	500.00	1.0000		.50000	.50000	1.0000	500.00
Range	20.000	20.000		20.000	20.000	20.000	20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.45462	.44314	.49186	177.85	.89199	282.10	490.77
SDev	.00210	.00133	.00001	.13	.02105	.67	.75
%RSD	.46130	.29973	.00162	.07325	2.3596	.23895	.15262
	.45313	.44408	.49186	177.76	.87711	281.62	491.30
	.45610	.44220	.49187	177.94	.90688	282.58	490.24
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	.50000	.50000	200.00	1.0000		500.00
Range	20.000	20.000	20.000	20.000	20.000		20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.45977	-.01001	.90695	-.70318	-.17124	.95750	.14572
SDev	.00109	.00228	.00000	.06630	.04343	.00181	.00036
%RSD	.23639	22.818	.00007	9.4281	25.360	.18891	.24638
#1	.45900	-.00839	.90695	-.75006	-.14053	.95878	.14547
#2	.46054	-.01162	.90695	-.65630	-.20195	.95622	.14597
Errors	QC Pass	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass	NOCHECK
Value	.50000		1.0000			1.0000	
Range	20.000		20.000			20.000	

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.46280	.94607	.01292	.19502
SDev	.00129	.00002	.00059	.00470
%RSD	.27980	.00182	4.5620	2.4111
	.46189	.94608	.01250	.19834
#2	.46372	.94606	.01333	.19169
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	.50000	1.0000		
Range	20.000	20.000		

lethod: EPACLP2 Sample Name: CCV12. Operator: WM
Run Time: 10/27/98 10:12:48
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1414	5.0222	1.9705	.51062	.49212	.50746	5.1587
SDev	.0207	.0212	.0441	.00000	.00026	.00187	.0134
%RSD	.40296	.42203	2.2377	.00000	.05205	.36915	.26055
#1	5.1561	5.0372	1.9393	.51062	.49194	.50613	5.1682
#2	5.1268	5.0072	2.0017	.51062	.49230	.50878	5.1492
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1070	.49503	.49362	5.0315	4.9130	5.1570	5.1788
SDev	.0021	.00395	.00100	.0022	.0026	.0147	.0335
%RSD	.04108	.79795	.20317	.04330	.05372	.28485	.64619
[illegible]	5.1055	.49224	.49291	5.0330	4.9149	5.1673	5.1552
[illegible]	5.1085	.49782	.49433	5.0299	4.9112	5.1466	5.2025
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49162	.48684	.51312	25.264	1.9871	.50647	25.604
SDev	.00071	.00384	.00772	.061	.0238	.00138	.003
%RSD	.14412	.78894	1.5048	.24055	1.1972	.27317	.00981
#1	.49112	.48412	.50766	25.221	2.0039	.50550	25.605
#2	.49213	.48956	.51858	25.307	1.9703	.50745	25.602
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49472	2.5003	.49667	.01215
SDev	.00167	.0072	.00000	.00470
%RSD	.33806	.28907	.00000	38.697
[illegible]	.49354	2.4952	.49667	.01548
#2	.49590	2.5054	.49667	.00883
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

Analysis Report QC Standard Tue 10-27-98 10:16:11 AM page 1

Method: EPACLP2 Sample Name: CCV12 Operator: WM
Run Time: 10/27/98 10:14:40
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.08089	-.02525	-.01664	.00066	.00037	-.00202	.07796
SDev	.00894	.00984	.02077	.00000	.00000	.00099	.01020
%RSD	11.053	38.959	124.83	.00000	.00094	49.263	13.089
#1	.08721	-.03220	-.03132	.00066	.00037	-.00132	.08518
#2	.07457	-.01829	-.00195	.00066	.00037	-.00272	.07075
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00382	-.17005	-.00047	.03628	-.00948	.07940	.02651
SDev	.00030	.00132	.00033	.00249	.01024	.01012	.06273
%RSD	7.8535	.77781	71.069	6.8582	108.10	12.744	236.59
	.00360	-.17099	-.00071	.03804	-.00223	.08656	.07087
	.00403	-.16912	-.00023	.03452	-.01672	.07225	-.01784
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00049	.00109	.00129	-.04297	-.02172	.00000	17.062
SDev	.00035	.00000	.00772	.04972	.01097	.00092	.014
%RSD	71.663	.15540	597.03	115.71	50.518	29030.	.07995
#1	-.00074	.00109	-.00417	-.00781	-.02948	-.00064	17.072
#2	-.00024	.00109	.00675	-.07813	-.01396	.00065	17.053
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00023	-.00206	.00125	9.9751
SDev	.00000	.00003	.00000	.0353
%RSD	.36071	1.2637	.00000	.35354
	-.00023	-.00204	.00125	9.9501
#2	-.00023	-.00208	.00125	10.000
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

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ı[illegible]sis Report

lethod: EPACLP2 Sample Name: CCB12 Operator: WM
:un Time: 10/27/98 10:16:38
:omment: SDG: T76201 MET9815876
lode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.03237	L.00054	L-.02107	L-.00000	L.00019	L-.00031	L.02886
SDev	.00611	.00164	.00512	.00000	.00027	.00006	.01145
%RSD	18.858	304.05	24.298	.00000	144.02	20.701	39.671
#1	L.03669	L-.00062	L-.01745	L-.00000	L.00038	L-.00036	L.03696
#2	L.02806	L.00170	L-.02469	L-.00000	L-.00000	L-.00027	L.02077
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00021	L.00092	L-.00071	L.01253	L-.01503	.03001	L.02362
SDev	.00120	.00131	.00000	.00373	.00271	.00947	.02510
%RSD	564.89	142.60	.00167	29.775	18.010	31.548	106.27
[illegible]	L-.00063	L-.00001	L-.00071	L.01517	L-.01312	.03670	L.00587
[illegible]	L.00106	L.00185	L-.00071	L.00990	L-.01694	.02331	L.04137
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

_em	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00075	-.00054	L-.00789	L.17580	L.00584	L.00097	L.02107
SDev	.00000	.00077	.00000	.08287	.01556	.00138	.00718
%RSD	.12525	141.47	.00779	47.140	266.49	141.76	34.077
#1	L-.00075	.00000	L-.00789	L.11720	L.01684	L-.00000	L.02615
#2	L-.00075	-.00109	L-.00789	L.23439	L-.00516	L.00195	L.01599
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00002	L-.00203	-.00021	.02213
SDev	.00114	.00000	.00029	.00470
%RSD	7331.5	.00640	141.42	21.252
[illegible]	L-.00083	L-.00203	-.00042	.02545
#2	L.00079	L-.00203	-.00000	.01880
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: PBW Operator: WM
Run Time: 10/27/98 10:22:48
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01375	L.00691	L.00904	L-.00000	L-.00018	L-.00119	L-.00405
SDev	.00521	.01055	.01641	.00000	.00026	.00059	.00224
%RSD	37.907	152.82	181.47	.00000	144.34	50.032	55.352
#1	L.01743	L.01437	L-.00256	L-.00000	L.00000	L-.00161	L-.00246
#2	L.01006	L-.00056	L.02065	L-.00000	L-.00037	L-.00077	L-.00563
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00254	L.00278	L-.00071	L.00308	L-.01158	.00946	L-.04141
SDev	.00030	.00130	.00000	.00031	.00482	.00065	.08365
%RSD	11.783	46.862	.00254	10.113	41.605	6.8986	201.99
	L-.00276	L.00370	L-.00071	L.00330	L-.00818	.00993	L-.10056
	L-.00233	L.00186	L-.00071	L.00286	L-.01499	.00900	L.01774
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00100	-.00326	L-.01032	L.38675	L.02976	L.00129	L.01066
SDev	.00035	.00000	.01201	.22651	.00366	.00000	.00682
%RSD	35.334	.09768	116.46	58.569	12.306	.00696	63.976
#1	L-.00125	-.00326	L-.01881	L.54692	L.02717	L.00129	L.01549
#2	L-.00075	-.00326	L-.00182	L.22658	L.03234	L.00129	L.00584
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00093	L-.00407	.00083	.00883
SDev	.00000	.00004	.00000	.00000
%RSD	.09540	1.0059	.00000	.00000
	L-.00093	L-.00404	.00083	.00883
#2	L-.00093	L-.00410	.00083	.00883
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: LCSW Operator: WM
Run Time: 10/27/98 10:24:47
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.2224	2.5399	2.5711	5.4124	.12855	1.2912	12.933
SDev	.0146	.0057	.0204	.0150	.00002	.0099	.097
%RSD	.28040	.22579	.79322	.27760	.01476	.76772	.75239
#1	5.2121	2.5439	2.5567	5.4230	.12856	1.2842	12.864
#2	5.2328	2.5358	2.5856	5.4017	.12853	1.2982	13.002
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.52388	1.2707	.64581	2.5884	2.5434	12.845	13.082
SDev	.00090	.0053	.00200	.0112	.0081	.061	.025
%RSD	.17147	.41313	.31031	.43216	.31955	.47267	.19158
[illegible]	.52324	1.2670	.64723	2.5805	2.5492	12.802	13.064
[illegible]	.52451	1.2744	.64440	2.5963	2.5377	12.888	13.100
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.2908	.98023	1.3520	12.868	2.4607	.64170	13.098
SDev	.0035	.00921	.0034	.254	.0055	.00415	.044
%RSD	.27458	.94007	.25408	1.9749	.22362	.64673	.33441
#1	1.2883	.97371	1.3544	12.688	2.4568	.63876	13.129
#2	1.2933	.98674	1.3495	13.048	2.4646	.64463	13.067
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	1.2759	1.3093	.00063	1.0096
SDev	.0045	.0102	.00147	.0141
%RSD	.35636	.77656	235.70	1.3972
[illegible]	1.2727	1.3021	-.00042	1.0196
#2	1.2791	1.3165	.00167	.99963
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76201 Operator: WM
Run Time: 10/27/98 10:28:06
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	59.220	L.02116	L-.13003	.33267	.00691	L.00196	76.801
SDev	.285	.00162	.00564	.00094	.00001	.00072	.455
%RSD	.48193	7.6547	4.3368	.28228	.06757	36.702	.59303
#1	59.018	L.02230	L-.13402	.33201	.00691	L.00145	76.479
#2	59.421	L.02001	L-.12605	.33333	.00690	L.00246	77.123
Errors	LC Pass	LC Low	LC Low	LC Pass	LC Pass	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.11340	.09398	.30219	37.056	L.00820	17.097	17.849
SDev	.00180	.00131	.00001	.210	.00647	.097	.137
%RSD	1.5864	1.3971	.00407	.56719	78.936	.56898	.76990
	.11213	.09491	.30218	36.907	L.01278	17.028	17.752
	.11467	.09305	.30220	37.205	L.00362	17.165	17.946
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.7232	-.00134	.17835	7.4342	L-.02504	L.00035	L1.9038
SDev	.0160	.00381	.00086	.2044	.01136	.00049	.0050
%RSD	.58623	283.94	.48149	2.7496	45.366	137.64	.26402
#1	2.7119	.00135	.17775	7.2896	L-.03307	L.00001	L1.9073
#2	2.7345	-.00403	.17896	7.5787	L-.01701	L.00070	L1.9002
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.12348	.22249	.17875	.05371
SDev	.00106	.00142	.00000	.00235
%RSD	.85679	.63808	.00000	4.3771
	.12273	.22148	.17875	.05205
#2	.12422	.22349	.17875	.05537
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76202 Operator: WM
Run Time: 10/27/98 10:30:08
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	* ppm	* ppm	ppm	ppm	* ppm	ppm
Avge	252.58	L.05628	7.4065	L.01461	.01051	.06137	145.97
SDev	1.21	.01773	.0256	.00000	.00025	.00305	.83
%RSD	.47872	31.502	.34566	.00000	2.4055	4.9664	.56708
#1	251.73	.06881	7.3884	L.01461	.01033	.05922	145.39
#2	253.44	L.04374	7.4246	L.01461	.01069	.06353	146.56
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.95589	1.7428	1.1433	H633.68	L.00444	41.829	45.208
SDev	.00363	.0099	.0055	2.42	.01504	.212	.248
%RSD	.38014	.56703	.48011	.38157	338.65	.50726	.54915
[illegible]	.95332	1.7358	1.1394	H631.97	.01508	41.679	45.032
#2	.95846	1.7498	1.1472	H635.39	L-.00620	41.979	45.383
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

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Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	8.9659	-.02395	4.6921	15.286	L-.71579	L.00599	25.137
SDev	.0500	.00269	.0438	.182	.00953	.00109	.092
%RSD	.55791	11.213	.93263	1.1927	1.3314	18.126	.36421
#1	8.9305	-.02585	4.6612	15.157	L-.72253	L.00676	25.072
#2	9.0012	-.02205	4.7231	15.415	L-.70906	L.00522	25.201
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.45809	.83510	.05208	.39285
SDev	.00242	.00608	.00000	.00705
%RSD	.52910	.72793	.00000	1.7954
[illegible]	.45638	.83080	.05208	.38786
#2	.45981	.83940	.05208	.39783
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

*Ag corrected for Fe: 12.162
*Sb corrected for Fe: 0.00787
*Cd corrected for both Fe and As: 0.02643

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Method: EPACLP2 Sample Name: T76202D Operator: WM
Run Time: 10/27/98 10:33:32
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	257.18	.07193	7.6764	L.01461	.01086	.05684	148.83
SDev	2.78	.02252	.1141	.00000	.00025	.00557	.83
%RSD	1.0819	31.311	1.4867	.00000	2.3295	9.8019	.55817
#1	255.21	.08786	7.5957	L.01461	.01068	.06078	148.25
#2	259.15	L.05601	7.7571	L.01461	.01104	.05290	149.42
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.97528	1.7703	1.1636	H641.15	L.02135	42.573	46.088
SDev	.00696	.0119	.0203	4.46	.00648	.282	.498
%RSD	.71391	.67034	1.7460	.69604	30.343	.66170	1.0796
	.97036	1.7619	1.1492	H638.00	L.02593	42.374	45.736
	.98021	1.7787	1.1779	H644.31	L.01677	42.772	46.440
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	9.1380	-.02711	4.8214	15.439	L-.81780	L.00558	25.647
SDev	.0759	.00147	.0669	.122	.04223	.00007	.332
%RSD	.83066	5.4169	1.3882	.78726	5.1643	1.2224	1.2949
#1	9.0843	-.02815	4.7741	15.353	L-.78794	L.00553	25.413
#2	9.1917	-.02607	4.8687	15.525	L-.84767	L.00563	25.882
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.46466	.85117	.05250	.40448
SDev	.00240	.00139	.00059	.01411
%RSD	.51621	.16386	1.1224	3.4875
	.46296	.85018	.05208	.39451
	.46635	.85215	.05292	.41446
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 12.432
* Sb corrected for Fe = 0.02387
* Cd corrected for both Fe & As = 0.02247

00120

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Method: EPACLP2 Sample Name: T76202S Operator: WM
Run Time: 10/27/98 10:35:36
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	* ppm	* ppm	ppm	ppm	* ppm	ppm
Avge	261.44	.56521	7.7720	2.1112	.06383	.10859	150.89
SDev	3.22	.00846	.2571	.0268	.00126	.00333	2.50
%RSD	1.2316	1.4970	3.3079	1.2677	1.9679	3.0675	1.6593
#1	259.17	.57119	7.5902	2.0923	.06294	.10624	149.12
#2	263.72	.55922	7.9538	2.1301	.06472	.11095	152.66
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.1859	2.2721	1.4266	H647.10	.47930	43.050	46.607
SDev	.0208	.0348	.0195	8.33	.02770	.649	.700
%RSD	1.7543	1.5337	1.3696	1.2878	5.7782	1.5067	1.5017
[illegible]	1.1712	2.2475	1.4128	H641.21	.45972	42.591	46.112
#2	1.2006	2.2968	1.4404	H653.00	.49889	43.508	47.102
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Pass	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	9.7363	.91921	5.3794	15.798	L-.84475	.05351	25.826
SDev	.1478	.01359	.1064	.044	.03479	.00057	.266
%RSD	1.5181	1.4783	1.9778	.27976	4.1182	1.0719	1.0315
#1	9.6318	.90960	5.3042	15.767	L-.82015	.05310	25.638
#2	9.8408	.92882	5.4546	15.829	L-.86935	.05391	26.015
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.96529	1.3571	.05250	1.3903
SDev	.01406	.0204	.00059	.0118
%RSD	1.4566	1.5006	1.1224	.84551
[illegible]	.95535	1.3427	.05208	1.3820
#2	.97523	1.3715	.05292	1.3986
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 12.661
* Sb corrected for Fe = 0.5158
* Cd corrected for both Fe and As = 0.07319

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00121

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Method: EPACLP2 Sample Name: T76202 Operator: WM
Run Time: 10/27/98 10:39:21
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	26.468	L.01200	.73146	L.00199	L.00109	.00731	15.872
SDev	.225	.00247	.02515	.00000	.00027	.00106	.055
%RSD	.85167	20.563	3.4379	.00000	24.447	14.481	.34810
#1	26.627	L.01026	.74924	L.00199	L.00090	.00656	15.911
#2	26.308	L.01375	.71368	L.00199	L.00128	.00806	15.833
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.10708	.19442	.12100	72.879	L-.00443	4.8225	L4.9270
SDev	.00151	.00461	.00037	.544	.00165	.0287	.0570
%RSD	1.4064	2.3697	.30229	.74623	37.201	.59566	1.1571
	.10814	.19116	.12126	73.264	L-.00327	4.8428	L4.9673
	.10601	.19767	.12074	72.494	L-.00560	4.8022	L4.8867
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.98958	-.00065	.53328	L1.8322	L-.07982	L.00189	L2.6400
SDev	.00506	.00145	.00171	.1934	.00388	.00039	.0259
%RSD	.51150	223.26	.32142	10.554	4.8629	20.701	.97916
#1	.99316	-.00168	.53207	L1.6954	L-.07707	L.00161	L2.6583
#2	.98600	.00038	.53449	L1.9689	L-.08256	L.00217	L2.6217
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.05005	.09222	.00604	.04207
SDev	.00074	.00066	.00030	.00000
%RSD	1.4742	.71889	4.8766	.00000
	.05057	.09268	.00583	.04207
#2	L.04952	.09175	.00625	.04207
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76202D Operator: WM
Run Time: 10/27/98 10:41:07
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	26.314	L.01252	.75188	L.00133	L.00128	L.00429	15.680
SDev	.110	.01147	.03412	.00000	.00001	.00120	.078
%RSD	.41765	91.655	4.5376	.00000	.40089	28.023	.49680
#1	26.236	L.00441	.72776	L.00133	L.00128	L.00344	15.625
#2	26.392	L.02063	.77601	L.00133	L.00128	.00514	15.735
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.10389	.19487	.12026	72.277	L-.00755	4.7745	L4.8429
SDev	.00060	.00000	.00069	.386	.00429	.0242	.0365
%RSD	.58223	.00189	.57505	.53432	56.854	.50593	.75458
[illegible]	.10346	.19487	.11977	72.004	L-.00451	4.7574	L4.8171
#2	.10431	.19487	.12075	72.550	L-.01058	4.7916	L4.8688
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.98070	-.00401	.51569	L1.5353	L-.07139	L.00279	L2.6260
SDev	.00397	.00160	.00944	.0829	.00833	.00097	.0054
%RSD	.40480	39.880	1.8305	5.3977	11.668	34.756	.20508
#1	.97790	-.00513	.50901	L1.5939	L-.06550	L.00210	L2.6222
#2	.98351	-.00288	.52236	L1.4767	L-.07728	L.00347	L2.6298
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.04856	.08978	.00542	.04207
SDev	.00121	.00137	.00118	.00000
%RSD	2.4994	1.5271	21.757	.00000
[illegible]	L.04771	.08881	.00458	.04207
#2	L.04942	.09075	.00625	.04207
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76202S Operator: WM
Run Time: 10/27/98 10:43:04
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	27.193	L.05665	.75833	.22211	.00701	.01132	16.137
SDev	.140	.01151	.02825	.00141	.00000	.00127	.008
%RSD	.51517	20.312	3.7252	.63418	.02148	11.228	.04936
#1	27.094	L.04851	.73836	.22112	.00701	.01043	16.132
#2	27.292	.06479	.77831	.22311	.00701	.01222	16.143
Errors	LC Pass	LC Low	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.12934	.24975	.14969	74.306	L.04283	4.9017	L4.9821
SDev	.00120	.00002	.00002	.335	.00019	.0127	.0010
%RSD	.93177	.00698	.01296	.45069	.44690	.25972	.01909
#1	.12848	.24973	.14968	74.069	L.04296	4.8927	L4.9828
#2	.13019	.24976	.14971	74.543	L.04269	4.9107	L4.9814
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.0605	.09623	.58787	L1.8009	L-.07696	L.00718	L2.6948
SDev	.0036	.00159	.01888	.0829	.02034	.00095	.0036
%RSD	.34001	1.6544	3.2115	4.6015	26.436	13.295	.13323
#1	1.0579	.09510	.57452	L1.8595	L-.06257	L.00650	L2.6974
#2	1.0630	.09735	.60122	L1.7423	L-.09134	L.00785	L2.6923
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10158	.14830	.00583	.15013
SDev	.00034	.00083	.00000	.00235
%RSD	.33232	.55991	.00000	1.5660
#1	.10182	.14889	.00583	.15179
#2	.10134	.14772	.00583	.14847
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76203 Operator: WM
Run Time: 10/27/98 10:45:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	256.18	L.04053	10.012	L.01394	.00802	.05725	122.03
SDev	.44	.02271	.088	.00000	.00001	.00318	.80
%RSD	.17080	56.024	.87440	.00000	.06055	5.5562	.65836
#1	256.49	L.02447	9.9499	L.01394	.00802	.05950	121.46
#2	255.87	L.05659	10.074	L.01394	.00802	.05500	122.60
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.0512	2.0373	1.4226	H631.50	L-.00429	34.784	36.960
SDev	.0030	.0124	.0066	1.09	.00101	.143	.070
%RSD	.28691	.61010	.46556	.17233	23.506	.41197	.18942
[illegible]	1.0491	2.0285	1.4272	H630.73	L-.00358	34.683	37.009
#2	1.0533	2.0461	1.4179	H632.26	L-.00500	34.886	36.910
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	7.1046	-.02408	5.4287	14.325	L-.88891	L.00483	22.507
SDev	.0239	.00093	.0266	.116	.09355	.00149	.136
%RSD	.33676	3.8500	.49014	.80989	10.524	30.945	.60616
#1	7.0877	-.02474	5.4475	14.243	L-.82276	L.00377	22.604
#2	7.1215	-.02343	5.4098	14.407	L-.95506	L.00588	22.411
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.47542	.73184	.06542	.39118
SDev	.00113	.00431	.00059	.01881
%RSD	.23704	.58856	.90077	4.8080
[illegible]	.47622	.72880	.06583	.40448
#2	.47462	.73489	.06500	.37788
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 14.59
* Sb corrected for Fe = -0.005
* Cd corrected for both Fe and As = 0.02628

[illegible] 10/28/98

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Method: EPACLP2 Sample Name: CCV13 Operator: WM
Run Time: 10/27/98 10:47:32
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9189	5.0046	2.0065	.50365	.48673	.51806	5.0770
SDev	.0109	.0440	.0039	.00329	.00316	.00384	.0075
%RSD	.22114	.87861	.19658	.65257	.64911	.74125	.14706
#1	4.9266	4.9735	2.0037	.50133	.48450	.51534	5.0823
#2	4.9113	5.0356	2.0093	.50598	.48897	.52077	5.0718
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1540	.49410	.48227	5.0976	4.9597	4.9762	5.0722
SDev	.0093	.00001	.00033	.0547	.0247	.0104	.0336
%RSD	.18028	.00133	.06879	1.0736	.49792	.20991	.66271
	5.1475	.49410	.48204	5.1363	4.9423	4.9688	5.0484
#2	5.1606	.49409	.48251	5.0589	4.9772	4.9836	5.0959
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49464	.48685	.52283	25.400	1.9356	.51036	25.171
SDev	.00070	.00383	.00086	.022	.0218	.00138	.174
%RSD	.14102	.78679	.16414	.08700	1.1283	.27141	.69179
#1	.49414	.48414	.52343	25.416	1.9201	.51134	25.047
#2	.49513	.48956	.52222	25.385	1.9510	.50938	25.294
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49209	2.5485	.49375	.01215
SDev	.00064	.0058	.00177	.00000
%RSD	.13003	.22811	.35803	.00000
	.49255	2.5443	.49250	.01215
#2	.49164	2.5526	.49500	.01215
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV13 Operator: WM
Run Time: 10/27/98 10:50:23
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02818	-.04716	-.00551	.00100	.00055	-.00269	.01601
SDev	.00796	.00649	.00885	.00047	.00026	.00007	.00522
%RSD	28.261	13.763	160.54	47.140	46.063	2.7233	32.625
#1	.03381	-.04257	-.01177	.00133	.00073	-.00264	.01971
#2	.02255	-.05175	.00075	.00066	.00037	-.00274	.01232
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00678	-.17051	-.00023	.06640	-.00169	.00808	-.01793
SDev	.00150	.00329	.00000	.01835	.00746	.00261	.00005
%RSD	22.073	1.9314	.48806	27.627	440.14	32.325	.29052
[illegible]	.00784	-.17284	-.00023	.07937	.00358	.00993	-.01797
#2	.00572	-.16818	-.00023	.05343	-.00697	.00623	-.01790
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00051	.00110	.00797	.68755	-.02487	.00131	16.967
SDev	.00036	.00000	.00686	.02210	.00270	.00090	.040
%RSD	69.606	.08745	86.134	3.2141	10.864	69.044	.23699
#1	.00077	.00110	.00312	.67193	-.02678	.00067	16.996
#2	.00026	.00110	.01282	.70318	-.02296	.00195	16.939
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00115	-.00055	.00104	10.143
SDev	.00194	.00075	.00030	.042
%RSD	169.51	136.28	28.284	.41722
[illegible]	.00252	-.00002	.00083	10.173
#2	-.00023	-.00108	.00125	10.113
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB13 Operator: WM
Run Time: 10/27/98 10:52:23
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01474	L.00288	L-.01133	L.00066	L.00019	L-.00095	L.00440
SDev	.00571	.00492	.00176	.00000	.00026	.00081	.00025
%RSD	38.732	170.67	15.510	.00000	136.98	85.656	5.6275
#1	L.01878	L-.00060	L-.01257	L.00066	L.00001	L-.00037	L.00423
#2	L.01070	L.00636	L-.01009	L.00066	L.00037	L-.00152	L.00458
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00085	L.00371	L-.00094	L.03298	L-.00188	.00092	L-.02375
SDev	.00030	.00263	.00033	.00156	.01023	.00033	.02510
%RSD	35.447	70.711	35.385	4.7195	544.12	35.355	105.67
#1	L.00106	L.00557	L-.00071	L.03408	L-.00911	.00115	L-.04150
#2	L.00064	L.00186	L-.00118	L.03188	L.00535	.00069	L-.00601
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00024	-.00054	L-.00061	L.89851	L.00330	L.00130	L.04417
SDev	.00071	.00077	.00343	.46408	.00641	.00092	.00610
%RSD	290.17	142.83	564.27	51.649	194.22	71.105	13.817
#1	L-.00074	-.00108	L-.00304	L.57036	L-.00123	L.00065	L.03986
#2	L.00026	.00001	L.00182	L1.2267	L.00783	L.00195	L.04849
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00056	L-.00000	.00083	.02378
SDev	.00119	.00001	.00118	.00927
%RSD	210.68	501.53	141.42	38.996
#1	L-.00140	L.00001	-.00000	.03034
#2	L.00028	L-.00001	.00167	.01722
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76203 Operator: WM
Run Time: 10/27/98 10:54:39
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	25.930	L.01111	.99156	L.00133	L.00091	.00553	12.654
SDev	.098	.00246	.00955	.00000	.00001	.00226	.046
%RSD	.37669	22.103	.96341	.00000	.74518	40.784	.36582
#1	25.999	L.00938	.99832	L.00133	L.00090	.00712	12.686
#2	25.861	L.01285	.98481	L.00133	L.00091	L.00393	12.621
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.11105	.21821	.14587	69.629	L-.00854	3.7956	L3.8183
SDev	.00180	.00262	.00102	.227	.00487	.0108	.0663
%RSD	1.6217	1.2027	.69662	.32600	57.057	.28380	1.7356
[illegible]	.11232	.22006	.14659	69.789	L-.01199	3.8032	L3.8652
#2	.10978	.21635	.14515	69.468	L-.00509	3.7880	L3.7715
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.74748	-.00331	.57878	L2.0353	L-.08490	L.00154	L2.2970
SDev	.00323	.00157	.00086	.0608	.01510	.00141	.0054
%RSD	.43217	47.472	.14848	2.9859	17.791	91.388	.23446
#1	.74976	-.00220	.57817	L1.9923	L-.07422	L.00254	L2.3008
#2	.74520	-.00442	.57939	L2.0783	L-.09558	L.00055	L2.2932
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.04940	.07708	.00708	.04837
SDev	.00161	.00215	.00000	.00232
%RSD	3.2480	2.7908	.00000	4.7930
[illegible]	.05054	.07860	.00708	.04673
#2	L.04827	.07556	.00708	.05001
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76204 Operator: WM
Run Time: 10/27/98 10:56:50
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288 *	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	14.238	L.01665	L-.54100	L.07636	L.00212	L.00276	139.73
SDev	.301	.00583	.02864	.00188	.00000	.00187	1.62
%RSD	2.1143	35.031	5.2933	2.4595	.09259	67.940	1.1570
#1	14.025	L.01253	L-.52075	L.07503	L.00212	L.00408	138.59
#2	14.451	L.02077	L-.56125	L.07769	L.00212	L.00143	140.87
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00862	.27233	L.01997	103.62	L.00076	33.466	35.413
SDev	.00177	.00525	.00077	1.78	.01631	.459	.689
%RSD	20.536	1.9282	3.8651	1.7140	2148.6	1.3724	1.9463
	L.00987	.26862	L.01942	102.36	L.01230	33.142	34.926
#2	L.00737	.27604	L.02051	104.87	L-.01078	33.791	35.900
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	6.7003	-.00407	.60606	8.0436	L-.14653	L.00155	14.805
SDev	.1090	.00104	.01716	.2818	.00899	.00020	.409
%RSD	1.6266	25.641	2.8314	3.5029	6.1382	12.660	2.7621
#1	6.6232	-.00481	.59393	8.2428	L-.14017	L.00141	14.516
#2	6.7774	-.00333	.61820	7.8444	L-.15289	L.00169	15.094
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.02669	.11944	.02354	.14344
SDev	.00081	.00117	.00030	.00232
%RSD	3.0521	.98141	1.2515	1.6161
	L.02612	.11861	.02333	.14508
#2	L.02727	.12026	.02375	.14180
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = -0.00360

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Method: EPACLP2 Sample Name: T76205 Operator: WM
Run Time: 10/27/98 11:04:15
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.0442	L.00500	L-.00993	L.02689	L.00112	L-.00018	57.107
SDev	.0391	.00079	.00329	.00047	.00001	.00005	.382
%RSD	1.2852	15.872	33.181	1.7459	.44637	28.149	.66941
#1	3.0165	L.00444	L-.01226	L.02656	L.00111	L-.00015	56.837
#2	3.0719	L.00556	L-.00760	L.02722	L.00112	L-.00022	57.377
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00169	L.02937	.07875	.60160	L-.00199	12.993	13.259
SDev	.00030	.00197	.00134	.01526	.00473	.123	.243
%RSD	17.798	6.7199	1.6970	2.5368	237.56	.94717	1.8298
[illegible]	L-.00190	L.03076	.07780	.61239	L-.00533	12.906	13.088
#2	L-.00147	L.02797	.07969	.59081	L.00135	13.080	13.431
Errors	LC Low	LC Low	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.8477	-.00261	.05399	6.0591	L.02951	L.00042	9.3175
SDev	.0152	.00077	.00171	.3039	.00636	.00093	.2143
%RSD	.82332	29.547	3.1771	5.0149	21.554	221.45	2.3004
#1	1.8369	-.00206	.05520	6.2739	L.02501	L.00107	9.1659
#2	1.8585	-.00315	.05278	5.8442	L.03401	L-.00024	9.4691
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00012	.06897	.00083	.05165
SDev	.00119	.00072	.00059	.00232
%RSD	1024.1	1.0407	70.711	4.4887
[illegible]	L.00095	.06947	.00042	.05001
#2	L-.00072	.06846	.00125	.05328
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76206 Operator: WM
Run Time: 10/27/98 11:07:57
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288 *	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	51.472	L.03198	L-.65119	L.00830	.01076	.00718	395.56
SDev	.004	.00416	.02783	.00047	.00000	.00027	3.03
%RSD	.00742	13.010	4.2730	5.6568	.02879	3.7544	.76653
#1	51.470	L.02904	L-.67087	L.00797	.01076	.00737	393.42
#2	51.475	L.03493	L-.63152	L.00863	.01076	.00698	397.71
Errors	LC Pass	LC Low	LC Low	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00324	.39387	1.2858	96.883	L.00287	84.263	95.928
SDev	.00090	.00132	.0023	.433	.00746	.452	.007
%RSD	27.935	.33546	.18004	.44656	260.08	.53693	.00743
#1	L.00260	.39293	1.2875	96.577	L-.00241	83.943	95.923
#2	L.00388	.39480	1.2842	97.189	L.00815	84.582	95.933
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	22.292	-.00347	.63149	23.596	L-.16777	L.00135	15.777
SDev	.122	.00300	.01201	.243	.01101	.00003	.073
%RSD	.54643	86.585	1.9024	1.0302	6.5638	2.5769	.46424
#1	22.206	-.00134	.62299	23.424	L-.17556	L.00133	15.828
#2	22.378	-.00559	.63998	23.767	L-.15998	L.00138	15.725
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00696	.90013	.00333	.31392
SDev	.00070	.00643	.00059	.00232
%RSD	10.103	.71441	17.678	.73847
#1	L.00646	.89559	.00375	.31228
#2	L.00745	.90468	.00292	.31556
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = 0.00123

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Method: EPACLP2 Sample Name: T76207 Operator: WM
Run Time: 10/27/98 11:09:49
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	43.541	L.04973	L-1.9307	L.01826	.00688	.01695	329.98
SDev	.423	.00031	.0293	.00047	.00026	.00072	4.78
%RSD	.97223	.61736	1.5171	2.5713	3.7450	4.2396	1.4492
#1	43.242	L.04951	L-1.9100	L.01793	.00670	.01644	326.60
#2	43.841	L.04995	L-1.9515	L.01859	.00707	.01746	333.36
Errors	LC Pass	LC Low	LC Low	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02100	.90428	L.01573	364.73	L.00629	69.797	78.029
SDev	.00022	.01247	.00030	5.17	.00487	.878	.834
%RSD	1.0338	1.3785	1.9065	1.4185	77.415	1.2585	1.0692
[illegible]	.02116	.89546	L.01552	361.07	L.00285	69.176	77.439
[illegible]	.02085	.91309	L.01594	368.39	L.00973	70.418	78.619
Errors	LC Pass	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	18.027	-.01206	2.0287	17.462	L-.59439	L.00554	24.040
SDev	.245	.00234	.0523	.210	.01803	.00058	.165
%RSD	1.3602	19.411	2.5800	1.2022	3.0335	10.416	.68699
#1	17.853	-.01372	1.9917	17.314	L-.58164	L.00513	23.923
#2	18.200	-.01041	2.0657	17.611	L-.60714	L.00595	24.156
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.08673	.39910	.00313	.34506
SDev	.00126	.00788	.00088	.00927
%RSD	1.4531	1.9752	28.284	2.6873
[illegible]	.08584	.39353	.00375	.33851
#2	.08762	.40468	.00250	.35162
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cal corrected for Fe = -0.00544

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Method: EPACLP2 Sample Name: T76208 Operator: WM
Run Time: 10/27/98 11:14:50
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	16.448	L.03159	L-.74325	L.06076	L.00246	L.00406	134.94
SDev	.111	.02041	.01374	.00047	.00000	.00087	.62
%RSD	.67453	64.605	1.8487	.77279	.07562	21.323	.46240
#1	16.369	L.01716	L-.75297	L.06042	L.00246	L.00467	134.50
#2	16.526	L.04602	L-.73353	L.06109	L.00246	L.00345	135.38
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00809	.33937	L.01010	137.31	L-.00029	30.904	31.842
SDev	.00089	.00459	.00071	.70	.01249	.140	.236
%RSD	10.975	1.3512	7.0158	.50704	4303.7	.45314	.74246
	L.00872	.33613	L.00960	136.81	L.00854	30.805	31.675
#2	L.00747	.34262	L.01060	137.80	L-.00912	31.003	32.009
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	6.7706	-.00539	.76622	10.141	L-.21093	L.00198	13.913
SDev	.0288	.00220	.00515	.110	.01406	.00145	.113
%RSD	.42537	40.784	.67227	1.0895	6.6650	73.189	.81026
#1	6.7502	-.00384	.76987	10.220	L-.20099	L.00096	13.834
#2	6.7909	-.00694	.76258	10.063	L-.22087	L.00301	13.993
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.03353	.15163	.01271	.14016
SDev	.00045	.00283	.00088	.00696
%RSD	1.3495	1.8670	6.9551	4.9618
	L.03385	.14963	.01333	.13524
#2	L.03321	.15363	.01208	.14508
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = -0.00437

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Method: EPACLP2 Sample Name: T76209 Operator: WM
Run Time: 10/27/98 11:17:07
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.5062	L.02388	L-.09800	L.01859	L.00221	L.00112	321.47
SDev	.1213	.00147	.01594	.00000	.00000	.00070	8.54
%RSD	3.4598	6.1370	16.265	.00000	.06223	62.120	2.6579
#1	3.4205	L.02492	L-.10928	L.01859	L.00221	L.00063	315.43
#2	3.5920	L.02285	L-.08673	L.01859	L.00221	L.00161	327.52
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00237	.25490	.03498	24.258	L.00941	78.857	87.244
SDev	.00001	.00528	.00172	.780	.00737	1.969	3.034
%RSD	.57350	2.0725	4.9065	3.2157	78.331	2.4974	3.4778
[illegible]	L-.00238	.25117	.03376	23.706	L.00420	77.464	85.099
#2	L-.00236	.25864	.03619	24.810	L.01462	80.249	89.390
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	15.002	-.00048	.57573	7.7350	L-.04306	L.00207	23.795
SDev	.444	.00166	.03089	.3978	.00290	.00048	.907
%RSD	2.9566	348.56	5.3655	5.1426	6.7338	23.040	3.8098
#1	14.688	-.00165	.55389	8.0163	L-.04101	L.00173	23.154
#2	15.315	.00070	.59757	7.4537	L-.04511	L.00241	24.436
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00598	.10887	.00563	.17623
SDev	.00029	.00270	.00147	.00696
%RSD	4.8681	2.4795	26.189	3.9464
[illegible]	L.00618	.10696	.00667	.17131
#2	L.00577	.11078	.00458	.18114
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: CRIF1 Operator: WM
Run Time: 10/27/98 11:29:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00109	.12547	.21056	L.00066	.01073	.00828	L.00464
SDev	.00572	.00326	.00262	.00000	.00000	.00229	.00075
%RSD	522.82	2.5948	1.2423	.00000	.03300	27.670	16.059
#1	L.00513	.12777	.20871	L.00066	.01073	.00666	L.00412
#2	L-.00295	.12317	.21241	L.00066	.01072	.00990	L.00517
Errors	LC Low	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02194	.10463	.04989	L.01066	.09477	.00115	L.01771
SDev	.00090	.00197	.00067	.00062	.01237	.00065	.06692
%RSD	4.0969	1.8810	1.3401	5.8312	13.055	56.569	377.76
	.02257	.10602	.05036	L.01110	.10352	.00162	L.06503
#2	.02130	.10323	.04941	L.01022	.08602	.00069	L-.02960
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.03104	-.00323	.08612	L1.4103	.20107	.01900	L.03123
SDev	.00035	.00307	.00258	.0608	.01921	.00046	.00287
%RSD	1.1370	95.023	2.9906	4.3092	9.5560	2.4363	9.1981
#1	.03129	-.00541	.08429	L1.4532	.18748	.01867	L.02919
#2	.03079	-.00106	.08794	L1.3673	.21466	.01933	L.03326
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10182	.04124	.00125	.00247
SDev	.00086	.00073	.00000	.00232
%RSD	.85002	1.7762	.00000	93.895
	.10120	.04176	.00125	.00411
#2	.10243	.04072	.00125	.00083
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: ICSAF1 Operator: WM
Run Time: 10/27/98 11:31:17
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	498.70	.03985	-1.1641	.00863	.00032	.00846	508.56
SDev	1.27	.02933	.0642	.00000	.00001	.00300	3.41
%RSD	.25549	73.600	5.5116	.00000	1.9692	35.502	.67094
#1	497.80	.01911	-1.2095	.00863	.00032	.01058	506.15
#2	499.60	.06059	-1.1187	.00863	.00031	.00634	510.97
Errors	QC Pass	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value	500.00						500.00
Range	20.000						20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00177	.00209	.00489	182.06	-.00884	289.28	505.29
SDev	.00089	.00064	.00039	.90	.00877	1.61	1.85
%RSD	50.285	30.649	7.9040	.49531	99.195	.55801	.36699
	-.00114	.00164	.00462	181.42	-.00264	288.13	503.97
#2	-.00239	.00255	.00517	182.70	-.01504	290.42	506.60
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass
Value				200.00			500.00
Range				20.000			20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01596	-.00527	-.01942	.12110	-.40455	.00404	.06093
SDev	.00018	.00371	.01802	.11602	.00113	.00103	.00108
%RSD	1.1180	70.330	92.802	95.800	.27955	25.515	1.7678
#1	.01584	-.00265	-.00668	.03907	-.40375	.00331	.06017
#2	.01609	-.00789	-.03216	.20314	-.40535	.00477	.06169
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.01219	.00313	.01292	.20245
SDev	.00144	.00150	.00000	.00232
%RSD	11.818	48.023	.00000	1.1451
#1	.01117	.00419	.01292	.20081
#2	.01321	.00207	.01292	.20409
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value				
Range				

Method: EPACLP2 Sample Name: ICSABF1 Operator: WM
Run Time: 10/27/98 11:33:15
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	502.25	1.0462	-1.1780	.50531	.48937	1.0685	528.14
SDev	2.35	.0139	.0960	.00282	.00367	.0073	2.27
%RSD	.46837	1.3314	8.1530	.55750	.74945	.68412	.43048
#1	503.92	1.0364	-1.2459	.50730	.49197	1.0737	529.75
#2	500.59	1.0561	-1.1101	.50332	.48678	1.0633	526.53
Errors	QC Pass	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass
Value	500.00	1.0000		.50000	.50000	1.0000	500.00
Range	20.000	20.000		20.000	20.000	20.000	20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49161	.46253	.48882	186.56	.98331	298.95	511.07
SDev	.00091	.00262	.00440	.89	.03346	.60	2.63
%RSD	.18531	.56651	.89968	.47754	3.4031	.19938	.51506
	.49225	.46067	.49193	187.19	1.0070	299.37	512.93
#2	.49097	.46438	.48571	185.93	.95965	298.53	509.21
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	.50000	.50000	200.00	1.0000		500.00
Range	20.000	20.000	20.000	20.000	20.000		20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.48953	-.00486	.97976	1.1407	-.36070	1.0079	.18736
SDev	.00266	.00320	.01030	.0331	.00238	.0038	.00108
%RSD	.54248	66.001	1.0509	2.9059	.65935	.37609	.57489
#1	.49141	-.00259	.97248	1.1642	-.36238	1.0106	.18659
#2	.48765	-.00712	.98704	1.1173	-.35902	1.0052	.18812
Errors	QC Pass	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass	NOCHECK
Value	.50000		1.0000			1.0000	
Range	20.000		20.000			20.000	

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.48433	1.0391	.01396	.20737
SDev	.00359	.0057	.00030	.00000
%RSD	.74165	.55122	2.1108	.00000
	.48687	1.0432	.01417	.20737
#2	.48179	1.0351	.01375	.20737
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	.50000	1.0000		
Range	20.000	20.000		

Method: EPACLP2 Sample Name: CCV14 Operator: WM
Run Time: 10/27/98 11:37:54
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9133	5.0668	2.0398	.50863	.50270	.54249	5.2935
SDev	.0151	.0099	.0232	.00094	.00000	.00804	.0109
%RSD	.30780	.19616	1.1380	.18462	.00078	1.4817	.20686
#1	4.9240	5.0738	2.0562	.50930	.50270	.53680	5.2857
#2	4.9026	5.0597	2.0234	.50797	.50269	.54817	5.3012
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.3221	.50194	.48890	5.0759	5.0312	5.1357	5.2408
SDev	.0168	.00065	.00100	.0016	.0459	.0003	.0209
%RSD	.31537	.13013	.20506	.03058	.91327	.00636	.39910
[illegible]	5.3102	.50148	.48960	5.0748	4.9987	5.1360	5.2556
#2	5.3339	.50241	.48819	5.0770	5.0637	5.1355	5.2260
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50138	.49554	.54467	26.104	1.9834	.52012	25.341
SDev	.00106	.00538	.00257	.122	.0055	.00138	.127
%RSD	.21198	1.0848	.47260	.46562	.27710	.26538	.50013
#1	.50063	.49174	.54285	26.018	1.9795	.51914	25.430
#2	.50214	.49934	.54649	26.190	1.9873	.52110	25.251
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49991	2.6591	.50271	.01066
SDev	.00098	.0087	.00030	.00464
%RSD	.19570	.32701	.05860	43.473
[illegible]	.49922	2.6530	.50250	.00739
#2	.50060	2.6653	.50292	.01394
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV14 Operator: WM
Run Time: 10/27/98 11:40:02
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.03288	-.06391	-.00641	.00133	.00074	-.00212	.03203
SDev	.00325	.00578	.02073	.00000	.00000	.00057	.00199
%RSD	9.8784	9.0400	323.57	.00000	.03218	26.813	6.2163
#1	.03518	-.05982	-.02107	.00133	.00075	-.00252	.03344
#2	.03059	-.06799	.00825	.00133	.00074	-.00172	.03062
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00466	-.16866	-.00165	.02243	-.00892	.02677	-.00006
SDev	.00090	.00459	.00000	.00155	.00147	.00098	.03346
%RSD	19.258	2.7187	.00495	6.9350	16.479	3.6574	52536.
	.00530	-.17190	-.00165	.02353	-.00996	.02747	-.02373
#2	.00403	-.16541	-.00165	.02133	-.00788	.02608	.02360
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00000	.00109	.00493	1.1407	-.02303	.00162	16.982
SDev	.00036	.00307	.01287	.0884	.00001	.00046	.064
%RSD	7769.6	281.27	260.95	7.7491	.03605	28.245	.37420
#1	-.00025	-.00108	.01404	1.0782	-.02303	.00195	17.027
#2	.00026	.00326	-.00417	1.2032	-.02304	.00130	16.937
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00023	-.00104	.00167	10.225
SDev	.00009	.00005	.00000	.012
%RSD	38.490	4.3560	.00000	.11336
	-.00029	-.00108	.00167	10.216
#2	-.00017	-.00101	.00167	10.233
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB14 Operator: WM
Run Time: 10/27/98 11:42:02
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01539	L.00170	L.00282	L.00100	L.00018	L-.00167	L.01390
SDev	.00755	.00323	.00422	.00047	.00026	.00151	.00124
%RSD	49.087	189.72	149.35	47.140	138.59	90.060	8.9391
#1	L.01005	L-.00058	L-.00016	L.00066	L.00000	L-.00274	L.01302
#2	L.02073	L.00399	L.00581	L.00133	L.00037	L-.00061	L.01478
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00191	L.00139	L-.00165	L.01363	L-.00677	.01246	L.01179
SDev	.00120	.00065	.00000	.00093	.00618	.00033	.05019
%RSD	62.830	46.886	.00527	6.8315	91.224	2.6189	425.63
[illegible]	L.00106	L.00093	L-.00165	L.01297	L-.01114	.01270	L-.02370
#2	L.00275	L.00184	L-.00165	L.01429	L-.00240	.01223	L.04728
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00050	-.00271	L-.00546	L1.3282	L.00908	L.00130	L.05611
SDev	.00035	.00077	.00687	.0221	.00732	.00184	.00646
%RSD	71.067	28.228	125.70	1.6638	80.590	141.76	11.518
#1	L-.00075	-.00326	L-.00061	L1.3439	L.00391	L-.00000	L.06067
#2	L-.00025	-.00217	L-.01032	L1.3126	L.01425	L.00260	L.05154
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00020	L.00002	.00104	.02870
SDev	.00158	.00002	.00030	.00696
%RSD	796.05	150.02	28.284	24.235
#1	L-.00092	L-.00000	.00125	.03361
#2	L.00131	L.00003	.00083	.02378
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: CCV15 Operator: WM
Run Time: 10/27/98 11:48:00
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0235	5.0292	2.0000	.50258	.50342	.50459	5.0329
SDev	.0000	.0061	.0059	.00046	.00077	.00223	.0205
%RSD	.00051	.12044	.29440	.09061	.15229	.44136	.40649
#1	5.0236	5.0335	1.9959	.50290	.50396	.50617	5.0474
#2	5.0235	5.0250	2.0042	.50225	.50288	.50302	5.0184
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0335	.50620	.50239	5.0347	5.0118	5.0359	4.9796
SDev	.0171	.00188	.00068	.0123	.0251	.0132	.0492
%RSD	.34056	.37135	.13437	.24396	.49984	.26140	.98779
	5.0456	.50753	.50192	5.0434	5.0295	5.0452	5.0144
#2	5.0213	.50487	.50287	5.0261	4.9940	5.0266	4.9448
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50366	.50156	.49833	25.173	2.0196	.50156	25.098
SDev	.00069	.00073	.00394	.087	.0181	.00131	.042
%RSD	.13722	.14660	.79009	.34458	.89869	.26135	.16747
#1	.50415	.50208	.50111	25.234	2.0068	.50249	25.068
#2	.50317	.50104	.49554	25.111	2.0325	.50064	25.127
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.50307	2.5229	.50184	.01558
SDev	.00006	.0048	.00087	.00232
%RSD	.01285	.19038	.17270	14.877
	.50311	2.5263	.50245	.01722
#2	.50302	2.5195	.50123	.01394
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV15 Operator: WM
Run Time: 10/27/98 11:49:54
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00973	-.01053	-.00226	.00059	.00049	-.00174	.00668
SDev	.00242	.00457	.00497	.00000	.00025	.00008	.00000
%RSD	24.838	43.423	220.20	.00000	51.869	4.4003	.00599
#1	.00802	-.00730	.00126	.00059	.00031	-.00179	.00668
#2	.01143	-.01376	-.00577	.00059	.00067	-.00168	.00668
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00435	-.17303	-.00164	.01035	-.01201	.00498	-.05582
SDev	.00111	.00252	.00068	.00120	.00663	.00063	.02051
%RSD	25.445	1.4574	41.142	11.590	55.204	12.593	36.747
[illegible]	.00513	-.17481	-.00212	.01120	-.01670	.00542	-.07033
#2	.00357	-.17124	-.00116	.00950	-.00732	.00453	-.04132
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00002	-.00062	-.00242	1.0683	-.01474	.00164	16.879
SDev	.00034	.00073	.00788	.0759	.00606	.00044	.118
%RSD	1918.5	118.57	325.79	7.1041	41.137	26.754	.69890
#1	-.00026	-.00010	-.00315	1.1220	-.01045	.00133	16.796
#2	.00023	-.00113	.00799	1.0147	-.01903	.00195	16.963
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00003	-.00173	.00136	10.210
SDev	.00035	.00066	.00087	.093
%RSD	1170.7	38.191	63.492	.90822
[illegible]	-.00028	-.00220	.00198	10.144
#2	.00022	-.00126	.00075	10.275
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

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Method: EPACLP2 Sample Name: CCB15 Operator: WM
Run Time: 10/27/98 11:52:47
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00524	L.00843	L-.00286	L-.00006	L.00031	L-.00061	L-.00096
SDev	.00234	.00774	.02224	.00000	.00000	.00026	.00188
%RSD	44.589	91.822	778.49	.00000	1.0350	42.840	195.79
#1	L.00359	L.01391	L-.01858	L-.00006	L.00031	L-.00042	L-.00229
#2	L.00689	L.00296	L.01287	L-.00006	L.00031	L-.00079	L.00037
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00024	L.00052	L-.00117	L.00336	L-.00416	.00010	L-.00359
SDev	.00028	.00188	.00000	.00030	.00456	.00063	.00410
%RSD	113.45	364.67	.00473	8.9240	109.71	613.80	114.19
	L.00044	L.00185	L-.00117	L.00314	L-.00739	.00055	L-.00069
#2	L.00005	L-.00082	L-.00117	L.00357	L-.00093	-.00034	L-.00649
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00002	-.00114	L-.00769	L-.49618	L.01623	L.00102	L.02903
SDev	.00034	.00000	.00157	.10587	.01211	.00044	.00141
%RSD	1782.9	.03320	20.475	21.337	74.626	43.259	4.8665
#1	L-.00026	-.00114	L-.00658	L-.57105	L.02480	L.00133	L.02803
#2	L.00022	-.00114	L-.00880	L-.42132	L.00767	L.00071	L.03003
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00032	L-.00072	.00075	.01013
SDev	.00076	.00068	.00000	.00681
%RSD	234.16	94.483	.00000	67.225
	L.00021	L-.00024	.00075	.01495
#2	L-.00086	L-.00121	.00075	.00532
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76210 Operator: WM
Run Time: 10/27/98 11:54:53
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.9891	L.00769	L.00513	L.03311	L.00067	L-.00050	75.039
SDev	.0062	.00619	.01652	.00046	.00000	.00125	.422
%RSD	.31089	80.450	322.26	1.3754	.02534	249.56	.56289
#1	1.9847	L.01207	L.01681	L.03343	L.00067	L.00038	74.740
#2	1.9935	L.00332	L-.00656	L.03279	L.00067	L-.00138	75.338
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00073	L.02368	.05862	.23325	L-.00999	18.162	18.625
SDev	.00055	.00062	.00000	.00178	.00328	.069	.033
%RSD	75.607	2.6310	.00036	.76485	32.870	.37794	.17616
[illegible]	L-.00034	L.02324	.05862	.23198	L-.00767	18.113	18.602
#2	L-.00112	L.02412	.05862	.23451	L-.01231	18.210	18.649
Errors	LC Low	LC Low	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.7728	-.00161	.04521	L3.6252	L.00818	L.00076	10.428
SDev	.0083	.00220	.00394	.0279	.00086	.00044	.030
%RSD	.46652	136.84	8.7116	.76852	10.566	57.042	.28450
#1	1.7670	-.00005	.04799	L3.6055	L.00879	L.00045	10.449
#2	1.7787	-.00316	.04242	L3.6449	L.00757	L.00107	10.407
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00092	.05844	.00259	.05349
SDev	.00007	.00068	.00029	.00000
%RSD	7.1737	1.1568	11.151	.00000
[illegible]	L.00096	.05892	.00239	.05349
#2	L.00087	.05796	.00279	.05349
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76211 Operator: WM
Run Time: 10/27/98 11:57:08
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	45.572	L.01176	L.00223	L.01025	L.00301	L.00119	159.15
SDev	.145	.00155	.00630	.00000	.00025	.00067	.79
%RSD	.31918	13.189	282.33	.00000	8.2270	55.885	.49952
#1	45.469	L.01066	L-.00222	L.01025	L.00319	L.00072	158.58
#2	45.675	L.01286	L.00669	L.01025	L.00283	L.00166	159.71
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00494	.17115	1.0618	.30631	L.00248	47.628	49.915
SDev	.00138	.00314	.0027	.00147	.02177	.201	.287
%RSD	27.951	1.8371	.25469	.48101	879.29	.42183	.57523
	L.00591	.16893	1.0599	.30527	L.01787	47.486	49.712
#2	L.00396	.17337	1.0637	.30736	L-.01292	47.770	50.118
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.5729	.00056	.34700	7.3999	L.03529	L-.00198	9.7352
SDev	.0155	.00073	.00079	.0724	.00697	.00042	.0201
%RSD	.43405	131.40	.22656	.97890	19.740	21.405	.20680
#1	3.5619	.00004	.34644	7.4512	L.04022	L-.00228	9.7210
#2	3.5839	.00108	.34755	7.3487	L.03037	L-.00168	9.7495
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00252	.40973	.00198	.06152
SDev	.00187	.00344	.00116	.00227
%RSD	73.992	.83921	58.426	3.6914
#1	L.00385	.40730	.00279	.06313
#2	L.00120	.41216	.00116	.05992
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76212 Operator: WM
Run Time: 10/27/98 11:59:07
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.20991	L.00632	L-.01904	L.01218	L.00012	L-.00243	23.725
SDev	.00947	.00927	.00089	.00000	.00025	.00142	.086
%RSD	4.5131	146.71	4.6871	.00000	217.16	58.610	.36439
#1	.20321	L-.00024	L-.01841	L.01218	L.00030	L-.00142	23.664
#2	.21660	L.01287	L-.01967	L.01218	L-.00006	L-.00343	23.786
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00073	L.00185	L.00363	.22833	L.00169	5.1547	5.1238
SDev	.00055	.00000	.00000	.00030	.01447	.0194	.0369
%RSD	75.233	.00340	.00372	.13132	854.56	.37699	.72049
#1	L-.00034	L.00185	L.00363	.22811	L-.00854	5.1410	5.0977
#2	L-.00113	L.00185	L.00363	.22854	L.01192	5.1684	5.1499
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01343	-.00110	L.00066	L1.2611	L.00320	L.00075	9.2277
SDev	.00000	.00000	.00079	.0613	.00692	.00087	.0237
%RSD	.00038	.01508	118.57	4.8602	216.06	116.30	.25645
#1	L.01343	-.00110	L.00122	L1.2178	L-.00169	L.00013	9.2110
#2	L.01343	-.00110	L.00011	L1.3045	L.00810	L.00136	9.2445
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00261	L-.00175	.00627	.02459
SDev	.00038	.00069	.00029	.00000
%RSD	14.503	39.430	4.6092	.00000
#1	L.00288	L-.00224	.00647	.02459
#2	L.00235	L-.00126	.00606	.02459
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76213 Operator: WM
Run Time: 10/27/98 12:01:05
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.09336	L.01450	L-.00261	L.06499	L-.00006	L-.00262	15.023
SDev	.00567	.00847	.01075	.00000	.00000	.00155	.008
%RSD	6.0769	58.409	412.23	.00000	5.2039	59.225	.05316
#1	L.09738	L.00851	L-.01021	L.06499	L-.00006	L-.00152	15.018
#2	L.08935	L.02049	L.00499	L.06499	L-.00006	L-.00371	15.029
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00152	L.00140	L.00315	.18215	L-.01124	4.4965	L4.4046
SDev	.00055	.00062	.00068	.00030	.01051	.0013	.0451
%RSD	36.381	44.196	21.479	.16441	93.535	.02788	1.0244
	L-.00191	L.00096	L.00267	.18236	L-.00380	4.4956	L4.3727
#2	L-.00113	L.00184	L.00363	.18194	L-.01867	4.4974	L4.4365
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm -	ppm	ppm	ppm	ppm	ppm
Avge	L.00928	-.00422	L-.00658	L3.1524	L.01782	L.00105	8.2277
SDev	.00034	.00000	.00630	.1170	.00346	.00043	.0145
%RSD	3.7155	.04128	95.827	3.7120	19.422	41.157	.17601
#1	L.00952	-.00422	L-.00212	L3.0697	L.02027	L.00136	8.2175
#2	L.00903	-.00422	L-.01103	L3.2352	L.01538	L.00074	8.2380
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00225	L-.00221	.00279	.02138
SDev	.00076	.00002	.00058	.00000
%RSD	33.588	.97551	20.672	.00000
#1	L.00172	L-.00223	.00239	.02138
#2	L.00279	L-.00219	.00320	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76214 Operator: WM
Run Time: 10/27/98 12:03:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	10.323	L.01777	L-.32838	L.03890	L.00154	L.00055	135.03
SDev	.100	.00378	.00562	.00046	.00025	.00142	.90
%RSD	.97308	21.261	1.7115	1.1705	16.425	256.76	.66509
#1	10.252	L.02045	L-.33236	L.03858	L.00172	L-.00045	134.40
#2	10.394	L.01510	L-.32441	L.03923	L.00136	L.00155	135.67
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00340	.23743	L.00658	51.091	L-.00375	31.304	32.171
SDev	.00193	.00189	.00065	.467	.00739	.255	.343
%RSD	56.733	.79717	9.8653	.91407	196.85	.81401	1.0669
[illegible]	L.00476	.23609	L.00704	50.761	L.00147	31.124	31.928
#2	L.00203	.23877	L.00612	51.422	L-.00898	31.484	32.414
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.7337	-.00250	.51071	6.0248	L-.00502	L.00153	13.391
SDev	.0528	.00008	.01339	.0557	.01891	.00004	.147
%RSD	.92120	2.9987	2.6216	.92487	376.87	2.7845	1.0973
#1	5.6964	-.00256	.50124	6.0642	L.00835	L.00150	13.287
#2	5.7711	-.00245	.52017	5.9854	L-.01839	L.00156	13.495
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00880	.09629	.00157	.09846
SDev	.00075	.00059	.00000	.00908
%RSD	8.5455	.60721	.00000	9.2265
#1	L.00934	.09588	.00157	.09203
#2	L.00827	.09670	.00157	.10488
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76215 Operator: WM
Run Time: 10/27/98 12:05:23
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.11980	L.00904	L-.00132	L.07046	L.00012	L-.00212	14.280
SDev	.00426	.00228	.02301	.00046	.00026	.00190	.016
%RSD	3.5585	25.252	1736.7	.64628	216.43	89.522	.11351
#1	L.12282	L.00742	L.01495	L.07078	L-.00006	L-.00078	14.292
#2	L.11679	L.01065	L-.01759	L.07014	L.00030	L-.00346	14.269
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00191	L.00185	L.00004	.21498	L-.00661	4.7101	L4.6394
SDev	.00166	.00001	.00372	.00180	.00263	.0138	.0000
%RSD	87.003	.57449	8431.4	.83593	39.811	.29279	.00011
[illegible]	L-.00073	L.00185	L-.00259	.21625	L-.00475	4.7199	L4.6394
#2	L-.00308	L.00184	L.00267	.21371	L-.00846	4.7004	L4.6394
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01075	-.00007	L-.00323	L3.4361	L.00932	L.00075	8.4093
SDev	.00034	.00000	.00945	.0724	.00520	.00000	.0127
%RSD	3.2097	4.1207	292.23	2.1082	55.745	.02385	.15121
#1	L.01099	-.00007	L.00345	L3.4873	L.01299	L.00075	8.4183
#2	L.01050	-.00007	L-.00992	L3.3849	L.00565	L.00075	8.4003
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00237	L-.00222	.00422	.02138
SDev	.00000	.00003	.00029	.00000
%RSD	.18418	1.4603	6.8378	.00000
#1	L.00238	L-.00225	.00402	.02138
#2	L.00237	L-.00220	.00443	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:07:30
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k1477.6	k.11260	k19.659	L.01669	k.05099	k.60845	471.20
SDev	15.9	.02559	.557	.00000	.00072	.00213	2.78
%RSD	1.0750	22.723	2.8310	.00000	1.4095	.35063	.58970
#1	k1466.4	k.09451	k19.265	L.01669	k.05049	k.60996	469.23
#2	k1488.9	k.13070	k20.052	L.01669	k.05150	k.60694	473.16
Errors	LC High	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k4.6151	k8.7683	k12.908	S3389.6	k-.46948	175.32	k224.52
SDev	.0323	.0557	.179	.0	.02452	.90	2.41
%RSD	.70061	.63474	1.3831	.00002	5.2224	.51487	1.0724
#1	k4.5923	k8.7290	k12.782	S3389.6	k-.48682	174.68	k222.82
#2	k4.6380	k8.8077	k13.034	S3389.6	k-.45214	175.96	k226.22
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k43.735	k.17863	k22.449	L-.93354	k2.5460	k.17242	17.665
SDev	.355	.00581	.168	.18946	.1007	.00218	.164
%RSD	.81161	3.2547	.74721	20.294	3.9570	1.2653	.92573
#1	k43.484	k.18274	k22.330	L-.79958	k2.6173	k.17396	17.550
#2	k43.986	k.17451	k22.567	L-1.0675	k2.4748	k.17088	17.781
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	k1.5746	k4.1061	.06020	1.0941
SDev	.0113	.0304	.00029	.0273
%RSD	.71623	.74025	.47991	2.4909
#1	k1.5666	k4.0846	.06040	1.0748
#2	k1.5825	k4.1276	.05999	1.1133
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

MB 5ea 1/2 dil
WM 10/27/98

ysis Report Tue 10-27-98 12:11:13 PM page 1

Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:09:27
Comment: SDG: T76201 1/2 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	772.55	L.03085	16.432	L.01025	.02688	.21624	259.54
SDev	14.08	.03022	.234	.00000	.00022	.00575	.10
%RSD	1.8222	97.958	1.4229	.00000	.82037	2.6604	.03667
#1	782.50	L.05222	16.598	L.01025	.02703	.21218	259.47
#2	762.60	L.00948	16.267	L.01025	.02672	.22031	259.61
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.5395	4.9074	6.5035	H989.29	L-.00923	108.21	122.21
SDev	.0125	.0171	.1636	5.59	.01301	.10	2.15
%RSD	.49306	.34795	2.5160	.56492	141.03	.08921	1.7558
	2.5483	4.9195	6.6192	H993.24	L-.01843	108.28	123.73
#2	2.5306	4.8953	6.3878	H985.34	L-.00003	108.15	120.70
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

3 sd.d. w/ dilution

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	23.807	-.03333	12.574	L.08696	L-.42738	L-.00485	9.2700
SDev	.146	.00427	.012	.64081	.01171	.00107	.2338
%RSD	.61264	12.804	.09390	736.87	2.7411	22.027	2.5224
#1	23.910	-.03635	12.582	L-.36616	L-.43567	L-.00560	9.4353
#2	23.704	-.03032	12.566	L.54008	L-.41910	L-.00409	9.1046
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.85159	2.3769	.03425	.61232
SDev	.00823	.0042	.00000	.00454
%RSD	.96639	.17571	.00000	.74177
#1	.85741	2.3739	.03425	.61553
#2	.84577	2.3798	.03425	.60911
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As Corrected for Fe = 24.369
* Sb Corrected for Fe = -0.049
* Cd corrected for both Fe and As = 0.1618

10/28/98

An sis Report Tue 10-27-98 12:13:22 PM page 1

Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:11:47
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	170.03	L.02885	3.5306	L.00284	.00581	.04780	58.130
SDev	1.57	.01244	.0463	.00046	.00025	.00049	.994
%RSD	.92562	43.122	1.3101	16.028	4.3125	1.0159	1.7099
#1	171.14	L.03764	3.5633	L.00316	.00599	.04815	58.833
#2	168.91	L.02005	3.4978	L.00252	.00563	.04746	57.427
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.58786	1.1514	1.4409	241.24	L-.01132	27.455	27.611
SDev	.00724	.0176	.0120	2.92	.01486	.380	.336
%RSD	1.2307	1.5259	.83308	1.2124	131.23	1.3836	1.2178
#1	.59298	1.1638	1.4493	243.31	L-.00082	27.724	27.849
#2	.58274	1.1389	1.4324	239.18	L-.02183	27.187	27.373
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.4894	-.00486	2.9574	L-.08640	L-.07478	L.00244	L2.1077
SDev	.0740	.00192	.0181	.17274	.00703	.00078	.0095
%RSD	1.3478	39.464	.61225	199.92	9.3959	31.791	.45245
#1	5.5417	-.00350	2.9702	L.03574	L-.07975	L.00299	L2.1145
#2	5.4371	-.00621	2.9446	L-.20855	L-.06981	L.00189	L2.1010
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.19419	.54614	.00770	.13860
SDev	.00122	.00715	.00000	.00227
%RSD	.62625	1.3086	.00000	1.6385
#1	.19505	.55120	.00770	.14021
#2	.19333	.54109	.00770	.13700
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76217 Operator: WM
Run Time: 10/27/98 12:16:13
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.12184	L.00523	L-.00632	L.13518	L.00011	L-.00054	28.850
SDev	.00999	.00314	.01739	.00091	.00025	.00266	.092
%RSD	8.1981	60.052	275.23	.67372	222.68	494.98	.31838
#1	L.11478	L.00745	L.00598	L.13582	L.00029	L.00135	28.915
#2	L.12890	L.00301	L-.01862	L.13454	L-.00006	L-.00242	28.785
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00024	L.00318	L.00315	.17809	L.00320	5.5000	5.4720
SDev	.00083	.00187	.00270	.00599	.01116	.0194	.0533
%RSD	342.94	58.845	85.888	3.3655	348.25	.35332	.97480
[illegible]	L.00083	L.00186	L.00506	.17385	L.01109	5.5137	5.5097
#2	L-.00034	L.00451	L.00124	.18233	L-.00468	5.4862	5.4342
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02926	-.00111	L-.00101	L2.9869	L.01536	L.00044	10.611
SDev	.00034	.00147	.01103	.1950	.02076	.00043	.119
%RSD	1.1756	132.24	1094.9	6.5294	135.21	98.576	1.1218
#1	.02950	-.00007	L.00679	L2.8490	L.03004	L.00013	10.695
#2	.02901	-.00215	L-.00880	L3.1248	L.00067	L.00074	10.527
Errors	LC Pass	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00369	L-.00320	.00279	.01977
SDev	.00118	.00004	.00116	.00227
%RSD	31.965	1.1286	41.345	11.487
#1	L.00452	L-.00323	.00361	.01816
#2	L.00285	L-.00317	.00198	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: CCV16 Operator: WM
Run Time: 10/27/98 12:18:29
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.8347	4.9640	2.0118	.47682	.48394	.52216	5.1975
SDev	.0047	.0040	.0363	.00046	.00076	.00105	.0047
%RSD	.09665	.07990	1.8052	.09550	.15742	.20188	.09036
#1	4.8314	4.9668	2.0375	.47649	.48341	.52290	5.1942
#2	4.8380	4.9612	1.9861	.47714	.48448	.52141	5.2009
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0581	.50311	.47178	5.0057	5.0789	5.0295	4.8753
SDev	.0011	.00253	.00068	.0030	.0092	.0028	.0656
%RSD	.02186	.50298	.14347	.05980	.18024	.05609	1.3460
#1	5.0573	.50490	.47130	5.0036	5.0724	5.0275	4.8289
#2	5.0589	.50133	.47226	5.0078	5.0853	5.0315	4.9217
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50243	.49172	.50891	24.957	1.9633	.50058	23.649
SDev	.00103	.00293	.01575	.028	.0286	.00087	.000
%RSD	.20608	.59496	3.0951	.11164	1.4551	.17306	.00000
#1	.50170	.48965	.52005	24.977	1.9431	.50119	23.649
#2	.50316	.49379	.49777	24.938	1.9835	.49997	23.649
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49243	2.5827	.48754	.01495
SDev	.00122	.0027	.00087	.00454
%RSD	.24828	.10447	.17776	30.377
#1	.49156	2.5846	.48693	.01174
#2	.49329	2.5808	.48815	.01816
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

Method: EPACLP2 Sample Name: CCV16 Operator: WM
Run Time: 10/27/98 12:20:55
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00989	-.01666	-.00702	.00304	.00019	-.00070	.01310
SDev	.00637	.00699	.00338	.00000	.00026	.00141	.00158
%RSD	64.392	41.967	48.104	.00000	135.15	202.40	12.069
#1	.01439	-.02161	-.00940	.00304	.00038	.00030	.01422
#2	.00539	-.01172	-.00463	.00304	.00001	-.00169	.01198
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00331	-.16401	-.00057	.02843	-.01004	.00493	.03580
SDev	.00082	.00000	.00000	.00299	.00001	.00125	.07569
%RSD	24.742	.00122	.02891	10.523	.05084	25.275	211.41
#1	.00389	-.16401	-.00057	.03054	-.01004	.00581	.08933
#2	.00273	-.16401	-.00057	.02631	-.01003	.00405	-.01772
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00047	-.00217	.00009	1.3261	-.01032	.00041	16.810
SDev	.00034	.00000	.00155	.1339	.00176	.00043	.094
%RSD	73.623	.04033	1742.8	10.093	17.044	104.87	.56147
#1	.00071	-.00217	.00118	1.4208	-.01156	.00011	16.877
#2	.00022	-.00217	-.00101	1.2315	-.00907	.00071	16.743
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00048	-.00231	.00148	9.7575
SDev	.00115	.00001	.00030	.0114
%RSD	241.97	.24574	19.958	.11637
#1	.00129	-.00231	.00127	9.7655
#2	-.00034	-.00230	.00169	9.7495
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
				10.000

Method: EPACLP2 Sample Name: CCB16 Operator: WM
Run Time: 10/27/98 12:22:56
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00642	L.00077	L-.01453	L.00304	L.00001	L-.00245	L.00047
SDev	.00443	.01094	.00091	.00000	.00001	.00140	.00226
%RSD	68.943	1427.9	6.2323	.00000	92.369	57.400	475.80
#1	L.00329	L-.00697	L-.01389	L.00304	L.00002	L-.00344	L-.00112
#2	L.00955	L.00850	L-.01517	L.00304	L.00000	L-.00145	L.00207
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00171	L.00273	L-.00108	L.01827	L-.00469	.00008	L-.03554
SDev	.00082	.00250	.00000	.00120	.01819	.00000	.02524
%RSD	47.765	91.711	.04796	6.5586	388.21	.00000	71.012
#1	L-.00229	L.00096	L-.00108	L.01912	L-.01755	.00008	L-.05339
#2	L-.00113	L.00450	L-.00108	L.01743	L.00818	.00008	L-.01769
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00026	-.00217	L-.00929	L1.6613	L-.00120	L.00040	L.09986
SDev	.00000	.00298	.00851	.1171	.00616	.00132	.00037
%RSD	.33866	137.27	91.598	7.0498	513.91	328.71	.37360
#1	L-.00026	-.00428	L-.01531	L1.5785	L-.00556	L-.00053	L.09959
#2	L-.00026	-.00006	L-.00327	L1.7442	L.00316	L.00133	L.10012
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00089	L-.00180	.00065	.01656
SDev	.00239	.00064	.00089	.00681
%RSD	268.07	35.454	137.48	41.146
#1	L-.00258	L-.00225	.00002	.02138
#2	L.00080	L-.00135	.00127	.01174
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76214L Operator: WM
Run Time: 10/27/98 12:26:02
Comment: SDG: T76201 1/5 SERIAL DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.0725	L.01191	L-.06890	L.01113	L.00056	L.00007	26.446
SDev	.0015	.01479	.00508	.00000	.00026	.00004	.041
%RSD	.07389	124.14	7.3666	.00000	47.065	50.601	.15382
#1	2.0714	L.02237	L-.07249	L.01113	L.00074	L.00010	26.474
#2	2.0736	L.00146	L-.06531	L.01113	L.00037	L.00005	26.417
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00001	.05124	L.00155	10.325	L-.00227	6.4819	6.5343
SDev	.00137	.00374	.00000	.021	.00510	.0115	.0378
%RSD	27036.	7.2977	.07442	.20578	224.70	.17786	.57835
#1	L.00096	L.04859	L.00155	10.340	L.00134	6.4901	6.5610
#2	L-.00097	.05388	L.00155	10.310	L-.00588	6.4738	6.5076
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.1541	.00049	.10124	L2.8839	L.01645	L.00114	L2.7760
SDev	.0014	.00000	.00387	.0167	.02650	.00000	.0015
%RSD	.11922	.87912	3.8244	.58020	161.09	.37675	.05375
#1	1.1551	.00049	.10397	L2.8957	L.03519	L.00114	L2.7750
#2	1.1532	.00049	.09850	L2.8720	L-.00229	L.00113	L2.7771
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00230	L.01822	.00148	.03101
SDev	.00039	.00068	.00030	.00000
%RSD	16.859	3.7446	19.958	.00000
#1	L.00257	L.01773	.00127	.03101
#2	L.00202	L.01870	.00169	.03101
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: Fe 500 ppm Operator: WM
Run Time: 10/27/98 12:28:05
Comment: SDG: T76201 IEC MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.02733	L.03326	L-3.2899	L.00641	L.00016	.03070	L.05928
SDev	.00152	.00227	.0058	.00000	.00026	.00138	.00045
%RSD	5.5635	6.8187	.17733	.00000	168.42	4.4834	.76262
#1	L.02625	L.03487	L-3.2940	L.00641	L-.00003	.02973	L.05896
#2	L.02840	L.03166	L-3.2858	L.00641	L.00034	.03168	L.05960
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00092	L.00622	L.00824	H479.43	L.00958	.01617	L.01256
SDev	.00029	.00249	.00112	.85	.00892	.00031	.01084
%RSD	31.176	40.073	13.650	.17809	93.137	1.9272	86.280
#1	L.00072	L.00446	L.00744	H478.83	L.00327	.01639	L.02022
#2	L.00112	L.00799	L.00903	H480.03	L.01588	.01595	L.00490
Errors	LC Low	LC Low	LC Low	LC High	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00016	-.01202	L-.02407	L1.6613	L-.19451	L.00370	L.11779
SDev	.00155	.00136	.01083	.0948	.02215	.00097	.00186
%RSD	941.32	11.279	45.009	5.7070	11.388	26.260	1.5835
#1	L.00093	-.01106	L-.03173	L1.5943	L-.21017	L.00302	L.11911
#2	L-.00126	-.01298	L-.01641	L1.7284	L-.17884	L.00439	L.11647
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00859	L.00711	.00127	.19480
SDev	.00004	.00148	.00000	.00454
%RSD	.46229	20.768	.00000	2.3316
#1	L.00862	L.00815	.00127	.19802
#2	L.00856	L.00606	.00127	.19159
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
	.05000	.02000		

Fe interference on As = -0.0065
Fe int. on Cd = 0.0000614 A
Fe int on Sb = 0.0000665

00159

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Method: EPACLP2 Sample Name: As 10 ppm Operator: WM
Run Time: 10/27/98 12:30:39
Comment: SDG: T76201 IEC MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01294	L.00686	10.106	L.00304	L-.00036	L-.00807	L.00383
SDev	.00003	.00701	.059	.00000	.00000	.00071	.00023
%RSD	.20670	102.16	.58517	.00000	.84058	8.8036	5.9231
#1	L.01292	L.01182	10.064	L.00304	L-.00036	L-.00857	L.00399
#2	L.01296	L.00190	10.148	L.00304	L-.00037	L-.00756	L.00367
Errors	LC Low	LC Low	LC Pass	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00190	L-.00123	L-.00031	.19519	L-.00298	.03115	L-.03307
SDev	.00000	.00062	.00035	.12510	.00384	.00031	.01297
%RSD	.18612	50.335	113.65	64.091	128.84	1.0003	39.229
#1	L-.00190	L-.00167	L-.00056	.28365	L-.00027	.03093	L-.04224
#2	L-.00191	L-.00079	L-.00006	.10673	L-.00570	.03137	L-.02390
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00047	-.00267	L-.00108	L2.1227	L.01415	L.00073	L.12465
SDev	.00037	.00225	.00464	.1785	.00821	.00001	.00485
%RSD	78.388	84.472	429.12	8.4075	58.007	1.5108	3.8906
#1	L-.00021	-.00107	L.00220	L2.2489	L.01996	L.00074	L.12808
#2	L-.00073	-.00426	L-.00437	L1.9965	L.00835	L.00073	L.12122
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00037	L-.00421	.00065	.02940
SDev	.00070	.00130	.00030	.00227
%RSD	191.85	30.950	45.825	7.7233
#1	L-.00086	L-.00329	.00086	.02780
#2	L.00013	L-.00513	.00044	.03101
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

As int on cal = 0.000847 ppm/ppb

00160

Method: EPACLP2 Standard: STD2

Elem	Sb2068	Ba4934	Cd2288	Cr2677	Ni2316	K_7665	Ag3280
Avge	1.2369	.22014	.13014	3.3712	.11836	1.3006	.21993
SDev	.0004	.00020	.00141	.0100	.00030	.0058	.00030
%RSD	.03267	.09177	1.0867	.29664	.25604	.44270	.13779
#1	1.2371	.22000	.12914	3.3641	.11814	1.2966	.21971
#2	1.2366	.22029	.13114	3.3783	.11857	1.3047	.22014

Elem	Na5889
Avge	14.175
SDev	.002
%RSD	.01639
#1	14.174
#2	14.177

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Method: EPACLP2 Standard: STD1-Blank

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Avge	.01043	-.00064	-.00029	.00500	.00071	.00021	.00107
SDev	.00040	.00010	.00141	.00000	.00000	.00030	.00051
%RSD	3.8746	15.713	494.97	.00000	.00000	141.42	47.140
#1	.01071	-.00071	.00071	.00500	.00071	.00000	.00143
#2	.01014	-.00057	-.00129	.00500	.00071	.00043	.00071

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Avge	.00064	-.00029	.00079	.03050	.00164	.00093	.00086
SDev	.00030	.00000	.00010	.00010	.00071	.00010	.00020
%RSD	47.140	.00000	12.856	.33120	43.041	10.879	23.570
#1	.00086	-.00029	.00086	.03043	.00214	.00100	.00071
#2	.00043	-.00029	.00071	.03057	.00114	.00086	.00100

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Avge	.00021	.00029	.00064	.38643	.00186	-.00043	.10736
SDev	.00010	.00000	.00010	.00000	.00040	.00061	.00091
%RSD	47.140	.00000	15.713	.00000	21.757	141.42	.84684
#1	.00029	.00029	.00071	.38643	.00157	.00000	.10800
#2	.00014	.00029	.00057	.38643	.00214	-.00086	.10671

Elem	V_2924	Zn2138	Ti3349	B_2496
Avge	.00021	.00071	.00114	.00400
SDev	.00010	.00000	.00000	.00000
%RSD	47.140	.00000	.00000	.00000
#1	.00029	.00071	.00114	.00400
#2	.00014	.00071	.00114	.00400

Method: CUMNCD Sample Name: CUMNCD Operator: WM
Run Time: 10/27/98 09:32:39
Comment: MET9815876
Mode: IR Corr. Factor: 1

Elem	Cd2288	Mn2576
Avge	717.5	.9078
SDev	4.0	.0054
%RSD	.5546	.5927
#1	714.0	.9100
#2	717.0	.9128
#3	721.0	.9127
#4	726.0	.9128
#5	719.0	.9120
#6	719.0	.9079
#7	716.0	.9038
#8	716.0	.8977
#9	712.0	.9010
#10	715.0	.9072

IntStd	1	2	3	4	5	6	7
Mode	*Counts	None	NOTUSED	NOTUSED	NOTUSED	NOTUSED	NOTUSED
Elem	Cu	--	--	--	--	--	--
Wavlen	324.754	--	--	--	--	--	--
Avge	1654	1	--	--	--	--	--
SDev	6.033241	.0000000	--	--	--	--	--
%RSD	.3648108	.0000000	--	--	--	--	--
#1	1644	1	--	--	--	--	--
#2	1652	1	--	--	--	--	--
#3	1660	1	--	--	--	--	--
#4	1652	1	--	--	--	--	--
#5	1648	1	--	--	--	--	--
#6	1661	1	--	--	--	--	--
#7	1653	1	--	--	--	--	--
#8	1662	1	--	--	--	--	--
#9	1657	1	--	--	--	--	--
#10	1649	1	--	--	--	--	--

Method: EPACLP2 Sample Name: ICV Operator: WM
Run Time: 10/27/98 09:48:26
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0904	2.5483	2.5019	5.1783	.12420	1.2752	12.557
SDev	.0202	.0009	.0325	.0061	.00026	.0036	.001
%RSD	.39734	.03418	1.3001	.11787	.21290	.27872	.00595
#1	5.0761	2.5489	2.4789	5.1740	.12438	1.2727	12.556
#2	5.1048	2.5477	2.5249	5.1826	.12401	1.2778	12.557
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	2.5000	2.5000	5.0000	.12500	1.2500	12.500
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50515	1.2400	.62501	2.5069	2.4998	12.513	12.588
SDev	.00090	.0039	.00134	.0047	.0075	.013	.063
%RSD	.17923	.31828	.21398	.18600	.29889	.10434	.49826
#1	.50451	1.2372	.62406	2.5036	2.5051	12.504	12.544
#2	.50579	1.2428	.62595	2.5102	2.4945	12.523	12.633
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	1.2500	.62500	2.5000	2.5000		12.500
Range	10.000	10.000	10.000	10.000	10.000		10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.2510	5.0143	1.3095	12.814	2.4832	.62891	12.639
SDev	.0007	.0169	.0034	.022	.0229	.00000	.011
%RSD	.05708	.33692	.26199	.17247	.92103	.00048	.08806
#1	1.2505	5.0023	1.3071	12.829	2.4994	.62891	12.631
#2	1.2515	5.0262	1.3119	12.798	2.4671	.62891	12.646
Errors	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	1.2500		1.2500	12.500	2.5000	.62500	12.500
Range	10.000		10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	1.2477	1.2744	.00188	.01515
SDev	.0005	.0029	.00030	.00238
%RSD	.04041	.22726	15.713	15.713
#1	1.2473	1.2723	.00208	.01683
#2	1.2480	1.2764	.00167	.01346
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	1.2500	1.2500		
Range	10.000	10.000		

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Method: EPACLP2 Sample Name: ICV Operator: WM
Run Time: 10/27/98 09:51:10
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00307	-.00306	-.00792	.00299	-.00003	.00036	.00563
SDev	.00049	.00000	.00951	.00047	.00026	.00145	.00249
%RSD	16.103	.10969	120.10	15.713	799.08	405.96	44.177
#1	-.00342	-.00306	-.01464	.00332	.00015	-.00067	.00739
#2	-.00272	-.00306	-.00119	.00266	-.00021	.00138	.00387
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00066	-.04218	-.00054	.00550	-.00557	.00554	.01181
SDev	.00090	.00002	.00000	.00124	.00069	.00229	.02509
%RSD	137.02	.03663	.79954	22.609	12.446	41.248	212.38
	-.00129	-.04217	-.00054	.00637	-.00508	.00716	.02956
	-.00002	-.04219	-.00054	.00462	-.00606	.00392	-.00593
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00050	.00434	-.00908	.14064	.00201	.00098	8.3876
SDev	.00036	.00307	.00343	.08840	.00275	.00045	.0323
%RSD	70.624	70.720	37.795	62.854	136.88	46.250	.38525
#1	.00075	.00651	-.01151	.20314	.00395	.00066	8.3647
#2	.00025	.00217	-.00665	.07813	.00006	.00130	8.4104
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00075	-.00376	5.1267	5.1229
SDev	.00126	.00001	.0112	.0000
%RSD	166.53	.32661	.21839	.00000
	.00164	-.00375	5.1188	5.1229
#2	-.00013	-.00377	5.1346	5.1229
Errors	NOCHECK	NOCHECK	QC Pass	QC Pass
Value			5.0000	5.0000
Range			10.000	10.000

Method: EPACLP2 Sample Name: ICB Operator: WM
Run Time: 10/27/98 09:53:10
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00239	L-.00290	L-.00672	L.00066	L-.00000	L-.00156	L-.00141
SDev	.00893	.00331	.03873	.00000	.00000	.00111	.00199
%RSD	373.80	113.91	576.00	.00000	1602.6	71.431	141.45
#1	L.00870	L-.00524	L.02066	L.00066	L.00000	L-.00077	L.00000
#2	L-.00393	L-.00056	L-.03411	L.00066	L-.00000	L-.00235	L-.00282
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00106	L.00277	L-.00047	L.00088	L-.00673	.00069	L.00295
SDev	.00120	.00132	.00033	.00031	.00346	.00065	.02091
%RSD	113.12	47.509	70.971	35.365	51.405	94.281	707.67
	L-.00021	L.00184	L-.00023	L.00066	L-.00918	.00115	L-.01183
#2	L-.00191	L.00371	L-.00071	L.00110	L-.00428	.00023	L.01774
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00050	-.00109	L-.00546	L.11720	L.00970	L.00032	L.01447
SDev	.00035	.00153	.00343	.02210	.00092	.00046	.00574
%RSD	70.760	141.16	62.828	18.856	9.4468	140.85	39.697
#1	L-.00025	-.00000	L-.00789	L.13282	L.00905	L.00065	L.01853
#2	L-.00075	-.00217	L-.00304	L.10157	L.01035	L.00000	L.01041
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00004	L-.00101	.00479	.01178
SDev	.00034	.00001	.00030	.00714
%RSD	930.95	1.2339	6.1488	60.609
	L-.00028	L-.00100	.00458	.01683
#2	L.00020	L-.00102	.00500	.00673
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Avge	4.9145	5.0001	1.9702	.50531	.48618	.50522	4.9133
#1	4.9252	4.9972	1.9860	.50531	.48637	.50339	4.9105
#2	4.9038	5.0029	1.9544	.50531	.48599	.50704	4.9162
Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Avge	5.0593	.48948	.48368	4.9178	4.8947	4.9224	4.9633
#1	5.0601	.48855	.48392	4.9152	4.8976	4.9181	4.9781
#2	5.0585	.49040	.48345	4.9204	4.8918	4.9268	4.9485
Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Avge	.48810	.48845	.51009	25.150	1.9695	.50158	25.259
#1	.48760	.48628	.51373	25.150	1.9455	.50223	25.287
#2	.48860	.49062	.50644	25.150	1.9934	.50094	25.231

Ignore
10/27/97
Accidental scan point

Analysis Report QC Standard Tue 10-27-98 10:00:42 AM page 1

Method: EPACLP2 Sample Name: CCV11 Operator: WM
Run Time: 10/27/98 09:56:18
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9145	5.0001	1.9702	.50531	.48618	.50522	4.9133
SDev	.0151	.0041	.0223	.00000	.00026	.00259	.0040
%RSD	.30716	.08115	1.1332	.00000	.05449	.51179	.08103
#1	4.9252	4.9972	1.9860	.50531	.48637	.50339	4.9105
#2	4.9038	5.0029	1.9544	.50531	.48599	.50704	4.9162
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0593	.48948	.48368	4.9178	4.8947	4.9224	4.9633
SDev	.0012	.00131	.00033	.0037	.0041	.0062	.0209
%RSD	.02367	.26751	.06910	.07584	.08321	.12600	.42154
	5.0601	.48855	.48392	4.9152	4.8976	4.9181	4.9781
#2	5.0585	.49040	.48345	4.9204	4.8918	4.9268	4.9485
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.48810	.48845	.51009	25.150	1.9695	.50158	25.259
SDev	.00071	.00307	.00515	.000	.0339	.00091	.039
%RSD	.14536	.62862	1.0095	.00000	1.7192	.18222	.15635
#1	.48760	.48628	.51373	25.150	1.9455	.50223	25.287
#2	.48860	.49062	.50644	25.150	1.9934	.50094	25.231
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49163	2.4685	.49208	.01010
SDev	.00048	.0058	.00059	.00000
%RSD	.09696	.23577	.11975	.00000
	.49129	2.4644	.49250	.01010
#2	.49197	2.4726	.49167	.01010
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

Analysis Report QC Standard Tue 10-27-98 10:03:41 AM page 1

Method: EPACLP2 Sample Name: CCV11 Operator: WM
Run Time: 10/27/98 10:01:09
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00185	-.02463	-.00172	-.00000	.00000	-.00329	.00018
SDev	.00102	.00897	.00257	.00000	.00000	.00079	.00075
%RSD	55.189	36.424	149.34	.00000	30.763	23.905	421.52
#1	.00257	-.03097	.00010	-.00000	.00001	-.00273	.00071
#2	.00113	-.01828	-.00354	-.00000	.00000	-.00385	-.00035
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00148	-.17097	-.00047	.00286	-.02251	.00069	-.08873
SDev	.00240	.00526	.00033	.00000	.00696	.00000	.05019
%RSD	161.65	3.0771	70.725	.02732	30.943	.00000	56.563
	.00318	-.16725	-.00024	.00286	-.01758	.00069	-.05324
	-.00021	-.17469	-.00071	.00286	-.02743	.00069	-.12422
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00050	-.00217	.00433	-.02344	-.01660	.00129	17.075
SDev	.00035	.00154	.00515	.02210	.02195	.00092	.069
%RSD	70.600	70.827	118.91	94.287	132.25	71.146	.40160
#1	-.00075	-.00108	.00797	-.00781	-.00108	.00064	17.027
#2	-.00025	-.00326	.00069	-.03906	-.03212	.00194	17.124
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00116	-.00207	-.00021	10.125
SDev	.00034	.00002	.00029	.010
%RSD	29.055	.81392	141.42	.09403
	-.00140	-.00208	-.00000	10.118
#2	-.00092	-.00206	-.00042	10.131
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB11 Operator: WM
Run Time: 10/27/98 10:04:02
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00372	L.00636	L.00791	L-.00000	L.00000	L-.00063	L-.00299
SDev	.00044	.01145	.01463	.00000	.00000	.00018	.00125
%RSD	11.798	180.04	184.91	.00000	220.58	28.277	41.628
#1	L.00341	L-.00174	L-.00243	L-.00000	L.00000	L-.00050	L-.00211
#2	L.00403	L.01445	L.01826	L-.00000	L-.00000	L-.00075	L-.00387
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00085	L.00186	L-.00047	L-.00088	L-.01256	-.00162	L-.00887
SDev	.00090	.00263	.00033	.00031	.00611	.00000	.01255
%RSD	105.79	141.46	70.641	35.366	48.652	.00000	141.45
#1	L-.00148	L.00371	L-.00024	L-.00110	L-.01688	-.00162	L-.01774
#2	L-.00021	L-.00000	L-.00071	L-.00066	L-.00824	-.00162	L.00000
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00075	-.00326	L-.00303	L-.01953	L.00582	L.00097	L.00584
SDev	.00000	.00153	.00343	.03867	.00823	.00046	.00574
%RSD	.05315	47.097	113.15	198.00	141.49	47.628	98.380
#1	L-.00075	-.00217	L-.00546	L.00781	L.01164	L.00064	L.00990
#2	L-.00075	-.00434	L-.00061	L-.04688	L-.00000	L.00130	L.00178
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00037	L-.00153	-.00021	.01215
SDev	.00073	.00071	.00029	.00470
%RSD	196.30	46.603	141.42	38.697
#1	L-.00089	L-.00203	-.00042	.01548
#2	L.00014	L-.00103	-.00000	.00883
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: CRII Operator: WM
Run Time: 10/27/98 10:06:42
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00373	.12719	.19846	L-.00000	.01036	.00841	L-.00222
SDev	.00192	.00241	.00428	.00000	.00000	.00081	.00149
%RSD	51.465	1.8966	2.1567	.00000	.01487	9.6594	67.332
#1	L.00509	.12548	.20148	L-.00000	.01036	.00783	L-.00327
#2	L.00237	.12889	.19543	L-.00000	.01036	.00898	L-.00116
Errors	LC Low	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02067	.10323	.05059	L.00011	.09474	-.00046	L-.00000
SDev	.00150	.00132	.00033	.00000	.00271	.00033	.00836
%RSD	7.2458	1.2800	.66065	.17598	2.8645	70.711	2607100.
	.02173	.10417	.05036	L.00011	.09282	-.00023	L-.00592
	.01961	.10230	.05083	L.00011	.09666	-.00069	L.00591
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02928	-.00215	.08430	L.16408	.19652	.01932	L.00457
SDev	.00000	.00153	.00686	.04420	.01647	.00092	.00108
%RSD	.00179	71.371	8.1433	26.937	8.3781	4.7559	23.570
#1	.02928	-.00323	.08915	L.19533	.20816	.01996	L.00533
#2	.02928	-.00106	.07944	L.13282	.18488	.01867	L.00381
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10047	.03868	-.00042	.00384
SDev	.00035	.00002	.00000	.00235
%RSD	.34483	.06233	.00000	61.245
	.10072	.03867	-.00042	.00550
#2	.10023	.03870	-.00042	.00218
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Analysis Report QC Standard Tue 10-27-98 10:10:26 AM page 1

Method: EPACLP2 Sample Name: ICSAI Operator: WM
Run Time: 10/27/98 10:08:43
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	498.00	.01790	-1.3493	.00764	-.00004	.01454	476.28
SDev	1.93	.00655	.0022	.00047	.00000	.00072	2.19
%RSD	.38656	36.613	.15994	6.1488	8.2051	4.9849	.45895
#1	496.64	.01327	-1.3478	.00730	-.00004	.01505	474.74
#2	499.36	.02254	-1.3508	.00797	-.00004	.01403	477.83
Errors	QC Pass	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value	500.00						500.00
Range	20.000						20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00505	.00172	.00284	175.27	-.03914	280.01	482.84
SDev	.00179	.00129	.00004	.67	.01134	1.07	.93
%RSD	35.401	74.980	1.3613	.38126	28.967	.38121	.19191
	-.00379	.00264	.00282	174.80	-.03113	279.25	482.18
	-.00631	.00081	.00287	175.74	-.04716	280.76	483.49
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass
Value				200.00			500.00
Range				20.000			20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01011	-.00740	-.02488	-.53910	-.16765	.00031	.04290
SDev	.00013	.00087	.00172	.00000	.03202	.00054	.00574
%RSD	1.3201	11.771	6.9015	.00000	19.100	176.04	13.389
#1	.01001	-.00801	-.02609	-.53910	-.14501	-.00008	.04697
#2	.01020	-.00678	-.02366	-.53910	-.19029	.00069	.03884
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00937	.00296	.01271	.19169
SDev	.00080	.00154	.00030	.00000
%RSD	8.5130	51.943	2.3184	.00000
	.00881	.00405	.01292	.19169
#2	.00994	.00187	.01250	.19169
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value				
Range				

Analysis Report QC Standard Tue 10-27-98 10:12:14 AM page 1

Method: EPACLP2 Sample Name: ICSABI Operator: WM
Run Time: 10/27/98 10:10:41
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	505.72	1.0062	-1.3660	.50000	.46826	.97265	483.52
SDev	.68	.0000	.0319	.00188	.00053	.00198	1.16
%RSD	.13366	.00002	2.3359	.37562	.11408	.20321	.24022
#1	506.20	1.0062	-1.3886	.50133	.46864	.97125	482.69
#2	505.25	1.0062	-1.3435	.49867	.46788	.97405	484.34
Errors	QC Pass	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass
Value	500.00	1.0000		.50000	.50000	1.0000	500.00
Range	20.000	20.000		20.000	20.000	20.000	20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.45462	.44314	.49186	177.85	.89199	282.10	490.77
SDev	.00210	.00133	.00001	.13	.02105	.67	.75
%RSD	.46130	.29973	.00162	.07325	2.3596	.23895	.15262
	.45313	.44408	.49186	177.76	.87711	281.62	491.30
	.45610	.44220	.49187	177.94	.90688	282.58	490.24
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	.50000	.50000	200.00	1.0000		500.00
Range	20.000	20.000	20.000	20.000	20.000		20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.45977	-.01001	.90695	-.70318	-.17124	.95750	.14572
SDev	.00109	.00228	.00000	.06630	.04343	.00181	.00036
%RSD	.23639	22.818	.00007	9.4281	25.360	.18891	.24638
#1	.45900	-.00839	.90695	-.75006	-.14053	.95878	.14547
#2	.46054	-.01162	.90695	-.65630	-.20195	.95622	.14597
Errors	QC Pass	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass	NOCHECK
Value	.50000		1.0000			1.0000	
Range	20.000		20.000			20.000	

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.46280	.94607	.01292	.19502
SDev	.00129	.00002	.00059	.00470
%RSD	.27980	.00182	4.5620	2.4111
	.46189	.94608	.01250	.19834
	.46372	.94606	.01333	.19169
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	.50000	1.0000		
Range	20.000	20.000		

Method: EPACLP2 Sample Name: CCV12 Operator: WM
Run Time: 10/27/98 10:12:48
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1414	5.0222	1.9705	.51062	.49212	.50746	5.1587
SDev	.0207	.0212	.0441	.00000	.00026	.00187	.0134
%RSD	.40296	.42203	2.2377	.00000	.05205	.36915	.26055
#1	5.1561	5.0372	1.9393	.51062	.49194	.50613	5.1682
#2	5.1268	5.0072	2.0017	.51062	.49230	.50878	5.1492
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1070	.49503	.49362	5.0315	4.9130	5.1570	5.1788
SDev	.0021	.00395	.00100	.0022	.0026	.0147	.0335
%RSD	.04108	.79795	.20317	.04330	.05372	.28485	.64619
	5.1055	.49224	.49291	5.0330	4.9149	5.1673	5.1552
	5.1085	.49782	.49433	5.0299	4.9112	5.1466	5.2025
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49162	.48684	.51312	25.264	1.9871	.50647	25.604
SDev	.00071	.00384	.00772	.061	.0238	.00138	.003
%RSD	.14412	.78894	1.5048	.24055	1.1972	.27317	.00981
#1	.49112	.48412	.50766	25.221	2.0039	.50550	25.605
#2	.49213	.48956	.51858	25.307	1.9703	.50745	25.602
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49472	2.5003	.49667	.01215
SDev	.00167	.0072	.00000	.00470
%RSD	.33806	.28907	.00000	38.697
	.49354	2.4952	.49667	.01548
#2	.49590	2.5054	.49667	.00883
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV12 Operator: WM
Run Time: 10/27/98 10:14:40
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.08089	-.02525	-.01664	.00066	.00037	-.00202	.07796
SDev	.00894	.00984	.02077	.00000	.00000	.00099	.01020
%RSD	11.053	38.959	124.83	.00000	.00094	49.263	13.089
#1	.08721	-.03220	-.03132	.00066	.00037	-.00132	.08518
#2	.07457	-.01829	-.00195	.00066	.00037	-.00272	.07075
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00382	-.17005	-.00047	.03628	-.00948	.07940	.02651
SDev	.00030	.00132	.00033	.00249	.01024	.01012	.06273
%RSD	7.8535	.77781	71.069	6.8582	108.10	12.744	236.59
	.00360	-.17099	-.00071	.03804	-.00223	.08656	.07087
	.00403	-.16912	-.00023	.03452	-.01672	.07225	-.01784
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00049	.00109	.00129	-.04297	-.02172	.00000	17.062
SDev	.00035	.00000	.00772	.04972	.01097	.00092	.014
%RSD	71.663	.15540	597.03	115.71	50.518	29030.	.07995
#1	-.00074	.00109	-.00417	-.00781	-.02948	-.00064	17.072
#2	-.00024	.00109	.00675	-.07813	-.01396	.00065	17.053
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00023	-.00206	.00125	9.9751
SDev	.00000	.00003	.00000	.0353
%RSD	.36071	1.2637	.00000	.35354
	-.00023	-.00204	.00125	9.9501
#2	-.00023	-.00208	.00125	10.000
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

lethod: EPACLP2 Sample Name: CCB12 Operator: WM
:un Time: 10/27/98 10:16:38
:omment: SDG: T76201 MET9815876
lode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.03237	L.00054	L-.02107	L-.00000	L.00019	L-.00031	L.02886
SDev	.00611	.00164	.00512	.00000	.00027	.00006	.01145
%RSD	18.858	304.05	24.298	.00000	144.02	20.701	39.671
#1	L.03669	L-.00062	L-.01745	L-.00000	L.00038	L-.00036	L.03696
#2	L.02806	L.00170	L-.02469	L-.00000	L-.00000	L-.00027	L.02077
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00021	L.00092	L-.00071	L.01253	L-.01503	.03001	L.02362
SDev	.00120	.00131	.00000	.00373	.00271	.00947	.02510
%RSD	564.89	142.60	.00167	29.775	18.010	31.548	106.27
[illegible]	L-.00063	L-.00001	L-.00071	L.01517	L-.01312	.03670	L.00587
[illegible]	L.00106	L.00185	L-.00071	L.00990	L-.01694	.02331	L.04137
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

_em	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00075	-.00054	L-.00789	L.17580	L.00584	L.00097	L.02107
SDev	.00000	.00077	.00000	.08287	.01556	.00138	.00718
%RSD	.12525	141.47	.00779	47.140	266.49	141.76	34.077
#1	L-.00075	.00000	L-.00789	L.11720	L.01684	L-.00000	L.02615
#2	L-.00075	-.00109	L-.00789	L.23439	L-.00516	L.00195	L.01599
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00002	L-.00203	-.00021	.02213
SDev	.00114	.00000	.00029	.00470
%RSD	7331.5	.00640	141.42	21.252
[illegible]	L-.00083	L-.00203	-.00042	.02545
#2	L.00079	L-.00203	-.00000	.01880
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: PBW Operator: WM
Run Time: 10/27/98 10:22:48
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01375	L.00691	L.00904	L-.00000	L-.00018	L-.00119	L-.00405
SDev	.00521	.01055	.01641	.00000	.00026	.00059	.00224
%RSD	37.907	152.82	181.47	.00000	144.34	50.032	55.352
#1	L.01743	L.01437	L-.00256	L-.00000	L.00000	L-.00161	L-.00246
#2	L.01006	L-.00056	L.02065	L-.00000	L-.00037	L-.00077	L-.00563
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00254	L.00278	L-.00071	L.00308	L-.01158	.00946	L-.04141
SDev	.00030	.00130	.00000	.00031	.00482	.00065	.08365
%RSD	11.783	46.862	.00254	10.113	41.605	6.8986	201.99
	L-.00276	L.00370	L-.00071	L.00330	L-.00818	.00993	L-.10056
	L-.00233	L.00186	L-.00071	L.00286	L-.01499	.00900	L.01774
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00100	-.00326	L-.01032	L.38675	L.02976	L.00129	L.01066
SDev	.00035	.00000	.01201	.22651	.00366	.00000	.00682
%RSD	35.334	.09768	116.46	58.569	12.306	.00696	63.976
#1	L-.00125	-.00326	L-.01881	L.54692	L.02717	L.00129	L.01549
#2	L-.00075	-.00326	L-.00182	L.22658	L.03234	L.00129	L.00584
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00093	L-.00407	.00083	.00883
SDev	.00000	.00004	.00000	.00000
%RSD	.09540	1.0059	.00000	.00000
	L-.00093	L-.00404	.00083	.00883
#2	L-.00093	L-.00410	.00083	.00883
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: LCSW Operator: WM
Run Time: 10/27/98 10:24:47
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.2224	2.5399	2.5711	5.4124	.12855	1.2912	12.933
SDev	.0146	.0057	.0204	.0150	.00002	.0099	.097
%RSD	.28040	.22579	.79322	.27760	.01476	.76772	.75239
#1	5.2121	2.5439	2.5567	5.4230	.12856	1.2842	12.864
#2	5.2328	2.5358	2.5856	5.4017	.12853	1.2982	13.002
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.52388	1.2707	.64581	2.5884	2.5434	12.845	13.082
SDev	.00090	.0053	.00200	.0112	.0081	.061	.025
%RSD	.17147	.41313	.31031	.43216	.31955	.47267	.19158
	.52324	1.2670	.64723	2.5805	2.5492	12.802	13.064
	.52451	1.2744	.64440	2.5963	2.5377	12.888	13.100
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.2908	.98023	1.3520	12.868	2.4607	.64170	13.098
SDev	.0035	.00921	.0034	.254	.0055	.00415	.044
%RSD	.27458	.94007	.25408	1.9749	.22362	.64673	.33441
#1	1.2883	.97371	1.3544	12.688	2.4568	.63876	13.129
#2	1.2933	.98674	1.3495	13.048	2.4646	.64463	13.067
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	1.2759	1.3093	.00063	1.0096
SDev	.0045	.0102	.00147	.0141
%RSD	.35636	.77656	235.70	1.3972
	1.2727	1.3021	-.00042	1.0196
#2	1.2791	1.3165	.00167	.99963
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76201 Operator: WM
Run Time: 10/27/98 10:28:06
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	59.220	L.02116	L-.13003	.33267	.00691	L.00196	76.801
SDev	.285	.00162	.00564	.00094	.00001	.00072	.455
%RSD	.48193	7.6547	4.3368	.28228	.06757	36.702	.59303
#1	59.018	L.02230	L-.13402	.33201	.00691	L.00145	76.479
#2	59.421	L.02001	L-.12605	.33333	.00690	L.00246	77.123
Errors	LC Pass	LC Low	LC Low	LC Pass	LC Pass	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.11340	.09398	.30219	37.056	L.00820	17.097	17.849
SDev	.00180	.00131	.00001	.210	.00647	.097	.137
%RSD	1.5864	1.3971	.00407	.56719	78.936	.56898	.76990
	.11213	.09491	.30218	36.907	L.01278	17.028	17.752
	.11467	.09305	.30220	37.205	L.00362	17.165	17.946
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.7232	-.00134	.17835	7.4342	L-.02504	L.00035	L1.9038
SDev	.0160	.00381	.00086	.2044	.01136	.00049	.0050
%RSD	.58623	283.94	.48149	2.7496	45.366	137.64	.26402
#1	2.7119	.00135	.17775	7.2896	L-.03307	L.00001	L1.9073
#2	2.7345	-.00403	.17896	7.5787	L-.01701	L.00070	L1.9002
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.12348	.22249	.17875	.05371
SDev	.00106	.00142	.00000	.00235
%RSD	.85679	.63808	.00000	4.3771
	.12273	.22148	.17875	.05205
#2	.12422	.22349	.17875	.05537
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76202 Operator: WM
Run Time: 10/27/98 10:30:08
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	* ppm	ppm	ppm	ppm	* ppm	ppm
Avge	252.58	L.05628	* 7.4065	L.01461	.01051	.06137	145.97
SDev	1.21	.01773	.0256	.00000	.00025	.00305	.83
%RSD	.47872	31.502	.34566	.00000	2.4055	4.9664	.56708
#1	251.73	.06881	7.3884	L.01461	.01033	.05922	145.39
#2	253.44	L.04374	7.4246	L.01461	.01069	.06353	146.56
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.95589	1.7428	1.1433	H633.68	L.00444	41.829	45.208
SDev	.00363	.0099	.0055	2.42	.01504	.212	.248
%RSD	.38014	.56703	.48011	.38157	338.65	.50726	.54915
	.95332	1.7358	1.1394	H631.97	.01508	41.679	45.032
#2	.95846	1.7498	1.1472	H635.39	L-.00620	41.979	45.383
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

5 ppm solution 10/27/98

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	8.9659	-.02395	4.6921	15.286	L-.71579	L.00599	25.137
SDev	.0500	.00269	.0438	.182	.00953	.00109	.092
%RSD	.55791	11.213	.93263	1.1927	1.3314	18.126	.36421
#1	8.9305	-.02585	4.6612	15.157	L-.72253	L.00676	25.072
#2	9.0012	-.02205	4.7231	15.415	L-.70906	L.00522	25.201
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.45809	.83510	.05208	.39285
SDev	.00242	.00608	.00000	.00705
%RSD	.52910	.72793	.00000	1.7954
	.45638	.83080	.05208	.38786
#2	.45981	.83940	.05208	.39783
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

*Ag corrected for Fe: 12.162
*Sb corrected for Fe: 0.00787
*Cd corrected for both Fe and As: 0.02643

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Method: EPACLP2 Sample Name: T76202D Operator: WM
Run Time: 10/27/98 10:33:32
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	257.18	.07193	7.6764	L.01461	.01086	.05684	148.83
SDev	2.78	.02252	.1141	.00000	.00025	.00557	.83
%RSD	1.0819	31.311	1.4867	.00000	2.3295	9.8019	.55817
#1	255.21	.08786	7.5957	L.01461	.01068	.06078	148.25
#2	259.15	L.05601	7.7571	L.01461	.01104	.05290	149.42
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.97528	1.7703	1.1636	H641.15	L.02135	42.573	46.088
SDev	.00696	.0119	.0203	4.48	.00648	.282	.498
%RSD	.71391	.67034	1.7460	.69604	30.343	.66170	1.0796
	.97036	1.7619	1.1492	H638.00	L.02593	42.374	45.736
	.98021	1.7787	1.1779	H644.31	L.01677	42.772	46.440
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	9.1380	-.02711	4.8214	15.439	L-.81780	L.00558	25.647
SDev	.0759	.00147	.0669	.122	.04223	.00007	.332
%RSD	.83066	5.4169	1.3882	.78726	5.1643	1.2224	1.2949
#1	9.0843	-.02815	4.7741	15.353	L-.78794	L.00553	25.413
#2	9.1917	-.02607	4.8687	15.525	L-.84767	L.00563	25.882
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.46466	.85117	.05250	.40448
SDev	.00240	.00139	.00059	.01411
%RSD	.51621	.16386	1.1224	3.4875
	.46296	.85018	.05208	.39451
	.46635	.85215	.05292	.41446
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 12.432
* Sb corrected for Fe = 0.02387
* Cd corrected for both Fe & As = 0.02247

00120

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Method: EPACLP2 Sample Name: T76202S Operator: WM
Run Time: 10/27/98 10:35:36
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	261.44	.56521	7.7720	2.1112	.06383	.10859	150.89
SDev	3.22	.00846	.2571	.0268	.00126	.00333	2.50
%RSD	1.2316	1.4970	3.3079	1.2677	1.9679	3.0675	1.6593
#1	259.17	.57119	7.5902	2.0923	.06294	.10624	149.12
#2	263.72	.55922	7.9538	2.1301	.06472	.11095	152.66
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.1859	2.2721	1.4266	H647.10	.47930	43.050	46.607
SDev	.0208	.0348	.0195	8.33	.02770	.649	.700
%RSD	1.7543	1.5337	1.3696	1.2878	5.7782	1.5067	1.5017
[illegible]	1.1712	2.2475	1.4128	H641.21	.45972	42.591	46.112
#2	1.2006	2.2968	1.4404	H653.00	.49889	43.508	47.102
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Pass	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	9.7363	.91921	5.3794	15.798	L-.84475	.05351	25.826
SDev	.1478	.01359	.1064	.044	.03479	.00057	.266
%RSD	1.5181	1.4783	1.9778	.27976	4.1182	1.0719	1.0315
#1	9.6318	.90960	5.3042	15.767	L-.82015	.05310	25.638
#2	9.8408	.92882	5.4546	15.829	L-.86935	.05391	26.015
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.96529	1.3571	.05250	1.3903
SDev	.01406	.0204	.00059	.0118
%RSD	1.4566	1.5006	1.1224	.84551
[illegible]	.95535	1.3427	.05208	1.3820
#2	.97523	1.3715	.05292	1.3986
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 12.661
* Sb corrected for Fe = 0.5158
* Cd corrected for both Fe and As = 0.07319

[illegible] 10/28/98

00121

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Method: EPACLP2 Sample Name: T76202 Operator: WM
Run Time: 10/27/98 10:39:21
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	26.468	L.01200	.73146	L.00199	L.00109	.00731	15.872
SDev	.225	.00247	.02515	.00000	.00027	.00106	.055
%RSD	.85167	20.563	3.4379	.00000	24.447	14.481	.34810
#1	26.627	L.01026	.74924	L.00199	L.00090	.00656	15.911
#2	26.308	L.01375	.71368	L.00199	L.00128	.00806	15.833
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.10708	.19442	.12100	72.879	L-.00443	4.8225	L4.9270
SDev	.00151	.00461	.00037	.544	.00165	.0287	.0570
%RSD	1.4064	2.3697	.30229	.74623	37.201	.59566	1.1571
[illegible]	.10814	.19116	.12126	73.264	L-.00327	4.8428	L4.9673
2	.10601	.19767	.12074	72.494	L-.00560	4.8022	L4.8867
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.98958	-.00065	.53328	L1.8322	L-.07982	L.00189	L2.6400
SDev	.00506	.00145	.00171	.1934	.00388	.00039	.0259
%RSD	.51150	223.26	.32142	10.554	4.8629	20.701	.97916
#1	.99316	-.00168	.53207	L1.6954	L-.07707	L.00161	L2.6583
#2	.98600	.00038	.53449	L1.9689	L-.08256	L.00217	L2.6217
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.05005	.09222	.00604	.04207
SDev	.00074	.00066	.00030	.00000
%RSD	1.4742	.71889	4.8766	.00000
[illegible]	.05057	.09268	.00583	.04207
#2	L.04952	.09175	.00625	.04207
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76202D Operator: WM
Run Time: 10/27/98 10:41:07
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	26.314	L.01252	.75188	L.00133	L.00128	L.00429	15.680
SDev	.110	.01147	.03412	.00000	.00001	.00120	.078
%RSD	.41765	91.655	4.5376	.00000	.40089	28.023	.49680
#1	26.236	L.00441	.72776	L.00133	L.00128	L.00344	15.625
#2	26.392	L.02063	.77601	L.00133	L.00128	.00514	15.735
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.10389	.19487	.12026	72.277	L-.00755	4.7745	L4.8429
SDev	.00060	.00000	.00069	.386	.00429	.0242	.0365
%RSD	.58223	.00189	.57505	.53432	56.854	.50593	.75458
[illegible]	.10346	.19487	.11977	72.004	L-.00451	4.7574	L4.8171
#2	.10431	.19487	.12075	72.550	L-.01058	4.7916	L4.8688
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.98070	-.00401	.51569	L1.5353	L-.07139	L.00279	L2.6260
SDev	.00397	.00160	.00944	.0829	.00833	.00097	.0054
%RSD	.40480	39.880	1.8305	5.3977	11.668	34.756	.20508
#1	.97790	-.00513	.50901	L1.5939	L-.06550	L.00210	L2.6222
#2	.98351	-.00288	.52236	L1.4767	L-.07728	L.00347	L2.6298
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.04856	.08978	.00542	.04207
SDev	.00121	.00137	.00118	.00000
%RSD	2.4994	1.5271	21.757	.00000
[illegible]	L.04771	.08881	.00458	.04207
#2	L.04942	.09075	.00625	.04207
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76202S Operator: WM
Run Time: 10/27/98 10:43:04
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	27.193	L.05665	.75833	.22211	.00701	.01132	16.137
SDev	.140	.01151	.02825	.00141	.00000	.00127	.008
%RSD	.51517	20.312	3.7252	.63418	.02148	11.228	.04936
#1	27.094	L.04851	.73836	.22112	.00701	.01043	16.132
#2	27.292	.06479	.77831	.22311	.00701	.01222	16.143
Errors	LC Pass	LC Low	LC Pass	LC Pass	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.12934	.24975	.14969	74.306	L.04283	4.9017	L4.9821
SDev	.00120	.00002	.00002	.335	.00019	.0127	.0010
%RSD	.93177	.00698	.01296	.45069	.44690	.25972	.01909
[illegible]	.12848	.24973	.14968	74.069	L.04296	4.8927	L4.9828
[illegible]	.13019	.24976	.14971	74.543	L.04269	4.9107	L4.9814
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.0605	.09623	.58787	L1.8009	L-.07696	L.00718	L2.6948
SDev	.0036	.00159	.01888	.0829	.02034	.00095	.0036
%RSD	.34001	1.6544	3.2115	4.6015	26.436	13.295	.13323
#1	1.0579	.09510	.57452	L1.8595	L-.06257	L.00650	L2.6974
#2	1.0630	.09735	.60122	L1.7423	L-.09134	L.00785	L2.6923
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10158	.14830	.00583	.15013
SDev	.00034	.00083	.00000	.00235
%RSD	.33232	.55991	.00000	1.5660
[illegible]	.10182	.14889	.00583	.15179
#2	.10134	.14772	.00583	.14847
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76203 Operator: WM
Run Time: 10/27/98 10:45:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	256.18	L.04053	10.012	L.01394	.00802	.05725	122.03
SDev	.44	.02271	.088	.00000	.00001	.00318	.80
%RSD	.17080	56.024	.87440	.00000	.06055	5.5562	.65836
#1	256.49	L.02447	9.9499	L.01394	.00802	.05950	121.46
#2	255.87	L.05659	10.074	L.01394	.00802	.05500	122.60
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.0512	2.0373	1.4226	H631.50	L-.00429	34.784	36.960
SDev	.0030	.0124	.0066	1.09	.00101	.143	.070
%RSD	.28691	.61010	.46556	.17233	23.506	.41197	.18942
[illegible]	1.0491	2.0285	1.4272	H630.73	L-.00358	34.683	37.009
#2	1.0533	2.0461	1.4179	H632.26	L-.00500	34.886	36.910
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	7.1046	-.02408	5.4287	14.325	L-.88891	L.00483	22.507
SDev	.0239	.00093	.0266	.116	.09355	.00149	.136
%RSD	.33676	3.8500	.49014	.80989	10.524	30.945	.60616
#1	7.0877	-.02474	5.4475	14.243	L-.82276	L.00377	22.604
#2	7.1215	-.02343	5.4098	14.407	L-.95506	L.00588	22.411
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.47542	.73184	.06542	.39118
SDev	.00113	.00431	.00059	.01881
%RSD	.23704	.58856	.90077	4.8080
[illegible]	.47622	.72880	.06583	.40448
#2	.47462	.73489	.06500	.37788
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As corrected for Fe = 14.57
* Sb corrected for Fe = -0.005
* Cd corrected for both Fe and As = 0.02628

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00125

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Method: EPACLP2 Sample Name: CCV13 Operator: WM
Run Time: 10/27/98 10:47:32
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9189	5.0046	2.0065	.50365	.48673	.51806	5.0770
SDev	.0109	.0440	.0039	.00329	.00316	.00384	.0075
%RSD	.22114	.87861	.19658	.65257	.64911	.74125	.14706
#1	4.9266	4.9735	2.0037	.50133	.48450	.51534	5.0823
#2	4.9113	5.0356	2.0093	.50598	.48897	.52077	5.0718
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.1540	.49410	.48227	5.0976	4.9597	4.9762	5.0722
SDev	.0093	.00001	.00033	.0547	.0247	.0104	.0336
%RSD	.18028	.00133	.06879	1.0736	.49792	.20991	.66271
	5.1475	.49410	.48204	5.1363	4.9423	4.9688	5.0484
#2	5.1606	.49409	.48251	5.0589	4.9772	4.9836	5.0959
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49464	.48685	.52283	25.400	1.9356	.51036	25.171
SDev	.00070	.00383	.00086	.022	.0218	.00138	.174
%RSD	.14102	.78679	.16414	.08700	1.1283	.27141	.69179
#1	.49414	.48414	.52343	25.416	1.9201	.51134	25.047
#2	.49513	.48956	.52222	25.385	1.9510	.50938	25.294
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49209	2.5485	.49375	.01215
SDev	.00064	.0058	.00177	.00000
%RSD	.13003	.22811	.35803	.00000
	.49255	2.5443	.49250	.01215
#2	.49164	2.5526	.49500	.01215
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV13 Operator: WM
Run Time: 10/27/98 10:50:23
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02818	-.04716	-.00551	.00100	.00055	-.00269	.01601
SDev	.00796	.00649	.00885	.00047	.00026	.00007	.00522
%RSD	28.261	13.763	160.54	47.140	46.063	2.7233	32.625
#1	.03381	-.04257	-.01177	.00133	.00073	-.00264	.01971
#2	.02255	-.05175	.00075	.00066	.00037	-.00274	.01232
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00678	-.17051	-.00023	.06640	-.00169	.00808	-.01793
SDev	.00150	.00329	.00000	.01835	.00746	.00261	.00005
%RSD	22.073	1.9314	.48806	27.627	440.14	32.325	.29052
[illegible]	.00784	-.17284	-.00023	.07937	.00358	.00993	-.01797
#2	.00572	-.16818	-.00023	.05343	-.00697	.00623	-.01790
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00051	.00110	.00797	.68755	-.02487	.00131	16.967
SDev	.00036	.00000	.00686	.02210	.00270	.00090	.040
%RSD	69.606	.08745	86.134	3.2141	10.864	69.044	.23699
#1	.00077	.00110	.00312	.67193	-.02678	.00067	16.996
#2	.00026	.00110	.01282	.70318	-.02296	.00195	16.939
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00115	-.00055	.00104	10.143
SDev	.00194	.00075	.00030	.042
%RSD	169.51	136.28	28.284	.41722
[illegible]	.00252	-.00002	.00083	10.173
#2	-.00023	-.00108	.00125	10.113
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB13 Operator: WM
Run Time: 10/27/98 10:52:23
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01474	L.00288	L-.01133	L.00066	L.00019	L-.00095	L.00440
SDev	.00571	.00492	.00176	.00000	.00026	.00081	.00025
%RSD	38.732	170.67	15.510	.00000	136.98	85.656	5.6275
#1	L.01878	L-.00060	L-.01257	L.00066	L.00001	L-.00037	L.00423
#2	L.01070	L.00636	L-.01009	L.00066	L.00037	L-.00152	L.00458
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00085	L.00371	L-.00094	L.03298	L-.00188	.00092	L-.02375
SDev	.00030	.00263	.00033	.00156	.01023	.00033	.02510
%RSD	35.447	70.711	35.385	4.7195	544.12	35.355	105.67
	L.00106	L.00557	L-.00071	L.03408	L-.00911	.00115	L-.04150
#2	L.00064	L.00186	L-.00118	L.03188	L.00535	.00069	L-.00601
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00024	-.00054	L-.00061	L.89851	L.00330	L.00130	L.04417
SDev	.00071	.00077	.00343	.46408	.00641	.00092	.00610
%RSD	290.17	142.83	564.27	51.649	194.22	71.105	13.817
#1	L-.00074	-.00108	L-.00304	L.57036	L-.00123	L.00065	L.03986
#2	L.00026	.00001	L.00182	L1.2267	L.00783	L.00195	L.04849
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00056	L-.00000	.00083	.02378
SDev	.00119	.00001	.00118	.00927
%RSD	210.68	501.53	141.42	38.996
	L-.00140	L.00001	-.00000	.03034
#2	L.00028	L-.00001	.00167	.01722
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76203 Operator: WM
Run Time: 10/27/98 10:54:39
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	25.930	L.01111	.99156	L.00133	L.00091	.00553	12.654
SDev	.098	.00246	.00955	.00000	.00001	.00226	.046
%RSD	.37669	22.103	.96341	.00000	.74518	40.784	.36582
#1	25.999	L.00938	.99832	L.00133	L.00090	.00712	12.686
#2	25.861	L.01285	.98481	L.00133	L.00091	L.00393	12.621
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Low	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.11105	.21821	.14587	69.629	L-.00854	3.7956	L3.8183
SDev	.00180	.00262	.00102	.227	.00487	.0108	.0663
%RSD	1.6217	1.2027	.69662	.32600	57.057	.28380	1.7356
[illegible]	.11232	.22006	.14659	69.789	L-.01199	3.8032	L3.8652
#2	.10978	.21635	.14515	69.468	L-.00509	3.7880	L3.7715
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.74748	-.00331	.57878	L2.0353	L-.08490	L.00154	L2.2970
SDev	.00323	.00157	.00086	.0608	.01510	.00141	.0054
%RSD	.43217	47.472	.14848	2.9859	17.791	91.388	.23446
#1	.74976	-.00220	.57817	L1.9923	L-.07422	L.00254	L2.3008
#2	.74520	-.00442	.57939	L2.0783	L-.09558	L.00055	L2.2932
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.04940	.07708	.00708	.04837
SDev	.00161	.00215	.00000	.00232
%RSD	3.2480	2.7908	.00000	4.7930
[illegible]	.05054	.07860	.00708	.04673
#2	L.04827	.07556	.00708	.05001
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76204 Operator: WM
Run Time: 10/27/98 10:56:50
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288 *	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	14.238	L.01665	L-.54100	L.07636	L.00212	L.00276	139.73
SDev	.301	.00583	.02864	.00188	.00000	.00187	1.62
%RSD	2.1143	35.031	5.2933	2.4595	.09259	67.940	1.1570
#1	14.025	L.01253	L-.52075	L.07503	L.00212	L.00408	138.59
#2	14.451	L.02077	L-.56125	L.07769	L.00212	L.00143	140.87
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00862	.27233	L.01997	103.62	L.00076	33.466	35.413
SDev	.00177	.00525	.00077	1.78	.01631	.459	.689
%RSD	20.536	1.9282	3.8651	1.7140	2148.6	1.3724	1.9463
	L.00987	.26862	L.01942	102.36	L.01230	33.142	34.926
#2	L.00737	.27604	L.02051	104.87	L-.01078	33.791	35.900
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	6.7003	-.00407	.60606	8.0436	L-.14653	L.00155	14.805
SDev	.1090	.00104	.01716	.2818	.00899	.00020	.409
%RSD	1.6266	25.641	2.8314	3.5029	6.1382	12.660	2.7621
#1	6.6232	-.00481	.59393	8.2428	L-.14017	L.00141	14.516
#2	6.7774	-.00333	.61820	7.8444	L-.15289	L.00169	15.094
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.02669	.11944	.02354	.14344
SDev	.00081	.00117	.00030	.00232
%RSD	3.0521	.98141	1.2515	1.6161
	L.02612	.11861	.02333	.14508
#2	L.02727	.12026	.02375	.14180
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = -0.00360

by 10/28/98

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Method: EPACLP2 Sample Name: T76205 Operator: WM
Run Time: 10/27/98 11:04:15
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.0442	L.00500	L-.00993	L.02689	L.00112	L-.00018	57.107
SDev	.0391	.00079	.00329	.00047	.00001	.00005	.382
%RSD	1.2852	15.872	33.181	1.7459	.44637	28.149	.66941
#1	3.0165	L.00444	L-.01226	L.02656	L.00111	L-.00015	56.837
#2	3.0719	L.00556	L-.00760	L.02722	L.00112	L-.00022	57.377
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00169	L.02937	.07875	.60160	L-.00199	12.993	13.259
SDev	.00030	.00197	.00134	.01526	.00473	.123	.243
%RSD	17.798	6.7199	1.6970	2.5368	237.56	.94717	1.8298
[illegible]	L-.00190	L.03076	.07780	.61239	L-.00533	12.906	13.088
#2	L-.00147	L.02797	.07969	.59081	L.00135	13.080	13.431
Errors	LC Low	LC Low	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.8477	-.00261	.05399	6.0591	- L.02951	L.00042	9.3175
SDev	.0152	.00077	.00171	.3039	.00636	.00093	.2143
%RSD	.82332	29.547	3.1771	5.0149	21.554	221.45	2.3004
#1	1.8369	-.00206	.05520	6.2739	L.02501	L.00107	9.1659
#2	1.8585	-.00315	.05278	5.8442	L.03401	L-.00024	9.4691
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00012	.06897	.00083	.05165
SDev	.00119	.00072	.00059	.00232
%RSD	1024.1	1.0407	70.711	4.4887
[illegible]	L.00095	.06947	.00042	.05001
#2	L-.00072	.06846	.00125	.05328
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76206 Operator: WM
Run Time: 10/27/98 11:07:57
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	51.472	L.03198	L-.65119	L.00830	.01076	.00718	395.56
SDev	.004	.00416	.02783	.00047	.00000	.00027	3.03
%RSD	.00742	13.010	4.2730	5.6568	.02879	3.7544	.76653
#1	51.470	L.02904	L-.67087	L.00797	.01076	.00737	393.42
#2	51.475	L.03493	L-.63152	L.00863	.01076	.00698	397.71
Errors	LC Pass	LC Low	LC Low	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00324	.39387	1.2858	96.883	L.00287	84.263	95.928
SDev	.00090	.00132	.0023	.433	.00746	.452	.007
%RSD	27.935	.33546	.18004	.44656	260.08	.53693	.00743
[illegible]	L.00260	.39293	1.2875	96.577	L-.00241	83.943	95.923
[illegible]	L.00388	.39480	1.2842	97.189	L.00815	84.582	95.933
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	22.292	-.00347	.63149	23.596	L-.16777	L.00135	15.777
SDev	.122	.00300	.01201	.243	.01101	.00003	.073
%RSD	.54643	86.585	1.9024	1.0302	6.5638	2.5769	.46424
#1	22.206	-.00134	.62299	23.424	L-.17556	L.00133	15.828
#2	22.378	-.00559	.63998	23.767	L-.15998	L.00138	15.725
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00696	.90013	.00333	.31392
SDev	.00070	.00643	.00059	.00232
%RSD	10.103	.71441	17.678	.73847
[illegible]	L.00646	.89559	.00375	.31228
#2	L.00745	.90468	.00292	.31556
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = 0.00123

00132

Method: EPACLP2 Sample Name: T76207 Operator: WM
Run Time: 10/27/98 11:09:49
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	43.541	L.04973	L-1.9307	L.01826	.00688	.01695	329.98
SDev	.423	.00031	.0293	.00047	.00026	.00072	4.78
%RSD	.97223	.61736	1.5171	2.5713	3.7450	4.2396	1.4492
#1	43.242	L.04951	L-1.9100	L.01793	.00670	.01644	326.60
#2	43.841	L.04995	L-1.9515	L.01859	.00707	.01746	333.36
Errors	LC Pass	LC Low	LC Low	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02100	.90428	L.01573	364.73	L.00629	69.797	78.029
SDev	.00022	.01247	.00030	5.17	.00487	.878	.834
%RSD	1.0338	1.3785	1.9065	1.4185	77.415	1.2585	1.0692
[illegible]	.02116	.89546	L.01552	361.07	L.00285	69.176	77.439
[illegible]	.02085	.91309	L.01594	368.39	L.00973	70.418	78.619
Errors	LC Pass	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	18.027	-.01206	2.0287	17.462	L-.59439	L.00554	24.040
SDev	.245	.00234	.0523	.210	.01803	.00058	.165
%RSD	1.3602	19.411	2.5800	1.2022	3.0335	10.416	.68699
#1	17.853	-.01372	1.9917	17.314	L-.58164	L.00513	23.923
#2	18.200	-.01041	2.0657	17.611	L-.60714	L.00595	24.156
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.08673	.39910	.00313	.34506
SDev	.00126	.00788	.00088	.00927
%RSD	1.4531	1.9752	28.284	2.6873
[illegible]	.08584	.39353	.00375	.33851
#2	.08762	.40468	.00250	.35162
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = -0.00544

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Method: EPACLP2 Sample Name: T76208 Operator: WM
Run Time: 10/27/98 11:14:50
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	16.448	L.03159	L-.74325	L.06076	L.00246	L.00406	134.94
SDev	.111	.02041	.01374	.00047	.00000	.00087	.62
%RSD	.67453	64.605	1.8487	.77279	.07562	21.323	.46240
#1	16.369	L.01716	L-.75297	L.06042	L.00246	L.00467	134.50
#2	16.526	L.04602	L-.73353	L.06109	L.00246	L.00345	135.38
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00809	.33937	L.01010	137.31	L-.00029	30.904	31.842
SDev	.00089	.00459	.00071	.70	.01249	.140	.236
%RSD	10.975	1.3512	7.0158	.50704	4303.7	.45314	.74246
	L.00872	.33613	L.00960	136.81	L.00854	30.805	31.675
#2	L.00747	.34262	L.01060	137.80	L-.00912	31.003	32.009
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	6.7706	-.00539	.76622	10.141	L-.21093	L.00198	13.913
SDev	.0288	.00220	.00515	.110	.01406	.00145	.113
%RSD	.42537	40.784	.67227	1.0895	6.6650	73.189	.81026
#1	6.7502	-.00384	.76987	10.220	L-.20099	L.00096	13.834
#2	6.7909	-.00694	.76258	10.063	L-.22087	L.00301	13.993
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.03353	.15163	.01271	.14016
SDev	.00045	.00283	.00088	.00696
%RSD	1.3495	1.8670	6.9551	4.9618
	L.03385	.14963	.01333	.13524
#2	L.03321	.15363	.01208	.14508
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* Cd corrected for Fe = -0.00437

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Method: EPACLP2 Sample Name: T76209 Operator: WM
Run Time: 10/27/98 11:17:07
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.5062	L.02388	L-.09800	L.01859	L.00221	L.00112	321.47
SDev	.1213	.00147	.01594	.00000	.00000	.00070	8.54
%RSD	3.4598	6.1370	16.265	.00000	.06223	62.120	2.6579
#1	3.4205	L.02492	L-.10928	L.01859	L.00221	L.00063	315.43
#2	3.5920	L.02285	L-.08673	L.01859	L.00221	L.00161	327.52
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00237	.25490	.03498	24.258	L.00941	78.857	87.244
SDev	.00001	.00528	.00172	.780	.00737	1.969	3.034
%RSD	.57350	2.0725	4.9065	3.2157	78.331	2.4974	3.4778
[illegible]	L-.00238	.25117	.03376	23.706	L.00420	77.464	85.099
#2	L-.00236	.25864	.03619	24.810	L.01462	80.249	89.390
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	15.002	-.00048	.57573	7.7350	L-.04306	L.00207	23.795
SDev	.444	.00166	.03089	.3978	.00290	.00048	.907
%RSD	2.9566	348.56	5.3655	5.1426	6.7338	23.040	3.8098
#1	14.688	-.00165	.55389	8.0163	L-.04101	L.00173	23.154
#2	15.315	.00070	.59757	7.4537	L-.04511	L.00241	24.436
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00598	.10887	.00563	.17623
SDev	.00029	.00270	.00147	.00696
%RSD	4.8681	2.4795	26.189	3.9464
[illegible]	L.00618	.10696	.00667	.17131
#2	L.00577	.11078	.00458	.18114
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: CRIF1 Operator: WM
Run Time: 10/27/98 11:29:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00109	.12547	.21056	L.00066	.01073	.00828	L.00464
SDev	.00572	.00326	.00262	.00000	.00000	.00229	.00075
%RSD	522.82	2.5948	1.2423	.00000	.03300	27.670	16.059
#1	L.00513	.12777	.20871	L.00066	.01073	.00666	L.00412
#2	L-.00295	.12317	.21241	L.00066	.01072	.00990	L.00517
Errors	LC Low	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02194	.10463	.04989	L.01066	.09477	.00115	L.01771
SDev	.00090	.00197	.00067	.00062	.01237	.00065	.06692
%RSD	4.0969	1.8810	1.3401	5.8312	13.055	56.569	377.76
	.02257	.10602	.05036	L.01110	.10352	.00162	L.06503
#2	.02130	.10323	.04941	L.01022	.08602	.00069	L-.02960
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.03104	-.00323	.08612	L1.4103	.20107	.01900	L.03123
SDev	.00035	.00307	.00258	.0608	.01921	.00046	.00287
%RSD	1.1370	95.023	2.9906	4.3092	9.5560	2.4363	9.1981
#1	.03129	-.00541	.08429	L1.4532	.18748	.01867	L.02919
#2	.03079	-.00106	.08794	L1.3673	.21466	.01933	L.03326
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.10182	.04124	.00125	.00247
SDev	.00086	.00073	.00000	.00232
%RSD	.85002	1.7762	.00000	93.895
	.10120	.04176	.00125	.00411
#2	.10243	.04072	.00125	.00083
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: ICSAF1 Operator: WM
Run Time: 10/27/98 11:31:17
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	498.70	.03985	-1.1641	.00863	.00032	.00846	508.56
SDev	1.27	.02933	.0642	.00000	.00001	.00300	3.41
%RSD	.25549	73.600	5.5116	.00000	1.9692	35.502	.67094
#1	497.80	.01911	-1.2095	.00863	.00032	.01058	506.15
#2	499.60	.06059	-1.1187	.00863	.00031	.00634	510.97
Errors	QC Pass	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value	500.00						500.00
Range	20.000						20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00177	.00209	.00489	182.06	-.00884	289.28	505.29
SDev	.00089	.00064	.00039	.90	.00877	1.61	1.85
%RSD	50.285	30.649	7.9040	.49531	99.195	.55801	.36699
[illegible]	-.00114	.00164	.00462	181.42	-.00264	288.13	503.97
#2	-.00239	.00255	.00517	182.70	-.01504	290.42	506.60
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass
Value				200.00			500.00
Range				20.000			20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01596	-.00527	-.01942	.12110	-.40455	.00404	.06093
SDev	.00018	.00371	.01802	.11602	.00113	.00103	.00108
%RSD	1.1180	70.330	92.802	95.800	.27955	25.515	1.7678
#1	.01584	-.00265	-.00668	.03907	-.40375	.00331	.06017
#2	.01609	-.00789	-.03216	.20314	-.40535	.00477	.06169
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.01219	.00313	.01292	.20245
SDev	.00144	.00150	.00000	.00232
%RSD	11.818	48.023	.00000	1.1451
[illegible]	.01117	.00419	.01292	.20081
#2	.01321	.00207	.01292	.20409
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value				
Range				

Method: EPACLP2 Sample Name: ICSABF1 Operator: WM
Run Time: 10/27/98 11:33:15
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	502.25	1.0462	-1.1780	.50531	.48937	1.0685	528.14
SDev	2.35	.0139	.0960	.00282	.00367	.0073	2.27
%RSD	.46837	1.3314	8.1530	.55750	.74945	.68412	.43048
#1	503.92	1.0364	-1.2459	.50730	.49197	1.0737	529.75
#2	500.59	1.0561	-1.1101	.50332	.48678	1.0633	526.53
Errors	QC Pass	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass
Value	500.00	1.0000		.50000	.50000	1.0000	500.00
Range	20.000	20.000		20.000	20.000	20.000	20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.49161	.46253	.48882	186.56	.98331	298.95	511.07
SDev	.00091	.00262	.00440	.89	.03346	.60	2.63
%RSD	.18531	.56651	.89968	.47754	3.4031	.19938	.51506
	.49225	.46067	.49193	187.19	1.0070	299.37	512.93
#2	.49097	.46438	.48571	185.93	.95965	298.53	509.21
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	.50000	.50000	200.00	1.0000		500.00
Range	20.000	20.000	20.000	20.000	20.000		20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.48953	-.00486	.97976	1.1407	-.36070	1.0079	.18736
SDev	.00266	.00320	.01030	.0331	.00238	.0038	.00108
%RSD	.54248	66.001	1.0509	2.9059	.65935	.37609	.57489
#1	.49141	-.00259	.97248	1.1642	-.36238	1.0106	.18659
#2	.48765	-.00712	.98704	1.1173	-.35902	1.0052	.18812
Errors	QC Pass	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass	NOCHECK
Value	.50000		1.0000			1.0000	
Range	20.000		20.000			20.000	

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.48433	1.0391	.01396	.20737
SDev	.00359	.0057	.00030	.00000
%RSD	.74165	.55122	2.1108	.00000
#1	.48687	1.0432	.01417	.20737
#2	.48179	1.0351	.01375	.20737
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	.50000	1.0000		
Range	20.000	20.000		

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Method: EPACLP2 Sample Name: CCV14 Operator: WM
Run Time: 10/27/98 11:37:54
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9133	5.0668	2.0398	.50863	.50270	.54249	5.2935
SDev	.0151	.0099	.0232	.00094	.00000	.00804	.0109
%RSD	.30780	.19616	1.1380	.18462	.00078	1.4817	.20686
#1	4.9240	5.0738	2.0562	.50930	.50270	.53680	5.2857
#2	4.9026	5.0597	2.0234	.50797	.50269	.54817	5.3012
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.3221	.50194	.48890	5.0759	5.0312	5.1357	5.2408
SDev	.0168	.00065	.00100	.0016	.0459	.0003	.0209
%RSD	.31537	.13013	.20506	.03058	.91327	.00636	.39910
[illegible]	5.3102	.50148	.48960	5.0748	4.9987	5.1360	5.2556
#2	5.3339	.50241	.48819	5.0770	5.0637	5.1355	5.2260
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50138	.49554	.54467	26.104	1.9834	.52012	25.341
SDev	.00106	.00538	.00257	.122	.0055	.00138	.127
%RSD	.21198	1.0848	.47260	.46562	.27710	.26538	.50013
#1	.50063	.49174	.54285	26.018	1.9795	.51914	25.430
#2	.50214	.49934	.54649	26.190	1.9873	.52110	25.251
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49991	2.6591	.50271	.01066
SDev	.00098	.0087	.00030	.00464
%RSD	.19570	.32701	.05860	43.473
#1	.49922	2.6530	.50250	.00739
#2	.50060	2.6653	.50292	.01394
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV14 Operator: WM
Run Time: 10/27/98 11:40:02
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.03288	-.06391	-.00641	.00133	.00074	-.00212	.03203
SDev	.00325	.00578	.02073	.00000	.00000	.00057	.00199
%RSD	9.8784	9.0400	323.57	.00000	.03218	26.813	6.2163
#1	.03518	-.05982	-.02107	.00133	.00075	-.00252	.03344
#2	.03059	-.06799	.00825	.00133	.00074	-.00172	.03062
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00466	-.16866	-.00165	.02243	-.00892	.02677	-.00006
SDev	.00090	.00459	.00000	.00155	.00147	.00098	.03346
%RSD	19.258	2.7187	.00495	6.9350	16.479	3.6574	52536.
	.00530	-.17190	-.00165	.02353	-.00996	.02747	-.02373
#2	.00403	-.16541	-.00165	.02133	-.00788	.02608	.02360
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00000	.00109	.00493	1.1407	-.02303	.00162	16.982
SDev	.00036	.00307	.01287	.0884	.00001	.00046	.064
%RSD	7769.6	281.27	260.95	7.7491	.03605	28.245	.37420
#1	-.00025	-.00108	.01404	1.0782	-.02303	.00195	17.027
#2	.00026	.00326	-.00417	1.2032	-.02304	.00130	16.937
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00023	-.00104	.00167	10.225
SDev	.00009	.00005	.00000	.012
%RSD	38.490	4.3560	.00000	.11336
	-.00029	-.00108	.00167	10.216
#2	-.00017	-.00101	.00167	10.233
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

Method: EPACLP2 Sample Name: CCB14 Operator: WM
Run Time: 10/27/98 11:42:02
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01539	L.00170	L.00282	L.00100	L.00018	L-.00167	L.01390
SDev	.00755	.00323	.00422	.00047	.00026	.00151	.00124
%RSD	49.087	189.72	149.35	47.140	138.59	90.060	8.9391
#1	L.01005	L-.00058	L-.00016	L.00066	L.00000	L-.00274	L.01302
#2	L.02073	L.00399	L.00581	L.00133	L.00037	L-.00061	L.01478
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00191	L.00139	L-.00165	L.01363	L-.00677	.01246	L.01179
SDev	.00120	.00065	.00000	.00093	.00618	.00033	.05019
%RSD	62.830	46.886	.00527	6.8315	91.224	2.6189	425.63
[illegible]	L.00106	L.00093	L-.00165	L.01297	L-.01114	.01270	L-.02370
#2	L.00275	L.00184	L-.00165	L.01429	L-.00240	.01223	L.04728
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00050	-.00271	L-.00546	L1.3282	L.00908	L.00130	L.05611
SDev	.00035	.00077	.00687	.0221	.00732	.00184	.00646
%RSD	71.067	28.228	125.70	1.6638	80.590	141.76	11.518
#1	L-.00075	-.00326	L-.00061	L1.3439	L.00391	L-.00000	L.06067
#2	L-.00025	-.00217	L-.01032	L1.3126	L.01425	L.00260	L.05154
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00020	L.00002	.00104	.02870
SDev	.00158	.00002	.00030	.00696
%RSD	796.05	150.02	28.284	24.235
#1	L-.00092	L-.00000	.00125	.03361
#2	L.00131	L.00003	.00083	.02378
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: CCV15 Operator: WM
Run Time: 10/27/98 11:48:00
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0235	5.0292	2.0000	.50258	.50342	.50459	5.0329
SDev	.0000	.0061	.0059	.00046	.00077	.00223	.0205
%RSD	.00051	.12044	.29440	.09061	.15229	.44136	.40649
#1	5.0236	5.0335	1.9959	.50290	.50396	.50617	5.0474
#2	5.0235	5.0250	2.0042	.50225	.50288	.50302	5.0184
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0335	.50620	.50239	5.0347	5.0118	5.0359	4.9796
SDev	.0171	.00188	.00068	.0123	.0251	.0132	.0492
%RSD	.34056	.37135	.13437	.24396	.49984	.26140	.98779
	5.0456	.50753	.50192	5.0434	5.0295	5.0452	5.0144
#2	5.0213	.50487	.50287	5.0261	4.9940	5.0266	4.9448
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50366	.50156	.49833	25.173	2.0196	.50156	25.098
SDev	.00069	.00073	.00394	.087	.0181	.00131	.042
%RSD	.13722	.14660	.79009	.34458	.89869	.26135	.16747
#1	.50415	.50208	.50111	25.234	2.0068	.50249	25.068
#2	.50317	.50104	.49554	25.111	2.0325	.50064	25.127
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.50307	2.5229	.50184	.01558
SDev	.00006	.0048	.00087	.00232
%RSD	.01285	.19038	.17270	14.877
	.50311	2.5263	.50245	.01722
#2	.50302	2.5195	.50123	.01394
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

Method: EPACLP2 Sample Name: CCV15 Operator: WM
Run Time: 10/27/98 11:49:54
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00973	-.01053	-.00226	.00059	.00049	-.00174	.00668
SDev	.00242	.00457	.00497	.00000	.00025	.00008	.00000
%RSD	24.838	43.423	220.20	.00000	51.869	4.4003	.00599
#1	.00802	-.00730	.00126	.00059	.00031	-.00179	.00668
#2	.01143	-.01376	-.00577	.00059	.00067	-.00168	.00668
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00435	-.17303	-.00164	.01035	-.01201	.00498	-.05582
SDev	.00111	.00252	.00068	.00120	.00663	.00063	.02051
%RSD	25.445	1.4574	41.142	11.590	55.204	12.593	36.747
[illegible]	.00513	-.17481	-.00212	.01120	-.01670	.00542	-.07033
#2	.00357	-.17124	-.00116	.00950	-.00732	.00453	-.04132
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00002	-.00062	-.00242	1.0683	-.01474	.00164	16.879
SDev	.00034	.00073	.00788	.0759	.00606	.00044	.118
%RSD	1918.5	118.57	325.79	7.1041	41.137	26.754	.69890
#1	-.00026	-.00010	-.00315	1.1220	-.01045	.00133	16.796
#2	.00023	-.00113	.00799	1.0147	-.01903	.00195	16.963
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00003	-.00173	.00136	10.210
SDev	.00035	.00066	.00087	.093
%RSD	1170.7	38.191	63.492	.90822
#1	-.00028	-.00220	.00198	10.144
#2	.00022	-.00126	.00075	10.275
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
Range				10.000

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Method: EPACLP2 Sample Name: CCB15 Operator: WM
Run Time: 10/27/98 11:52:47
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00524	L.00843	L-.00286	L-.00006	L.00031	L-.00061	L-.00096
SDev	.00234	.00774	.02224	.00000	.00000	.00026	.00188
%RSD	44.589	91.822	778.49	.00000	1.0350	42.840	195.79
#1	L.00359	L.01391	L-.01858	L-.00006	L.00031	L-.00042	L-.00229
#2	L.00689	L.00296	L.01287	L-.00006	L.00031	L-.00079	L.00037
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00024	L.00052	L-.00117	L.00336	L-.00416	.00010	L-.00359
SDev	.00028	.00188	.00000	.00030	.00456	.00063	.00410
%RSD	113.45	364.67	.00473	8.9240	109.71	613.80	114.19
#1	L.00044	L.00185	L-.00117	L.00314	L-.00739	.00055	L-.00069
#2	L.00005	L-.00082	L-.00117	L.00357	L-.00093	-.00034	L-.00649
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00002	-.00114	L-.00769	L-.49618	L.01623	L.00102	L.02903
SDev	.00034	.00000	.00157	.10587	.01211	.00044	.00141
%RSD	1782.9	.03320	20.475	21.337	74.626	43.259	4.8665
#1	L-.00026	-.00114	L-.00658	L-.57105	L.02480	L.00133	L.02803
#2	L.00022	-.00114	L-.00880	L-.42132	L.00767	L.00071	L.03003
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00032	L-.00072	.00075	.01013
SDev	.00076	.00068	.00000	.00681
%RSD	234.16	94.483	.00000	67.225
#1	L.00021	L-.00024	.00075	.01495
#2	L-.00086	L-.00121	.00075	.00532
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76210 Operator: WM
Run Time: 10/27/98 11:54:53
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.9891	L.00769	L.00513	L.03311	L.00067	L-.00050	75.039
SDev	.0062	.00619	.01652	.00046	.00000	.00125	.422
%RSD	.31089	80.450	322.26	1.3754	.02534	249.56	.56289
#1	1.9847	L.01207	L.01681	L.03343	L.00067	L.00038	74.740
#2	1.9935	L.00332	L-.00656	L.03279	L.00067	L-.00138	75.338
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00073	L.02368	.05862	.23325	L-.00999	18.162	18.625
SDev	.00055	.00062	.00000	.00178	.00328	.069	.033
%RSD	75.607	2.6310	.00036	.76485	32.870	.37794	.17616
#1	L-.00034	L.02324	.05862	.23198	L-.00767	18.113	18.602
#2	L-.00112	L.02412	.05862	.23451	L-.01231	18.210	18.649
Errors	LC Low	LC Low	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.7728	-.00161	.04521	L3.6252	L.00818	L.00076	10.428
SDev	.0083	.00220	.00394	.0279	.00086	.00044	.030
%RSD	.46652	136.84	8.7116	.76852	10.566	57.042	.28450
#1	1.7670	-.00005	.04799	L3.6055	L.00879	L.00045	10.449
#2	1.7787	-.00316	.04242	L3.6449	L.00757	L.00107	10.407
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00092	.05844	.00259	.05349
SDev	.00007	.00068	.00029	.00000
%RSD	7.1737	1.1568	11.151	.00000
#1	L.00096	.05892	.00239	.05349
#2	L.00087	.05796	.00279	.05349
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76211 Operator: WM
Run Time: 10/27/98 11:57:08
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	45.572	L.01176	L.00223	L.01025	L.00301	L.00119	159.15
SDev	.145	.00155	.00630	.00000	.00025	.00067	.79
%RSD	.31918	13.189	282.33	.00000	8.2270	55.885	.49952
#1	45.469	L.01066	L-.00222	L.01025	L.00319	L.00072	158.58
#2	45.675	L.01286	L.00669	L.01025	L.00283	L.00166	159.71
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00494	.17115	1.0618	.30631	L.00248	47.628	49.915
SDev	.00138	.00314	.0027	.00147	.02177	.201	.287
%RSD	27.951	1.8371	.25469	.48101	879.29	.42183	.57523
	L.00591	.16893	1.0599	.30527	L.01787	47.486	49.712
#2	L.00396	.17337	1.0637	.30736	L-.01292	47.770	50.118
Errors	LC Low	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	3.5729	.00056	.34700	7.3999	L.03529	L-.00198	9.7352
SDev	.0155	.00073	.00079	.0724	.00697	.00042	.0201
%RSD	.43405	131.40	.22656	.97890	19.740	21.405	.20680
#1	3.5619	.00004	.34644	7.4512	L.04022	L-.00228	9.7210
#2	3.5839	.00108	.34755	7.3487	L.03037	L-.00168	9.7495
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00252	.40973	.00198	.06152
SDev	.00187	.00344	.00116	.00227
%RSD	73.992	.83921	58.426	3.6914
#1	L.00385	.40730	.00279	.06313
#2	L.00120	.41216	.00116	.05992
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76212 Operator: WM
Run Time: 10/27/98 11:59:07
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.20991	L.00632	L-.01904	L.01218	L.00012	L-.00243	23.725
SDev	.00947	.00927	.00089	.00000	.00025	.00142	.086
%RSD	4.5131	146.71	4.6871	.00000	217.16	58.610	.36439
#1	.20321	L-.00024	L-.01841	L.01218	L.00030	L-.00142	23.664
#2	.21660	L.01287	L-.01967	L.01218	L-.00006	L-.00343	23.786
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00073	L.00185	L.00363	.22833	L.00169	5.1547	5.1238
SDev	.00055	.00000	.00000	.00030	.01447	.0194	.0369
%RSD	75.233	.00340	.00372	.13132	854.56	.37699	.72049
#1	L-.00034	L.00185	L.00363	.22811	L-.00854	5.1410	5.0977
#2	L-.00113	L.00185	L.00363	.22854	L.01192	5.1684	5.1499
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01343	-.00110	L.00066	L1.2611	L.00320	L.00075	9.2277
SDev	.00000	.00000	.00079	.0613	.00692	.00087	.0237
%RSD	.00038	.01508	118.57	4.8602	216.06	116.30	.25645
#1	L.01343	-.00110	L.00122	L1.2178	L-.00169	L.00013	9.2110
#2	L.01343	-.00110	L.00011	L1.3045	L.00810	L.00136	9.2445
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00261	L-.00175	.00627	.02459
SDev	.00038	.00069	.00029	.00000
%RSD	14.503	39.430	4.6092	.00000
#1	L.00288	L-.00224	.00647	.02459
#2	L.00235	L-.00126	.00606	.02459
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76213 Operator: WM
Run Time: 10/27/98 12:01:05
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.09336	L.01450	L-.00261	L.06499	L-.00006	L-.00262	15.023
SDev	.00567	.00847	.01075	.00000	.00000	.00155	.008
%RSD	6.0769	58.409	412.23	.00000	5.2039	59.225	.05316
#1	L.09738	L.00851	L-.01021	L.06499	L-.00006	L-.00152	15.018
#2	L.08935	L.02049	L.00499	L.06499	L-.00006	L-.00371	15.029
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00152	L.00140	L.00315	.18215	L-.01124	4.4965	L4.4046
SDev	.00055	.00062	.00068	.00030	.01051	.0013	.0451
%RSD	36.381	44.196	21.479	.16441	93.535	.02788	1.0244
[illegible]	L-.00191	L.00096	L.00267	.18236	L-.00380	4.4956	L4.3727
#2	L-.00113	L.00184	L.00363	.18194	L-.01867	4.4974	L4.4365
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm -	ppm	ppm	ppm	ppm	ppm
Avge	L.00928	-.00422	L-.00658	L3.1524	L.01782	L.00105	8.2277
SDev	.00034	.00000	.00630	.1170	.00346	.00043	.0145
%RSD	3.7155	.04128	95.827	3.7120	19.422	41.157	.17601
#1	L.00952	-.00422	L-.00212	L3.0697	L.02027	L.00136	8.2175
#2	L.00903	-.00422	L-.01103	L3.2352	L.01538	L.00074	8.2380
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00225	L-.00221	.00279	.02138
SDev	.00076	.00002	.00058	.00000
%RSD	33.588	.97551	20.672	.00000
#1	L.00172	L-.00223	.00239	.02138
#2	L.00279	L-.00219	.00320	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76214 Operator: WM
Run Time: 10/27/98 12:03:09
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	10.323	L.01777	L-.32838	L.03890	L.00154	L.00055	135.03
SDev	.100	.00378	.00562	.00046	.00025	.00142	.90
%RSD	.97308	21.261	1.7115	1.1705	16.425	256.76	.66509
#1	10.252	L.02045	L-.33236	L.03858	L.00172	L-.00045	134.40
#2	10.394	L.01510	L-.32441	L.03923	L.00136	L.00155	135.67
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00340	.23743	L.00658	51.091	L-.00375	31.304	32.171
SDev	.00193	.00189	.00065	.467	.00739	.255	.343
%RSD	56.733	.79717	9.8653	.91407	196.85	.81401	1.0669
[illegible]	L.00476	.23609	L.00704	50.761	L.00147	31.124	31.928
#2	L.00203	.23877	L.00612	51.422	L-.00898	31.484	32.414
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.7337	-.00250	.51071	6.0248	L-.00502	L.00153	13.391
SDev	.0528	.00008	.01339	.0557	.01891	.00004	.147
%RSD	.92120	2.9987	2.6216	.92487	376.87	2.7845	1.0973
#1	5.6964	-.00256	.50124	6.0642	L.00835	L.00150	13.287
#2	5.7711	-.00245	.52017	5.9854	L-.01839	L.00156	13.495
Errors	LC Pass	NOCHECK	LC Pass	LC Pass	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00880	.09629	.00157	.09846
SDev	.00075	.00059	.00000	.00908
%RSD	8.5455	.60721	.00000	9.2265
#1	L.00934	.09588	.00157	.09203
#2	L.00827	.09670	.00157	.10488
Errors	LC Low	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76215 Operator: WM
Run Time: 10/27/98 12:05:23
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.11980	L.00904	L-.00132	L.07046	L.00012	L-.00212	14.280
SDev	.00426	.00228	.02301	.00046	.00026	.00190	.016
%RSD	3.5585	25.252	1736.7	.64628	216.43	89.522	.11351
#1	L.12282	L.00742	L.01495	L.07078	L-.00006	L-.00078	14.292
#2	L.11679	L.01065	L-.01759	L.07014	L.00030	L-.00346	14.269
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00191	L.00185	L.00004	.21498	L-.00661	4.7101	L4.6394
SDev	.00166	.00001	.00372	.00180	.00263	.0138	.0000
%RSD	87.003	.57449	8431.4	.83593	39.811	.29279	.00011
[illegible]	L-.00073	L.00185	L-.00259	.21625	L-.00475	4.7199	L4.6394
#2	L-.00308	L.00184	L.00267	.21371	L-.00846	4.7004	L4.6394
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01075	-.00007	L-.00323	L3.4361	L.00932	L.00075	8.4093
SDev	.00034	.00000	.00945	.0724	.00520	.00000	.0127
%RSD	3.2097	4.1207	292.23	2.1082	55.745	.02385	.15121
#1	L.01099	-.00007	L.00345	L3.4873	L.01299	L.00075	8.4183
#2	L.01050	-.00007	L-.00992	L3.3849	L.00565	L.00075	8.4003
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00237	L-.00222	.00422	.02138
SDev	.00000	.00003	.00029	.00000
%RSD	.18418	1.4603	6.8378	.00000
#1	L.00238	L-.00225	.00402	.02138
#2	L.00237	L-.00220	.00443	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

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Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:07:30
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k1477.6	k.11260	k19.659	L.01669	k.05099	k.60845	471.20
SDev	15.9	.02559	.557	.00000	.00072	.00213	2.78
%RSD	1.0750	22.723	2.8310	.00000	1.4095	.35063	.58970
#1	k1466.4	k.09451	k19.265	L.01669	k.05049	k.60996	469.23
#2	k1488.9	k.13070	k20.052	L.01669	k.05150	k.60694	473.16
Errors	LC High	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k4.6151	k8.7683	k12.908	S3389.6	k-.46948	175.32	k224.52
SDev	.0323	.0557	.179	.0	.02452	.90	2.41
%RSD	.70061	.63474	1.3831	.00002	5.2224	.51487	1.0724
#1	k4.5923	k8.7290	k12.782	S3389.6	k-.48682	174.68	k222.82
#2	k4.6380	k8.8077	k13.034	S3389.6	k-.45214	175.96	k226.22
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	k43.735	k.17863	k22.449	L-.93354	k2.5460	k.17242	17.665
SDev	.355	.00581	.168	.18946	.1007	.00218	.164
%RSD	.81161	3.2547	.74721	20.294	3.9570	1.2653	.92573
#1	k43.484	k.18274	k22.330	L-.79958	k2.6173	k.17396	17.550
#2	k43.986	k.17451	k22.567	L-1.0675	k2.4748	k.17088	17.781
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	k1.5746	k4.1061	.06020	1.0941
SDev	.0113	.0304	.00029	.0273
%RSD	.71623	.74025	.47991	2.4909
#1	k1.5666	k4.0846	.06040	1.0748
#2	k1.5825	k4.1276	.05999	1.1133
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

NR
see 1/2 dil
WM 10/27/98

00151

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Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:09:27
Comment: SDG: T76201 1/2 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	* Sb2068	* As1936	Ba4934	Be3130	* Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	772.55	L.03085	16.432	L.01025	.02688	.21624	259.54
SDev	14.08	.03022	.234	.00000	.00022	.00575	.10
%RSD	1.8222	97.958	1.4229	.00000	.82037	2.6604	.03667
#1	782.50	L.05222	16.598	L.01025	.02703	.21218	259.47
#2	762.60	L.00948	16.267	L.01025	.02672	.22031	259.61
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.5395	4.9074	6.5035	H989.29	L-.00923	108.21	122.21
SDev	.0125	.0171	.1636	5.59	.01301	.10	2.15
%RSD	.49306	.34795	2.5160	.56492	141.03	.08921	1.7558
	2.5483	4.9195	6.6192	H993.24	L-.01843	108.28	123.73
#2	2.5306	4.8953	6.3878	H985.34	L-.00003	108.15	120.70
Errors	LC Pass	LC Pass	LC Pass	LC High	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

See d.l.

interfering

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	23.807	-.03333	12.574	L.08696	L-.42738	L-.00485	9.2700
SDev	.146	.00427	.012	.64081	.01171	.00107	.2338
%RSD	.61264	12.804	.09390	736.87	2.7411	22.027	2.5224
#1	23.910	-.03635	12.582	L-.36616	L-.43567	L-.00560	9.4353
#2	23.704	-.03032	12.566	L.54008	L-.41910	L-.00409	9.1046
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.85159	2.3769	.03425	.61232
SDev	.00823	.0042	.00000	.00454
%RSD	.96639	.17571	.00000	.74177
#1	.85741	2.3739	.03425	.61553
#2	.84577	2.3798	.03425	.60911
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

* As Corrected for Fe = 24.369

* Sb Corrected for Fe = -0.049

* Cal corrected for both Fe and As = 0.1618

10/28/98

Method: EPACLP2 Sample Name: T76216 Operator: WM
Run Time: 10/27/98 12:11:47
Comment: SDG: T76201 1/10 DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	170.03	L.02885	3.5306	L.00284	.00581	.04780	58.130
SDev	1.57	.01244	.0463	.00046	.00025	.00049	.994
%RSD	.92562	43.122	1.3101	16.028	4.3125	1.0159	1.7099
#1	171.14	L.03764	3.5633	L.00316	.00599	.04815	58.833
#2	168.91	L.02005	3.4978	L.00252	.00563	.04746	57.427
Errors	LC Pass	LC Low	LC Pass	LC Low	LC Pass	LC Pass	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.58786	1.1514	1.4409	241.24	L-.01132	27.455	27.611
SDev	.00724	.0176	.0120	2.92	.01486	.380	.336
%RSD	1.2307	1.5259	.83308	1.2124	131.23	1.3836	1.2178
#1	.59298	1.1638	1.4493	243.31	L-.00082	27.724	27.849
#2	.58274	1.1389	1.4324	239.18	L-.02183	27.187	27.373
Errors	LC Pass	LC Pass	LC Pass	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.4894	-.00486	2.9574	L-.08640	L-.07478	L.00244	L2.1077
SDev	.0740	.00192	.0181	.17274	.00703	.00078	.0095
%RSD	1.3478	39.464	.61225	199.92	9.3959	31.791	.45245
#1	5.5417	-.00350	2.9702	L.03574	L-.07975	L.00299	L2.1145
#2	5.4371	-.00621	2.9446	L-.20855	L-.06981	L.00189	L2.1010
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.19419	.54614	.00770	.13860
SDev	.00122	.00715	.00000	.00227
%RSD	.62625	1.3086	.00000	1.6385
#1	.19505	.55120	.00770	.14021
#2	.19333	.54109	.00770	.13700
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76217 Operator: WM
Run Time: 10/27/98 12:16:13
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.12184	L.00523	L-.00632	L.13518	L.00011	L-.00054	28.850
SDev	.00999	.00314	.01739	.00091	.00025	.00266	.092
%RSD	8.1981	60.052	275.23	.67372	222.68	494.98	.31838
#1	L.11478	L.00745	L.00598	L.13582	L.00029	L.00135	28.915
#2	L.12890	L.00301	L-.01862	L.13454	L-.00006	L-.00242	28.785
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00024	L.00318	L.00315	.17809	L.00320	5.5000	5.4720
SDev	.00083	.00187	.00270	.00599	.01116	.0194	.0533
%RSD	342.94	58.845	85.888	3.3655	348.25	.35332	.97480
[illegible]	L.00083	L.00186	L.00506	.17385	L.01109	5.5137	5.5097
#2	L-.00034	L.00451	L.00124	.18233	L-.00468	5.4862	5.4342
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.02926	-.00111	L-.00101	L2.9869	L.01536	L.00044	10.611
SDev	.00034	.00147	.01103	.1950	.02076	.00043	.119
%RSD	1.1756	132.24	1094.9	6.5294	135.21	98.576	1.1218
#1	.02950	-.00007	L.00679	L2.8490	L.03004	L.00013	10.695
#2	.02901	-.00215	L-.00880	L3.1248	L.00067	L.00074	10.527
Errors	LC Pass	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Pass
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00369	L-.00320	.00279	.01977
SDev	.00118	.00004	.00116	.00227
%RSD	31.965	1.1286	41.345	11.487
#1	L.00452	L-.00323	.00361	.01816
#2	L.00285	L-.00317	.00198	.02138
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: CCV16 Operator: WM
Run Time: 10/27/98 12:18:29
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.8347	4.9640	2.0118	.47682	.48394	.52216	5.1975
SDev	.0047	.0040	.0363	.00046	.00076	.00105	.0047
%RSD	.09665	.07990	1.8052	.09550	.15742	.20188	.09036
#1	4.8314	4.9668	2.0375	.47649	.48341	.52290	5.1942
#2	4.8380	4.9612	1.9861	.47714	.48448	.52141	5.2009
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0581	.50311	.47178	5.0057	5.0789	5.0295	4.8753
SDev	.0011	.00253	.00068	.0030	.0092	.0028	.0656
%RSD	.02186	.50298	.14347	.05980	.18024	.05609	1.3460
#1	5.0573	.50490	.47130	5.0036	5.0724	5.0275	4.8289
#2	5.0589	.50133	.47226	5.0078	5.0853	5.0315	4.9217
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.50243	.49172	.50891	24.957	1.9633	.50058	23.649
SDev	.00103	.00293	.01575	.028	.0286	.00087	.000
%RSD	.20608	.59496	3.0951	.11164	1.4551	.17306	.00000
#1	.50170	.48965	.52005	24.977	1.9431	.50119	23.649
#2	.50316	.49379	.49777	24.938	1.9835	.49997	23.649
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49243	2.5827	.48754	.01495
SDev	.00122	.0027	.00087	.00454
%RSD	.24828	.10447	.17776	30.377
#1	.49156	2.5846	.48693	.01174
#2	.49329	2.5808	.48815	.01816
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

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Method: EPACLP2 Sample Name: CCV16 Operator: WM
Run Time: 10/27/98 12:20:55
Comment: SDG: T76201 BORON MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00989	-.01666	-.00702	.00304	.00019	-.00070	.01310
SDev	.00637	.00699	.00338	.00000	.00026	.00141	.00158
%RSD	64.392	41.967	48.104	.00000	135.15	202.40	12.069
#1	.01439	-.02161	-.00940	.00304	.00038	.00030	.01422
#2	.00539	-.01172	-.00463	.00304	.00001	-.00169	.01198
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00331	-.16401	-.00057	.02843	-.01004	.00493	.03580
SDev	.00082	.00000	.00000	.00299	.00001	.00125	.07569
%RSD	24.742	.00122	.02891	10.523	.05084	25.275	211.41
#1	.00389	-.16401	-.00057	.03054	-.01004	.00581	.08933
#2	.00273	-.16401	-.00057	.02631	-.01003	.00405	-.01772
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00047	-.00217	.00009	1.3261	-.01032	.00041	16.810
SDev	.00034	.00000	.00155	.1339	.00176	.00043	.094
%RSD	73.623	.04033	1742.8	10.093	17.044	104.87	.56147
#1	.00071	-.00217	.00118	1.4208	-.01156	.00011	16.877
#2	.00022	-.00217	-.00101	1.2315	-.00907	.00071	16.743
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.00048	-.00231	.00148	9.7575
SDev	.00115	.00001	.00030	.0114
%RSD	241.97	.24574	19.958	.11637
#1	.00129	-.00231	.00127	9.7655
#2	-.00034	-.00230	.00169	9.7495
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
				10.000

Method: EPACLP2 Sample Name: CCB16 Operator: WM
Run Time: 10/27/98 12:22:56
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00642	L.00077	L-.01453	L.00304	L.00001	L-.00245	L.00047
SDev	.00443	.01094	.00091	.00000	.00001	.00140	.00226
%RSD	68.943	1427.9	6.2323	.00000	92.369	57.400	475.80
#1	L.00329	L-.00697	L-.01389	L.00304	L.00002	L-.00344	L-.00112
#2	L.00955	L.00850	L-.01517	L.00304	L.00000	L-.00145	L.00207
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00171	L.00273	L-.00108	L.01827	L-.00469	.00008	L-.03554
SDev	.00082	.00250	.00000	.00120	.01819	.00000	.02524
%RSD	47.765	91.711	.04796	6.5586	388.21	.00000	71.012
#1	L-.00229	L.00096	L-.00108	L.01912	L-.01755	.00008	L-.05339
#2	L-.00113	L.00450	L-.00108	L.01743	L.00818	.00008	L-.01769
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00026	-.00217	L-.00929	L1.6613	L-.00120	L.00040	L.09986
SDev	.00000	.00298	.00851	.1171	.00616	.00132	.00037
%RSD	.33866	137.27	91.598	7.0498	513.91	328.71	.37360
#1	L-.00026	-.00428	L-.01531	L1.5785	L-.00556	L-.00053	L.09959
#2	L-.00026	-.00006	L-.00327	L1.7442	L.00316	L.00133	L.10012
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00089	L-.00180	.00065	.01656
SDev	.00239	.00064	.00089	.00681
%RSD	268.07	35.454	137.48	41.146
#1	L-.00258	L-.00225	.00002	.02138
#2	L.00080	L-.00135	.00127	.01174
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: T76214L Operator: WM
Run Time: 10/27/98 12:26:02
Comment: SDG: T76201 1/5 SERIAL DILUTION MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	2.0725	L.01191	L-.06890	L.01113	L.00056	L.00007	26.446
SDev	.0015	.01479	.00508	.00000	.00026	.00004	.041
%RSD	.07389	124.14	7.3666	.00000	47.065	50.601	.15382
#1	2.0714	L.02237	L-.07249	L.01113	L.00074	L.00010	26.474
#2	2.0736	L.00146	L-.06531	L.01113	L.00037	L.00005	26.417
Errors	LC Pass	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00001	.05124	L.00155	10.325	L-.00227	6.4819	6.5343
SDev	.00137	.00374	.00000	.021	.00510	.0115	.0378
%RSD	27036.	7.2977	.07442	.20578	224.70	.17786	.57835
#1	L.00096	L.04859	L.00155	10.340	L.00134	6.4901	6.5610
#2	L-.00097	.05388	L.00155	10.310	L-.00588	6.4738	6.5076
Errors	LC Low	LC Pass	LC Low	LC Pass	LC Low	NOCHECK	LC Pass
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	1.1541	.00049	.10124	L2.8839	L.01645	L.00114	L2.7760
SDev	.0014	.00000	.00387	.0167	.02650	.00000	.0015
%RSD	.11922	.87912	3.8244	.58020	161.09	.37675	.05375
#1	1.1551	.00049	.10397	L2.8957	L.03519	L.00114	L2.7750
#2	1.1532	.00049	.09850	L2.8720	L-.00229	L.00113	L2.7771
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00230	L.01822	.00148	.03101
SDev	.00039	.00068	.00030	.00000
%RSD	16.859	3.7446	19.958	.00000
#1	L.00257	L.01773	.00127	.03101
#2	L.00202	L.01870	.00169	.03101
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: Fe 500 ppm Operator: WM
Run Time: 10/27/98 12:28:05
Comment: SDG: T76201 IEC MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.02733	L.03326	L-3.2899	L.00641	L.00016	.03070	L.05928
SDev	.00152	.00227	.0058	.00000	.00026	.00138	.00045
%RSD	5.5635	6.8187	.17733	.00000	168.42	4.4834	.76262
#1	L.02625	L.03487	L-3.2940	L.00641	L-.00003	.02973	L.05896
#2	L.02840	L.03166	L-3.2858	L.00641	L.00034	.03168	L.05960
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00092	L.00622	L.00824	H479.43	L.00958	.01617	L.01256
SDev	.00029	.00249	.00112	.85	.00892	.00031	.01084
%RSD	31.176	40.073	13.650	.17809	93.137	1.9272	86.280
#1	L.00072	L.00446	L.00744	H478.83	L.00327	.01639	L.02022
#2	L.00112	L.00799	L.00903	H480.03	L.01588	.01595	L.00490
Errors	LC Low	LC Low	LC Low	LC High	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00016	-.01202	L-.02407	L1.6613	L-.19451	L.00370	L.11779
SDev	.00155	.00136	.01083	.0948	.02215	.00097	.00186
%RSD	941.32	11.279	45.009	5.7070	11.388	26.260	1.5835
#1	L.00093	-.01106	L-.03173	L1.5943	L-.21017	L.00302	L.11911
#2	L-.00126	-.01298	L-.01641	L1.7284	L-.17884	L.00439	L.11647
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L.00859	L.00711	.00127	.19480
SDev	.00004	.00148	.00000	.00454
%RSD	.46229	20.768	.00000	2.3316
#1	L.00862	L.00815	.00127	.19802
#2	L.00856	L.00606	.00127	.19159
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
	[illegible]	.02000		

Fe interference on As = -0.0065
Fe int. on Cd = 0.0000614 A
Fe int on Sb = 0.0000665

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Method: EPACLP2 Sample Name: As 10 ppm Operator: WM
Run Time: 10/27/98 12:30:39
Comment: SDG: T76201 IEC MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.01294	L.00686	10.106	L.00304	L-.00036	L-.00807	L.00383
SDev	.00003	.00701	.059	.00000	.00000	.00071	.00023
%RSD	.20670	102.16	.58517	.00000	.84058	8.8036	5.9231
#1	L.01292	L.01182	10.064	L.00304	L-.00036	L-.00857	L.00399
#2	L.01296	L.00190	10.148	L.00304	L-.00037	L-.00756	L.00367
Errors	LC Low	LC Low	LC Pass	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00190	L-.00123	L-.00031	.19519	L-.00298	.03115	L-.03307
SDev	.00000	.00062	.00035	.12510	.00384	.00031	.01297
%RSD	.18612	50.335	113.65	64.091	128.84	1.0003	39.229
#1	L-.00190	L-.00167	L-.00056	.28365	L-.00027	.03093	L-.04224
#2	L-.00191	L-.00079	L-.00006	.10673	L-.00570	.03137	L-.02390
Errors	LC Low	LC Low	LC Low	LC Pass	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00047	-.00267	L-.00108	L2.1227	L.01415	L.00073	L.12465
SDev	.00037	.00225	.00464	.1785	.00821	.00001	.00485
%RSD	78.388	84.472	429.12	8.4075	58.007	1.5108	3.8906
#1	L-.00021	-.00107	L.00220	L2.2489	L.01996	L.00074	L.12808
#2	L-.00073	-.00426	L-.00437	L1.9965	L.00835	L.00073	L.12122
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00037	L-.00421	.00065	.02940
SDev	.00070	.00130	.00030	.00227
%RSD	191.85	30.950	45.825	7.7233
#1	L-.00086	L-.00329	.00086	.02780
#2	L.00013	L-.00513	.00044	.03101
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

As int on cal = 0.000847 ppm/ppb

00160

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Method: EPACLP2 Sample Name: CRIF2 Operator: WM
Run Time: 10/27/98 12:34:20
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00115	.12482	.23187	L.00304	.00986	.00716	L.00053
SDev	.00145	.00233	.00322	.00000	.00026	.00004	.00339
%RSD	125.72	1.8708	1.3886	.00000	2.6792	.58754	641.61
#1	L.00218	.12647	.23415	L.00304	.00967	.00713	L.00293
#2	L.00013	.12317	.22959	L.00304	.01004	.00719	L-.00187
Errors	LC Low	LC Pass	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01887	.10251	.05010	L.05414	.09958	-.00014	L-.02375
SDev	.00109	.00125	.00072	.00598	.00451	.00031	.04204
%RSD	5.7953	1.2145	1.4305	11.055	4.5258	228.48	177.04
#1	.01964	.10163	.05061	L.05837	.10277	.00008	L.00598
#2	.01809	.10339	.04959	L.04991	.09639	-.00036	L-.05347
Errors	LC Pass	LC Pass	LC Pass	LC Low	LC Pass	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.03007	-.00214	.07713	L2.0281	.18764	.01848	L.09379
SDev	.00034	.00000	.00232	.1339	.00178	.00087	.00224
%RSD	1.1445	.07189	3.0111	6.5999	.94762	4.7195	2.3866
#1	.03031	-.00214	.07877	L1.9334	.18890	.01910	L.09221
#2	.02982	-.00214	.07549	L2.1227	.18638	.01787	L.09537
Errors	LC Pass	NOCHECK	LC Pass	LC Low	LC Pass	LC Pass	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.09902	.03747	.00107	.01013
SDev	.00000	.00066	.00030	.00227
%RSD	.00295	1.7548	27.806	22.408
#1	.09903	.03794	.00086	.00853
#2	.09902	.03701	.00127	.01174
Errors	LC Pass	LC Pass	NOCHECK	NOCHECK
High	50.000	200.00		
Low	.05000	.02000		

Method: EPACLP2 Sample Name: ICSAF2 Operator: WM
Run Time: 10/27/98 12:36:16
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	488.64	.04042	-1.4180	.01113	.00034	.01571	468.56
SDev	1.97	.01870	.0439	.00000	.00001	.00053	1.94
%RSD	.40258	46.259	3.0989	.00000	1.3369	3.3489	.41418
#1	487.25	.02720	-1.3869	.01113	.00033	.01534	467.19
#2	490.03	.05365	-1.4490	.01113	.00034	.01608	469.93
Errors	QC Pass	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value	500.00						500.00
Range	20.000						20.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00397	.00140	-.00087	173.87	.00554	289.77	478.01
SDev	.00190	.00185	.00318	.83	.00572	.84	2.46
%RSD	47.767	131.39	365.73	.47868	103.20	.28980	.51509
#1	-.00263	.00271	.00138	173.28	.00958	289.17	476.27
#2	-.00531	.00010	-.00311	174.46	.00150	290.36	479.75
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass
Value				200.00			500.00
Range				20.000			20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.01227	-.00559	-.02133	1.1092	-.19055	.00063	.12755
SDev	.00018	.00534	.00851	.0056	.04722	.00140	.00448
%RSD	1.4317	95.599	39.908	.50275	24.783	222.19	3.5097
#1	.01239	-.00937	-.02735	1.1132	-.15716	-.00036	.13072
#2	.01214	-.00181	-.01531	1.1053	-.22394	.00162	.12439
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.01012	.00165	.01342	.19962
SDev	.00100	.00013	.00059	.01136
%RSD	9.8506	7.8734	4.4135	5.6882
#1	.01083	.00174	.01384	.19159
#2	.00942	.00156	.01300	.20765
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value				

Method: EPACLP2 Sample Name: ICSABF2 Operator: WM
Run Time: 10/27/98 12:38:03
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	496.47	.99596	-1.5092	.48416	.46954	.94199	474.65
SDev	2.65	.00776	.0695	.00286	.00342	.00749	.39
%RSD	.53276	.77953	4.6021	.59048	.72804	.79557	.08242
#1	494.60	.99047	-1.5584	.48214	.46712	.93669	474.38
#2	498.34	1.0015	-1.4601	.48619	.47196	.94728	474.93
Errors	QC Pass	QC Pass	NOCHECK	QC Pass	QC Pass	QC Pass	QC Pass
Value	500.00	1.0000		.50000	.50000	1.0000	500.00
Range	20.000	20.000		20.000	20.000	20.000	20.000

Elem	Cr2677	Cb2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.43914	.44126	.48541	176.15	.91932	291.29	485.71
SDev	.00383	.00127	.00648	.51	.03139	.45	2.83
%RSD	.87224	.28847	1.3345	.29054	3.4140	.15404	.58245
#1	.43643	.44036	.48083	175.78	.94152	291.60	483.71
#2	.44185	.44216	.48999	176.51	.89713	290.97	487.71
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	NOCHECK	QC Pass
Value	.50000	.50000	.50000	200.00	1.0000		500.00
Range	20.000	20.000	20.000	20.000	20.000		20.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.46185	-.00289	.88258	.95936	-.18090	.93544	.23149
SDev	.00182	.00216	.00542	.23982	.02592	.00357	.00448
%RSD	.39320	74.618	.61394	24.998	14.330	.38105	1.9339
#1	.46057	-.00137	.88642	1.1289	-.19923	.93292	.23465
#2	.46313	-.00442	.87875	.78978	-.16257	.93796	.22832
Errors	QC Pass	NOCHECK	QC Pass	NOCHECK	NOCHECK	QC Pass	NOCHECK
Value	.50000		1.0000			1.0000	
Range	20.000		20.000			20.000	

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.46128	.93295	.01321	.19802
SDev	.00340	.00129	.00089	.00454
%RSD	.73706	.13789	6.7252	2.2937
#1	.45887	.93204	.01384	.20123
#2	.46368	.93386	.01259	.19480
Errors	QC Pass	QC Pass	NOCHECK	NOCHECK
Value	.50000	1.0000		
Range	20.000	20.000		

Method: EPACLP2 Sample Name: CCV17 Operator: WM
Run Time: 10/27/98 12:40:16
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	5.0692	4.8957	1.9374	.49057	.48828	.49384	5.1023
SDev	.0371	.0233	.0037	.00143	.00106	.00139	.0560
%RSD	.73258	.47665	.19225	.29139	.21702	.28106	1.0985
#1	5.0954	4.8792	1.9348	.48956	.48753	.49482	5.1419
#2	5.0429	4.9122	1.9401	.49158	.48903	.49286	5.0627
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	5.0000	2.0000	.50000	.50000	.50000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	4.9009	.49078	.48961	4.9628	4.8879	5.1084	5.1904
SDev	.0003	.00436	.00179	.0180	.0079	.0489	.0841
%RSD	.00558	.88868	.36568	.36184	.16162	.95764	1.6196
#1	4.9007	.48770	.48834	4.9755	4.8823	5.1430	5.2499
#2	4.9011	.49387	.49087	4.9501	4.8935	5.0738	5.1310
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	5.0000	.50000	.50000	5.0000	5.0000	5.0000	5.0000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.48835	.49051	.49234	24.716	1.9525	.49348	24.608
SDev	.00034	.00149	.00310	.106	.0008	.00044	.075
%RSD	.06938	.30435	.62924	.42874	.04339	.08961	.30472
#1	.48811	.49157	.49453	24.791	1.9519	.49379	24.555
#2	.48859	.48946	.49015	24.641	1.9531	.49316	24.661
Errors	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass	QC Pass
Value	.50000	.50000	.50000	25.000	2.0000	.50000	25.000
Range	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	.49052	2.4666	.48953	.01816
SDev	.00081	.0007	.00089	.00454
%RSD	.16542	.02750	.18154	25.006
#1	.49109	2.4661	.48890	.02138
#2	.48994	2.4671	.49016	.01495
Errors	QC Pass	QC Pass	QC Pass	NOCHECK
Value	.50000	2.5000	.50000	
Range	10.000	10.000	10.000	

lethod: EPACLP2 Sample Name: CCV17 Operator: WM
Run Time: 10/27/98 12:42:05
Comment: SDG: T76201 BORON MET9815876
lode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.08820	-.01723	.00203	.00304	.00038	-.00271	.08501
SDev	.00928	.01087	.00091	.00000	.00000	.00137	.00339
%RSD	10.519	63.118	44.864	.00000	.47487	50.456	3.9872
#1	.09476	-.00954	.00139	.00304	.00038	-.00368	.08741
#2	.08164	-.02492	.00268	.00304	.00038	-.00174	.08262
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	.00389	-.16004	-.00006	.05467	-.02056	.08491	.05655
SDev	.00055	.00063	.00072	.00179	.00322	.00343	.00420
%RSD	14.035	.39211	1129.1	3.2830	15.649	4.0366	7.4285
#1	.00351	-.16048	.00044	.05594	-.01828	.08733	.05952
#2	.00428	-.15959	-.00057	.05340	-.02283	.08249	.05358
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	-.00001	-.00058	-.00101	1.4287	-.01091	.00195	16.610
SDev	.00034	.00223	.00310	.0892	.01851	.00087	.016
%RSD	2712.1	382.41	307.22	6.2461	169.67	44.865	.09433
#1	.00023	.00100	-.00320	1.4918	-.02400	.00257	16.621
#2	-.00026	-.00216	.00118	1.3656	.00218	.00133	16.599
Errors	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK	NOCHECK
Value							
Range							

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	-.00056	-.00183	.00107	9.6756
SDev	.00045	.00065	.00030	.0091
%RSD	80.096	35.712	27.806	.09388
#1	-.00024	-.00230	.00127	9.6692
#2	-.00088	-.00137	.00086	9.6820
Errors	NOCHECK	NOCHECK	NOCHECK	QC Pass
Value				10.000
				10.000

Method: EPACLP2 Sample Name: CCB17 Operator: WM
Run Time: 10/27/98 12:44:02
Comment: SDG: T76201 MET9815876
Mode: CONC Corr. Factor: 1

Elem	Al3082	Sb2068	As1936	Ba4934	Be3130	Cd2288	Ca3179
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.04276	L.00735	L-.00216	L.00304	L.00001	L-.00113	L.03260
SDev	.00981	.00934	.00072	.00000	.00001	.00069	.00384
%RSD	22.940	127.10	33.039	.00000	77.557	60.551	11.782
#1	L.03583	L.00074	L-.00267	L.00304	L.00001	L-.00065	L.02988
#2	L.04970	L.01396	L-.00166	L.00304	L.00000	L-.00162	L.03531
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low	LC Low
High	1000.0	100.00	100.00	200.00	20.000	100.00	1000.0
Low	.20000	.06000	.10000	.20000	.00500	.00500	5.0000

Elem	Cr2677	Co2286	Cu3247	Fe2599	Pb2203	Mg2795	Mg3832
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L.00061	L.00185	L-.00007	L.02949	L-.01161	.03423	L.01201
SDev	.00136	.00125	.00000	.00090	.00063	.00031	.01682
%RSD	225.60	67.521	.51536	3.0458	5.4184	.91016	140.09
#1	L-.00036	L.00097	L-.00007	L.03012	L-.01116	.03446	L.00011
#2	L.00157	L.00273	L-.00006	L.02885	L-.01205	.03401	L.02391
Errors	LC Low	LC Low	LC Low	LC Low	LC Low	NOCHECK	LC Low
High	100.00	100.00	100.00	400.00	200.00		800.00
Low	.01000	.05000	.02500	.10000	.05000		5.0000

Elem	Mn2576	Mo2020	Ni2316	K_7665	Se1960	Ag3280	Na5889
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Avge	L-.00050	-.00164	L-.00929	L1.3853	L.00069	L.00164	L.09775
SDev	.00034	.00074	.00077	.0056	.01762	.00043	.00037
%RSD	68.173	45.321	8.3224	.40256	2569.5	26.110	.38167
#1	L-.00026	-.00217	L-.00984	L1.3813	L-.01178	L.00194	L.09801
#2	L-.00075	-.00112	L-.00875	L1.3892	L.01315	L.00134	L.09748
Errors	LC Low	NOCHECK	LC Low	LC Low	LC Low	LC Low	LC Low
High	200.00		200.00	500.00	100.00	5.0000	500.00
Low	.01500		.04000	5.0000	.10000	.01000	5.0000

Elem	V_2924	Zn2138	Ti3349	B_2496
Units	ppm	ppm	ppm	ppm
Avge	L-.00033	L-.00133	.00044	.03583
SDev	.00156	.00133	.00059	.01590
%RSD	475.18	100.21	135.58	44.370
#1	L-.00143	L-.00039	.00002	.04707
#2	L.00077	L-.00228	.00086	.02459
Errors	LC Low	LC Low	NOCHECK	NOCHECK
High	50.000	200.00		

Varian SpectrAA 300/400 Zeeman Report

Columbia Analytical Services VARIAN-5
1317 South 13th Ave. P.O. Box 479
Kelso, WA 98626 (360) 577-7222

OPERATOR J Bruno
DATE 10/26/98 Time 07:00
BATCH T76201 As1 (98-6762)

PROGRAM 5 As EPA PLATFORM W/Pd

SAMPLE	Dilution	CONC ppb	Time	%RSD	MEAN ABS	READINGS		Comments
BLANK		0.0			0.006	0.005	0.007	
STANDARD 1		10.0		1.0	0.036	0.036	0.037	
STANDARD 2		20.0		0.4	0.074	0.074	0.074	
STANDARD 3		40.0		1.4	0.143	0.144	0.141	
STANDARD 4		60.0		0.1	0.213	0.213	0.213	
1 ICV	—	28.0	07:24	2.0	0.095	0.093	0.096	
2 ICB	—	0.5	07:28	48.3	0.002	0.002	0.001	
3 CCV11	—	41.2	07:32	0.4	0.147	0.147	0.147	
4 CCB11	—	0.5	07:36	34.9	0.002	0.001	0.002	
5 CBA	—	11.2	07:40	0.8	0.041	0.040	0.041	
6 PBW	—	1.7	·	4.6	0.006	0.006	0.006	
7 PBWA	—	22.0	·	0.7	0.082	0.082	0.081	
8 LCSW	—	28.3	·	0.7	0.103	0.104	0.103	
9 LCSWA	—	48.1	·	1.0	0.175	0.174	0.176	
10CCV12	—	41.7	08:00	1.4	0.149	0.147	0.150	
11CCB12	—	0.5	08:04	48.3	0.002	0.002	0.001	

C. Bruno
10/26/98 07:00
T 762d As 1
Program 5 As Platform.

Dilution	Time					Comments
~~13T76201~~	[illegible]	1.2	0.313	0.315	0.310	
~~13T76201A~~ —	[illegible]	0.4	0.356	0.356	0.354	> Diluted & rerun @ 10/26/98
14T76202 $\frac{1}{400}$	26.0	0.0	0.098	0.098	0.096	
15T76202A $\frac{1}{400}$	47.9	0.7	0.171	0.170	0.171	
16T76202D $\frac{1}{400}$	27.0	0.7	0.098	0.099	0.098	
17T76202DA $\frac{1}{400}$	47.0	0.8	0.167	0.163	0.166	
18T76202S $\frac{1}{400}$	23.7	0.1	0.087	0.087	0.087	Sample level > 4 Times spike level @ dil 400
19T76203 $\frac{1}{400}$	31.9	0.1	0.115	0.115	0.115	
20T76203A $\frac{1}{400}$	31.0	0.9	0.164	0.165	0.165	
21CC713 —	41.8 08:44	0.7	0.152	0.153	0.151	
22CCB13 —	[illegible] 08:48	18.7	0.002	0.001	0.001	
23T76204 $\frac{1}{3}$	31.1	1.1	0.112	0.113	0.112	
24T76204A $\frac{1}{3}$	81.4	0.1	0.183	0.183	0.183	
25T76205 —	1.6	0.9	0.008	0.009	0.009	
26T76205A —	11.5	0.1	0.083	0.083	0.083	
27T76206 —	1.6	7.1	0.007	0.006	0.007	
28T76206A —	23.6	0.7	0.076	0.076	0.077	
29T76207 $\frac{1}{20}$	27.2	0.1	0.099	0.099	0.099	
30T76207A $\frac{1}{20}$	47.7	0.0	0.170	0.170	0.170	
31T76208 $\frac{1}{10}$	1.2	1.2	0.074	0.075	0.074	
32T76208A $\frac{1}{10}$	41.9	0.7	0.148	0.149	0.147	
33CCV14 —	41.8 09:32	0.7	0.148	0.148	0.149	
34CCB14 —	1.0 09:36	18.3	0.004	0.004	0.003	
35T76209 $\frac{1}{2}$	[illegible]	0.1	0.130	0.130	0.130	
36T76209A $\frac{1}{2}$	56.0 09:44	2.1	0.199	0.196	0.202	

Cf Bourg
10/26/98 07:00
T 762d As 1
Program 5 As Platform

	Dilution	ppb	Time		ABS			Comments
37T76210	—	2.2	-	13.7	0.008	0.009	0.007	
38T76210A	—	22.1	·	1.7	0.081	0.082	0.080	
39T76211	—	1.3	·	23.4	0.005	0.006	0.004	
40T76211A	—	20.7	·	0.9	0.076	0.076	0.077	
41T76212	—	2.2	·	0.0	0.008	0.009	0.008	
42T76212A	—	22.4	·	0.3	0.082	0.082	0.083	
43CCV15	—	41.9	10:12	1.5	0.150	0.151	0.146	
44CCB15	—	1.1	10:16	3.0	0.004	0.004	0.004	
BLANK		0.0	·		0.003	0.002	0.003	> Baseline Correcti & reslope of 10/2
RESLOPE	3	40.0	·	3.5	0.149	0.145	0.152	
1 CCV16	—	41.4	10:25	1.0	0.154	0.153	0.155	
2 CCB16	—	0.3	10:32	67.9	0.001	0.002	0.001	
3 T76213	—	4.1	·	0.4	0.016	0.016	0.016	
4 T76213A	—	25.5	·	0.1	0.097	0.097	0.097	
~~5 T76214~~	~~—~~	~~40.0~~	~~·~~	~~0.1~~	~~0.170~~	~~0.170~~	~~0.170~~	> Diluted & rerun of 10/26
6 T76214A	—	OVER	·	0.0	0.236	0.236	0.238	
7 T76215	—	3.3	·	5.6	0.012	0.013	0.012	
8 T76215A	—	24.8	·	0.8	0.094	0.094	0.095	
~~9 T76216~~	~~1/200~~	~~85.6~~	~~·~~	~~0.2~~	~~0.224~~	~~0.225~~	~~0.224~~	> Diluted & rerun of 10
10T76216A	1/100	OVER	·	0.8	0.305	0.303	0.306	
11T76217	—	2.4	·	10.2	0.013	0.014	0.012	

J. Bruno
10/26/98 07:00
T 762 Cl ASI
Program 5 As Platform

	Dilution	Time					Comments
13CCV17	—	41.4	11:16	1.7	0.154	0.156	0.152	
14CCB17	—	0.8	11:20	18.3	0.002	0.002	0.002	
BLANK		0.0			0.001	0.001	0.001	Baseline Correction of 10/26/98
15T76214	1/2	22.2		0.4	0.085	0.085	0.084	
16T76214A	1/2	42.1		0.6	0.156	0.157	0.156	
17T76216	1/4000	10.3		0.3	0.039	0.039	0.039	
18T76216A	1/4000	29.7		0.3	0.112	0.112	0.112	
19CCV18	—	41.3	11:44	1.9	0.153	0.155	0.151	
20CCB18	~	-0.1	11:48	99.9	-0.000	-0.001	0.000	

STANDARD / MODIFIER FORM

Solution : GFAA Intermediate Stock GIS 100198 Exp. Date 2/11/99
Volume : 500 mls
Date : 10/01/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	50.0	✓	10 %
As	CPI	720620	02/25/99	5.0	✓	10.0
Pb	CPI	800712	7/99	5.0	✓	10.0
Se	CPI	8CB063	5/99	5.0	✓	10.0
Tl	CPI	719209	02/11/99	5.0	✓	10.0
Cd	Hi Purity	805543	3/9/99	5.0	✓	10.0

Solution : Working Standard GWS 102698
Volume : 100 mls
Date : 10/26/98
Analyst : C. Bourro

GIS 100198		Aliquot / 100 mls	Check as Added	Concentration (ug/l)
		1 mls	✓	100

Solution : ICV Solution
Volume : 500 mls
Date : 4/14/98
Analyst : Eric Molin

ICV Solution Exp. Date 2/1/99	Aliquot /500 mls of a 1/200 dilution 5.0 ml	Lot # of IV soln QCP-CICV-3: M-MEB58063	Final Conc in ug/l for As,Pb,Se,Tl = 25 Cd = 12.5

Solution : Palladium Modifier
Volume : 500 mls
Date : 4/22/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	JT Baker	L17543	Opened08/06/98	5.0 mls	✓	1.0%
Pd	IV*	K-PD01075	———	0.500 g	✓	1000

Solution : Magnesium Nitrate Modifier
Volume : 100 mls
Date : 8/22/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 100 mls	Check as Added	Conc. (mg/L)
$HN_0 3$	Baker	L17543	Opened 8/6/98	1.0 mls	✓	1.0%
$Mg(NO_3)_2$	EM Science	9266	Opened 3/4/91	0.100 g	✓	1000

As,Se : 50/50 (V/V) mixture of Palladium and Magnesium Nitrate modifiers
Cd,Pb,TL : Palladium Modifier
*Inorganic Ventures

PROGRAM 5 As EPA PLATFORM W/Pd

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK AREA
LAMP POSITION	1
LAMP CURRENT (mA)	10
SLIT WIDTH (nm)	1.0
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	193.7
SAMPLE INTRODUCTION	SAMPLER PREMIXED
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	1.0
REPLICATES	1
BACKGROUND CORRECTION	ON
MAXIMUM ABSORBANCE	0.95

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	300	35.0	3.0	ALTERNATE	NO
2	600	20.0	3.0	ALTERNATE	NO
3	1300	5.0	3.0	ALTERNATE	NO
4	1300	5.0	3.0	ALTERNATE	NO
5	2650	1.0	0.0	ALTERNATE	YES
6	2650	2.0	0.0	ALTERNATE	YES
7	2700	1.0	3.0	ALTERNATE	NO
8	100	13.0	3.0	ALTERNATE	NO

SAMPLER PARAMETERS
VOLUMES (fL)

	SOLUTION	BLANK	MODIFIER
BLANK	--	12	4
STANDARD 1	12	0	4
STANDARD 2	12	0	4
STANDARD 3	12	0	4
STANDARD 4	12	0	4
SAMPLE	12	0	4

RECALIBRATION RATE	0
RESLOPE RATE	0

MULTIPLE INJECT	NO	HOT INJECT	YES	PRE INJECT	NO
		TEMPERATURE	120		
		INJECT RATE	2		

Varian SpectrAA 300/400 Zeeman Report

Columbia Analytical Services VARIAN-5
1317 South 13th Ave. P.O. Box 479
Kelso, WA 98626 (360) 577-7222

OPERATOR [illegible]
DATE 10/28/98 Time 18:00
BATCH T67201 As2 (K98P06762)

PROGRAM 5 As EPA PLATFORM W/Pd

SAMPLE	CONC ppb	%RSD	MEAN ABS	READINGS		
BLANK	0.0		0.002	0.002	0.002
STANDARD 1	10.0	3.9	0.035	0.034	0.036
STANDARD 2	20.0	0.4	0.072	0.072	0.072
STANDARD 3	40.0	1.6	0.139	0.141	0.137
STANDARD 4	60.0	1.9	0.205	0.202	0.208
1 ICV2	25.8 18:24	2.0	0.092	0.091	0.094
2 ICB2	-0.4 18:28	21.2	-0.001	-0.002	-0.001
3 CCV21	41.8 18:32	1.1	0.145	0.144	0.146
4 CCB21	-0.1 18:36	99.9	-0.000	0.001	-0.002
5 CRA	10.4 18:40	2.8	0.037	0.036	0.037
6 ~~T67~~201 762 1/4	25.4	1.8	0.091	0.092	0.090
7 ~~T67~~201A 762	45.9	0.1	0.158	0.158	0.158
8 S94701	38.0	1.0	0.133	0.134	0.132
9 S94701A	59.2	0.8	0.202	0.203	0.201
10S94701D	36.6	0.8	0.128	0.129	0.127
11S94701DA	57.4	0.5	0.196	0.197	0.196
12S94701S	55.2	2.1	0.189	0.186	0.192
13S94706	23.9	1.6	0.086	0.085	0.087
14S94706A	44.7	0.4	0.154	0.154	0.155
15CCV22	42.9 19:20	1.0	0.149	0.148	0.150
16CCB22	0.8 19:24	25.5	0.003	0.003	0.002

Unrelated samples
Em 10/28/98

00173

STANDARD / MODIFIER FORM

Solution : GFAA Intermediate Stock GIS 100198 Exp. Date 2/11/99
Volume : 500 mls
Date : 10/01/98
Analyst : C. Bourot

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	50.0	✓	10 %
As	CPI	720620	02/25/99	5.0	✓	10.0
Pb	CPI	800712	7/99	5.0	✓	10.0
Se	CPI	8CB063	5/99	5.0	✓	10.0
Tl	CPI	719209	02/11/99	5.0	✓	10.0
Cd	Hi Purity	805543	3/9/99	5.0	✓	10.0

Solution : Working Standard GWS 102898
Volume : 100 mls
Date : 10/28/98
Analyst : Eric Mohn

GIS 100198		Aliquot / 100 mls	Check as Added	Concentration (ug/l)
		1 mls	✓	100

Solution : ICV Solution
Volume : 500 mls
Date : 4/14/98
Analyst : Eric Mohn

ICV Solution Exp. Date 2/1/99	Aliquot /500 mls of a 1/200 dilution 5.0 ml	Lot # of IV soln QCP-CICV-3: M-MEB58063	Final Conc in ug/l for As,Pb,Se,Tl = 25 Cd = 12.5

Solution : Palladium Modifier
Volume : 500 mls
Date : 4/22/98
Analyst : C. Bourot

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	JT Baker	L17543	Opened08/06/98	5.0 mls	✓	1.0%
Pd	IV*	K-PD01075	———	0.500 g	✓	1000

Solution : Magnesium Nitrate Modifier
Volume : 100 mls
Date : 8/22/98
Analyst : C. Bourot

Element	Source	Lot No.	Expiration Date	Aliquot / 100 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	1.0 mls	✓	1.0%
$Mg(NO_3)_2$	EM Science	9266	Opened 3/4/91	0.100 g	✓	1000

As,Se : 50/50 (V/V) mixture of Palladium and Magnesium Nitrate modifiers
Cd,Pb,TL : Palladium Modifier
*Inorganic Ventures

PROGRAM 5 As EPA PLATFORM W/Pd

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK AREA
LAMP POSITION	1
LAMP CURRENT (mA)	10
SLIT WIDTH (nm)	1.0
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	193.7
SAMPLE INTRODUCTION	SAMPLER PREMIXED
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	1.0
REPLICATES	1
BACKGROUND CORRECTION	ON
MAXIMUM ABSORBANCE	0.95

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	300	35.0	3.0	ALTERNATE	NO
2	600	20.0	3.0	ALTERNATE	NO
3	1300	5.0	3.0	ALTERNATE	NO
4	1300	5.0	3.0	ALTERNATE	NO
5	2650	1.0	0.0	ALTERNATE	YES
6	2650	2.0	0.0	ALTERNATE	YES
7	2700	1.0	3.0	ALTERNATE	NO
8	100	13.0	3.0	ALTERNATE	NO

SAMPLER PARAMETERS
VOLUMES (fL)

	SOLUTION	BLANK	MODIFIER
BLANK	--	12	4
STANDARD 1	12	0	4
STANDARD 2	12	0	4
STANDARD 3	12	0	4
STANDARD 4	12	0	4
SAMPLE	12	0	4

RECALIBRATION RATE	0
RESLOPE RATE	0

MULTIPLE INJECT NO HOT INJECT YES PRE INJECT NO
TEMPERATURE 120
INJECT RATE 2

Varian SpectrAA 300/400 Zeeman Report

Columbia Analytical Services F VARIAN-2
1317 South 13th Street P.O. Box 479
Kelso, WA 98626 (360) 577-7222

OPERATOR Cf Bruno
DATE 10/27/98 Time 01:00
BATCH T76201 Pb1 (98-6762)

PROGRAM 7 Pb EPA/CLP PLATFORM

SAMPLE Dilution	CONC ppb	Time	%RSD	MEAN ABS	READINGS		Comments
~~BLANK~~	~~0.0~~			~~-0.000~~	~~0.001~~	~~-0.001~~	Restarted @ 10/27/98
~~STANDARD 1~~	~~3.0~~		~~4.3~~	~~0.008~~	~~0.008~~	~~0.008~~	
BLANK	0.0			0.000	-0.000	0.001	
STANDARD 1	3.0		0.0	0.008	0.008	0.008	
STANDARD 2	30.0		0.4	0.083	0.083	0.082	
STANDARD 3	40.0		0.6	0.110	0.109	0.110	
STANDARD 4	50.0		1.0	0.136	0.135	0.137	
1 ICV	26.7	01:32	0.2	0.074	0.074	0.074	
2 ICB	0.5	01:36	23.6	0.001	0.001	0.002	
3 CCV11	40.3	01:40	0.2	0.111	0.110	0.111	
4 CCB11	0.6	01:44	17.8	0.002	0.001	0.002	
5 CRA	3.4	01:45	3.1	0.010	0.010	0.009	
6 PBW	0.6		16.6	0.002	0.002	0.002	
7 PBWA	21.9		0.3	0.060	0.060	0.060	
8 LCSW	27.5		1.6	0.076	0.075	0.077	
9 LCSWA	48.2		0.9	0.132	0.132	0.131	
10T76201	9.4		2.6	0.026	0.027	0.026	
11T76201A	27.3		0.5	0.075	0.076	0.075	
12T76202	7.0		1.1	0.019	0.019	0.020	
13T76202A	23.2		0.4	0.064	0.064	0.064	-W
14CCV12	38.3	02:24	0.2	0.105	0.105	0.105	
15CCB12	0.5	02:28	16.9	0.001	0.001	0.001	

Cf Powro
10/27/98 Time 01:00
T 762 01 Pb1
Program 7 Pb EPA ICLP

	Dilution	Time					Comments
16T76202D	7.2		2.6	0.020	0.020	0.020	
17T76202DA	23.3		3.6	0.064	0.063	0.066	-W
18T76202S	22.8		1.7	0.063	0.062	0.064	
~~19T76203~~	~~8.9~~		~~2.1~~	~~0.025~~	~~0.025~~	~~0.024~~	> Rerun by MSA cf 10/27/98
20T76203A	24.9		3.4	0.069	0.067	~~0.070~~	
21T76204	1.3		11.8	0.004	0.004	0.003	
22T76204A	20.2		0.0	0.056	0.056	0.056	
23T76205	0.5		47.0	0.001	0.001	0.002	
24T76205A	19.2		0.6	0.053	0.053	0.053	
25CCV13	39.1	03:08	0.4	0.107	0.107	0.108	
26CCB13	0.7	03:12	12.5	0.002	0.002	0.002	
27T76206	0.8		0.0	0.002	0.002	0.002	
28T76206A	18.0		1.6	0.050	0.049	0.050	
29T76207	0.6		27.2	0.002	0.002	0.001	
30T76207A	18.0		1.2	0.050	0.050	0.049	
31T76208	1.1		41.6	0.003	0.004	0.002	
32T76208A	20.2		0.0	0.056	0.056	0.056	
33T76209	0.5		30.7	0.001	0.002	0.001	
34T76209A	19.8		0.4	0.055	0.055	0.055	
35T76210	0.4		29.8	0.001	0.001	0.001	
36T76210A	19.3		0.0	0.053	0.053	0.053	

SAMPLE	CONC ppb		%RSD	MEAN ABS	READINGS		
37CCV14	39.9	03:56	0.1	0.109	0.109	0.109	
38CCB14	0.6	04:00	0.0	0.002	0.002	0.002	

00177

cf Pozuro
10/27/98 01:00
T 762d Pb1
Program 7 Pb EPA/CLP Platform

	Dilution	Time				Comments
39T76211 —	1.1		0.0	0.003	0.003	0.003	
40T76211A —	20.2		1.5	0.056	0.056	0.055	
41T76212 —	0.7		20.7	0.002	0.002	0.002	
42T76212A —	20.8		0.8	0.058	0.057	0.058	
43CCV15 —	39.6	04:20	0.1	0.109	0.109	0.109	
44CCB15 —	0.5	04:24	20.0	0.001	0.002	0.001	
~~45~~	~~0.5~~	~~04:28~~	~~12.6~~	~~0.001~~	~~0.001~~	~~0.002~~	non related cf 10/26/98

cf Bruno
10/27/98 01:00
T 76201 Pb1
Program 7 Pb EPA ICLP

SAMPLE	Dilution	CONC ppb	Time	%RSD	MEAN ABS	READINGS		
BLANK		0.0			-0.000	0.000	-0.000	> Baseline Correcte & reslope of 10/27/98
RESLOPE	3	40.0		0.3	0.108	0.108	0.107	
1 CCV16	—	39.5	04:40	0.4	0.107	0.106	0.107	
2 CCB16	—	0.2	04:44	91.1	0.001	0.001	0.000	
3 T76213	—	0.4		76.7	0.001	0.000	0.002	
T76213A	—	20.9		1.1	0.057	0.057	0.056	
5 T76214	—	0.5		17.7	0.001	0.002	0.001	
6 T76214A	—	21.0		0.2	0.057	0.057	0.057	
7 T76215	—	0.5		29.4	0.001	0.001	0.002	
8 T76215A	—	21.0		0.8	0.057	0.057	0.057	
9 T76216	—	4.3		1.5	0.012	0.012	0.012	
10T76216A	—	24.3		1.6	0.066	0.065	0.067	
11T76217	—	0.6		25.3	0.002	0.001	0.002	
12T76217A	—	22.1		0.3	0.060	0.060	0.060	
13CCV17	—	43.0	05:25	0.6	0.116	0.116	0.115	
14CCB17	—	0.7	05:32	30.0	0.002	0.001	0.002	
BLANK		0.0			0.002	0.002		
RESLOPE	3	40.0		0.0	0.113	0.113		
15CCV18	—	38.7	05:35	0.0	0.110	0.110		
16CCB18	—	0.0	05:40	0.0	0.000	0.000		
17T762030	—	7.8		0.0	0.022	0.022		
18T762031	—	16.1		0.0	0.046	0.046		

20176203	—	30.8	0.0	0.086	0.086
21CCV19	—	39.0 0550	0.0	0.110	0.110
22CCB19	—	-0.3 05:52	0.0	-0.001	-0.001

Dilution Time Comments

Bruno
10/27/98 01:00
T 76201 Pb1
Program 7 Pb EPA / CLP Platform.

STANDARD / MODIFIER FORM

Solution : GFAA Intermediate Stock GIS 100198 Exp. Date 2/11/99
Volume : 500 mls
Date : 10/01/98
Analyst : CJ Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	50.0	✓	10 %
As	CPI	720620	02/25/99	5.0	✓	10.0
Pb	CPI	800712	7/99	5.0	✓	10.0
Se	CPI	8CB063	5/99	5.0	✓	10.0
Tl	CPI	719209	02/11/99	5.0	✓	10.0
Cd	Hi Purity	805543	3/9/99	5.0	✓	10.0

Solution : Working Standard GWS 102798
Volume : 100 mls
Date : 10/27/98
Analyst : CJ Bourro

GIS 100198		Aliquot / 100 mls	Check as Added	Concentration (ug/l)
		1 mls	✓	100

Solution : ICV Solution
Volume : 500 mls
Date : 4/14/98
Analyst : Eric Molin

ICV Solution Exp. Date 2/1/99	Aliquot /500 mls of a 1/200 dilution 5.0 ml	Lot # of IV soln QCP-CICV-3: M-MEB58063	Final Conc in ug/l for As,Pb,Se,Tl = 25 Cd = 12.5

Solution : Palladium Modifier
Volume : 500 mls
Date : 4/22/98
Analyst : CJ Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	JT Baker	L17543	Opened08/06/98	5.0 mls	✓	1.0%
Pd	IV*	K-PD01075	———	0.500 g	✓	1000

Solution : Magnesium Nitrate Modifier
Volume : 100 mls
Date : 8/22/98
Analyst : CJ Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 100 mls	Check as Added	Conc. (mg/L)
$HN_0 3$	Baker	L17543	Opened 8/6/98	1.0 mls	✓	1.0%
$g(NO_3)_2$	EM Science	9266	Opened 3/4/91	0.100 g	✓	1000

As,Se : 50/50 (V/V) mixture of Palladium and Magnesium Nitrate modifiers
Cd,Pb,TL : Palladium Modifier
*Inorganic Ventures

PROGRAM 7 Pb EPA/CLP PLATFORM

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK AREA
LAMP POSITION	2
LAMP CURRENT (mA)	5
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	283.3
SAMPLE INTRODUCTION	SAMPLER PREMIXED
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	1.0
REPLICATES	2
BACKGROUND CORRECTION	ON
MAXIMUM ABSORBANCE	1.40

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	300	35.0	3.0	ALTERNATE	NO
2	600	10.0	3.0	ALTERNATE	NO
3	1000	5.0	3.0	ALTERNATE	NO
4	1000	5.0	3.0	ALTERNATE	NO
5	2300	1.0	0.0	ALTERNATE	YES
6	2300	2.0	0.0	ALTERNATE	YES
7	2500	1.0	3.0	ALTERNATE	NO
8	100	13.0	3.0	NORMAL	NO

SAMPLER PARAMETERS
VOLUMES (fL)

	SOLUTION	BLANK	MODIFIER
BLANK	--	12	6
STANDARD 1	12	0	6
STANDARD 2	12	0	6
STANDARD 3	12	0	6
STANDARD 4	12	0	6
SAMPLE	12	0	6

RECALIBRATION RATE	0
RESLOPE RATE	0

MULTIPLE INJECT NO HOT INJECT YES PRE INJECT NO
TEMPERATURE 120
INJECT RATE 2

INSTRUMENT I.D.: Varian 2
BACKGROUND CORRECTION: BZ

Varian SpectrAA 300/400 Zeeman Report

Columbia Analytical Services VARIAN-4
1317 South 13th Ave. P.O.Box 479
Kelso, WA 98626 (360)-636-8161

OPERATOR J. Brown
DATE 10/26/98 Time 08:00
BATCH D76201 Se1
T Em 10/26/98
PROGRAM 30 **Se Platform High Ash**

SAMPLE	Dilution	CONC ppb	Time	%RSD	MEAN ABS	READINGS			Comments
~~BLANK~~		~~0.0~~			~~0.007~~	~~0.014~~	~~0.001~~		> Restarted @ 10/26/98
~~STANDARD 1~~		~~5.0~~		~~31.8~~	~~0.009~~	~~0.011~~	~~0.007~~		
BLANK		0.0			0.002	0.005	0.000		
BLANK		0.0			-0.000	-0.001	-0.000		
STANDARD 1		5.0		0.7	0.016	0.016	0.016		
STANDARD 2		30.0		1.7	0.093	0.092	0.094		
STANDARD 3		40.0		0.8	0.131	0.130	0.132		
STANDARD 4		50.0		0.9	0.156	0.155	0.157		
1 ICV —		26.3	08:36	1.1	0.082	0.081	0.083		
2 ICB —		0.9	08:40	6.0	0.003	0.003	0.003		
3 CCV11 —		39.1	08:44	1.1	0.127	0.128	0.126		
4 CCB11 —		1.1	08:48	28.9	0.004	0.004	0.003		
BLANK		0.0			-0.004	-0.006	-0.003		Baseline Correction
5 CRA —		5.5	08:56	12.2	0.017	0.016	0.019		
6 PBW —		0.0		99.9	0.000	-0.000	0.000		
7 PBWA —		10.2		6.1	0.032	0.030	0.033		
8 LCSW —		24.9		1.3	0.078	0.078	0.077		
9 LCSWA —		34.9		3.4	0.111	0.113	0.108		
10 CCV12 —		38.7	09:16	2.2	0.125	0.127	0.124		
11CCB12 —		1.6	09:20	37.2	0.005	0.006	0.004		

CJ Bruno
10/26/98 08:00
Analyst TD 76201 Se 1
Program 30 Se Platform

	Dilution	Time				Comments
BLANK	0.0		0.003	0.005	0.002	Baseline Correction & reslope of 10/26/98
RESLOPE 3	40.0	2.1	0.150	0.148	0.152	
10CCV13	39.2	09:32 0.5	0.148	0.148	0.147	
11CCB13	-1.8	09:36 9.4	-0.006	-0.005	-0.006	
BLANK	0.0		0.002	0.001	0.003	Baseline Correction of 10/26/
12T76201	1.5	83.7	0.006	0.002	0.009	Diluted & rerun of 10/26/98
13T76201A	2.6	14.1	0.010	0.011	0.009	
14T76202	0.2	42.9	0.001	0.001	0.001	
15T76202A	3.8	8.9	0.014	0.013	0.015	
16T76202D	0.8	11.1	0.003	0.003	0.003	
17T76202DA	3.7	15.6	0.013	0.012	0.015	
18T76202S	4.2	9.1	0.015	0.014	0.016	
19T76203	0.3	99.9	0.001	0.003	-0.001	CCV failed, recalibra of 10/26/98
20T76203A	4.2	2.4	0.015	0.015	0.016	
21CCV14	37.8	10:20 4.2	0.143	0.139	0.148	
22CCB14	0.5	10:24 99.9	0.002	0.004	0.000	
23T76204	0.7	84.0	0.002	0.001	0.004	
24T76204A	7.4	15.8	0.027	0.030	0.024	
25T76205	7.5	7.3	0.027	0.029	0.026	
26T76205A	15.5	2.6	0.057	0.056	0.058	
27T76206	0.2	0.0	0.001	0.001	0.001	
28T76206A	5.6	11.2	0.021	0.022	0.019	
29T76207	-0.1	23.1	-0.000	-0.001	-0.000	
30T76207A	5.4	3.8	0.020	0.019	0.020	
31T76208	0.1	53.6	0.000	0.001	0.000	
32T76208A	6.8	3.0	0.025	0.026	0.025	

NK	0.0		-0.000	-0.000	-0.000	
STANDARD 1	5.0	9.7	0.018	0.019	0.017	
STANDARD 2	30.0	1.8	0.096	0.098	0.095	
STANDARD 3	40.0	0.9	0.133	0.134	0.132	
STANDARD 4	50.0	1.2	0.162	0.164	0.161	
1 ICV2	26.2 11:32	2.4	0.086	0.084	0.087	
2 ICB2	0.2 11:36	99.9	0.001	-0.000	0.001	
3 CCV21	40.1 11:40	2.7	0.133	0.136	0.131	
4 CCB21	0.3 11:44	88.9	0.001	0.002	0.000	
5 CRA2	5.1 11:48	11.2	0.018	0.020	0.017	
6 T76204 —	1.3	52.0	0.004	0.003	0.006	-W
7 T76204A —	7.4	5.2	0.026	0.027	0.025	
8 T76205 —	8.3	8.6	0.029	0.031	0.027	
9 T76205A —	17.5	7.9	0.059	0.056	0.062	
10T76206 —	1.2	99.9	0.004	0.008	0.000	-W
11T76206A —	6.6	0.7	0.023	0.024	0.023	
12T76207 —	1.6	22.6	0.006	0.007	0.005	-W
13T76207A —	6.4	7.4	0.023	0.024	0.021	
14CCV22	42.2 12:24	8.1	0.140	0.132	0.148	
15CCB22	0.9 12:28	25.5	0.003	0.004	0.003	
16T76208 —	1.2	37.2	0.004	0.003	0.005	-W
17T76208A —	7.4	2.7	0.026	0.026	0.027	
18T76209 —	0.6	91.8	0.002	0.004	0.001	-W
19T76209A —	8.4	5.1	0.030	0.031	0.028	
~~20T76210~~ —	~~7.6~~	~~6.9~~	~~0.027~~	~~0.025~~	~~0.028~~	
21T76210A —	16.0	7.2	0.054	~~0.058~~	0.057	Run by MSA Ezm 10/26/96
~~22T76211~~ —	~~40.8~~	~~5.2~~	~~0.136~~	~~0.131~~	~~0.141~~	
23T76211A —	54.2	0.1	0.174	0.174	0.174	Dilute and rerun Ezm 10/26/9

Cu Mtn 10/26/96
TMn 08:00
T76201 Se 1
Program 30
Se Platform

Eric Nelson 10/26/95
Time 08:00
T76201 Se/
Program 30
Se Platform

24T76212 —	1.8		60.8	0.006	0.009	0.004 -W
25T76212A —	9.3		7.3	0.032	0.034	0.031
26CCV23	39.3	13:12	1.4	0.130	0.129	0.131
27CCB23	0.7	13:16	30.7	0.003	0.002	0.003
28T76213 —	1.1		47.1	0.004	0.005	0.003 -W
29T76213A —	7.9		1.0	0.028	0.027	0.028
30T76214 —	0.9		46.0	0.003	0.004	0.002 -W
31T76214A —	8.3		7.3	0.029	0.027	0.030
32T76215 —	1.6		3.7	0.006	0.005	0.006 -W
33T76215A —	8.3		1.1	0.029	0.029	0.029
76216 —	OVER		39.2	0.689B	0.880B	0.498B Dilute and rerun Eric 10/26/
~~35T76216A —~~	~~OVER~~		~~13.3~~	~~0.578B~~	~~0.524B~~	~~0.633B~~
36T76217 —	-0.3		99.9	-0.001	0.001	-0.002 -W
37T76217A —	7.3		1.7	0.026	0.025	0.026
38CCV24	40.8	14:00	2.0	0.136	0.134	0.138
39CCB24	1.3	14:04	99.9	0.005	0.008	0.001
BLANK	0.0			0.009	0.011	0.006 } Baseline correction and
RESLOPE 3	40.0		0.4	0.113	0.112	0.113 } reslope Eric 10/26/95
1 CCV25	36.8	14:16	3.6	0.109	0.112	0.106
2 CCB25	-0.1	14:20	99.9	-0.000	0.000	-0.001
3 T76201 1/5	-0.3		99.9	-0.001	0.001	-0.002 -W
4 T76201A	7.4		4.3	0.023	0.022	0.023
5 T76202	0.4		8.1	0.001	0.001	0.001 -W
6 T76202A	6.4		5.7	0.020	0.019	0.021
7 T76202D	-0.0		99.9	-0.000	0.000	-0.001 -W
8 T76202DA	6.2		1.4	0.019	0.019	0.019
9 T76202S	0.7		0.0	0.002	0.002	0.002 -N

00186

Eric 10/26/95

Lin Molin 10/26/98
Time 08:00
T76201 Se/
Program 30
Se Platform

~~11T76216A~~	~~1/8~~	~~6.0~~		~~4.7~~	~~0.018~~	~~0.019~~	~~0.018~~
12CCV26		39.4	15:00	2.7	0.111	0.109	0.113
13CCB26		0.3	15:04	88.9	0.001	0.002	0.000
14~~CCV28~~ T76216	1/25	0.6		33.9	0.002	0.001	0.002
15~~CCB22~~ T76216A	↓	6.5		7.6	0.020	0.021	0.019
~~16T76200~~		~~17.8~~		~~99.9~~	~~0.053~~	~~0.108~~	~~-0.002~~
~~17T762~~~~09A~~ 11	~~1/2~~	~~18.6~~		~~3.4~~	~~0.055~~	~~0.056~~	~~0.053~~
~~18T762~~~~00~~ 11A	↓	26.6		1.6	0.076	0.075	~~0.077~~
~~T76209A~~ CCV27		37.7	15:28	4.8	0.106	0.102	0.109
20~~T76210~~ CCB27		-0.0	15:32	99.9	-0.000	-0.000	0.000

Dilute and rerun Em 10/26/98

No sample Em 10/26/98

Sample labels incorrect Em 10/26/98

Rinsing MS4 Em 10/26/98

BLANK		0.0		0.004	0.004
RESLOPE	3	40.0	0.0	0.116	0.116
19CCV28		37.6	15:38	0.0	0.109	0.109
20CCB28		0.1	15:40	0.0	0.000	0.000
21T762100 +0ug/l	—	5.9		0.0	0.019	0.019
22T762101 +10ug/l	—	13.2		0.0	0.041	0.041
23T762102 +20ug/l	—	21.1		0.0	0.063	0.063
24T762103 +30ug/l	—	31.7		0.0	0.092	0.092

Baseline correction and reslope Em 10/26/98

R = 0.997
X = 7.3

Eric Miller 10/26/98
Time 08:00
T76201 Se
program 3°
Se Platform

25T762110 +0ug/l	1/2	18.6	0.0	0.056	0.056
26T762111 +10ug/l		27.1	0.0	0.080	0.080
27T762112 +20ug/l		33.9	0.0	0.098	0.098
28T762113 +30ug/l		41.7	0.0	0.122	0.122
29CCV29		36.9 15:58	0.0	0.106	0.106
30CCB29		0.0 ~~14~~16:00 Sun 10/26/98	0.0	0.000	0.000

R = 0.998
X = 26.2

STANDARD / MODIFIER FORM

Solution : GFAA Intermediate Stock GIS 100198 Exp. Date 2/11/99
Volume : 500 mls
Date : 10/01/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	50.0	✓	10 %
As	CPI	720620	02/25/99	5.0	✓	10.0
Pb	CPI	800712	7/99	5.0	✓	10.0
Se	CPI	8CB063	5/99	5.0	✓	10.0
Tl	CPI	719209	02/11/99	5.0	✓	10.0
Cd	Hi Purity	805543	3/9/99	5.0	✓	10.0

Solution : Working Standard GWS 102698
Volume : 100 mls
Date : 10/26/98
Analyst : Eric Molin

GIS 100198		Aliquot / 100 mls	Check as Added	Concentration (ug/l)
		1 mls	✓	100

Solution : ICV Solution
Volume : 500 mls
Date : 4/14/98
Analyst : Eric Molin

ICV Solution Exp. Date 2/1/99	Aliquot /500 mls of a 1/200 dilution 5.0 ml	Lot # of IV soln QCP-CICV-3: M-MEB58063	Final Conc in ug/l for As,Pb,Se,Tl = 25 Cd = 12.5

Solution : Palladium Modifier
Volume : 500 mls
Date : 4/22/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	JT Baker	L17543	Opened08/06/98	5.0 mls	✓	1.0%
Pd	IV*	K-PD01075	———	0.500 g	✓	1000

Solution : Magnesium Nitrate Modifier
Volume : 100 mls
Date : 8/22/98
Analyst : C. Bourro

Element	Source	Lot No.	Expiration Date	Aliquot / 100 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	1.0 mls	✓	1.0%
$Mg(NO_3)_2$	EM Science	9266	Opened 3/4/91	0.100 g	✓	1000

As,Se : 50/50 (V/V) mixture of Palladium and Magnesium Nitrate modifiers
Cd,Pb,TL : Palladium Modifier
*Inorganic Ventures

PROGRAM 30 Se Platform High Ash

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK AREA
LAMP POSITION	1
LAMP CURRENT (mA)	9
SLIT WIDTH (nm)	1.0
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	196.0
SAMPLE INTRODUCTION	SAMPLER PREMIXED
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	1.0
REPLICATES	2
BACKGROUND CORRECTION	ON
MAXIMUM ABSORBANCE	1.20

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	300	35.0	3.0	ALTERNATE	NO
2	600	10.0	3.0	ALTERNATE	NO
3	900	15.0	3.0	ALTERNATE	NO
4	890	5.0	3.0	ALTERNATE	NO
5	2550	1.2	0.0	ALTERNATE	YES
6	2550	2.0	0.0	ALTERNATE	YES
7	2750	2.0	3.0	ALTERNATE	NO
8	100	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS
VOLUMES (fL)

	SOLUTION	BLANK	MODIFIER
BLANK	--	24	8
STANDARD 1	19	5	8
STANDARD 2	19	5	8
STANDARD 3	19	5	8
STANDARD 4	19	5	8
SAMPLE	19	5	8

RECALIBRATION RATE	0
RESLOPE RATE	0

MULTIPLE INJECT	NO	HOT INJECT	YES	PRE INJECT	NO
		TEMPERATURE	100		
		INJECT RATE	2		

CONDITIONS FOR Se :
Alternative Wavelengths (nm) : 204.0
Spectral Bandwidths (nm) : 0.5
[illegible] : 1200 °C

Varian SpectrAA 300/400 Zeeman Report

Columbia Analytical Services F VARIAN-2
1317 South 13th Street P.O. Box 479
Kelso, WA 98626 (360) 577-7222

OPERATOR CJ Brown
DATE 10/26/98 Time 10:00
BATCH T76201 T11 (98-6762)

PROGRAM 14 T1 Super 200.9 & 7841

SAMPLE	Dilution	CONC ppb	Time	%RSD	MEAN ABS	READINGS		Comments
BLANK		0.0			-0.008	-0.007	-0.009	
STANDARD 1		10.0		6.8	0.030	0.032	0.029	
STANDARD 2		20.0		2.0	0.061	0.060	0.062	
STANDARD 3		40.0		0.6	0.118	0.117	0.118	
STANDARD 4		60.0		1.3	0.169	0.168	0.171	
1 ICV	—	26.1	10:24	0.2	0.078	0.079	0.078	
2 ICB	—	0.3	10:28	99.9	0.001	0.002	-0.000	
3 CCV11	—	40.7	10:32	0.7	0.119	0.119	0.120	
4 CCB11	—	0.2	10:36	35.1	0.001	0.001	0.000	
5 CRA	—	10.7	10:40	3.9	0.032	0.031	0.033	
6 PBW	—	0.2	-	62.2	0.001	0.000	0.001	
7 PBWA	—	21.8	-	0.2	0.066	0.066	0.066	
8 LCSW	—	26.8	-	1.2	0.081	0.080	0.081	
9 LCSWA	—	48.1	-	0.5	0.139	0.139	0.140	
10CCV12	—	41.8	11:00	0.4	0.122	0.123	0.122	
11CCB12	—	0.7	11:04	63.2	0.002	0.003	0.001	

Cf Bruno
10/26/98 Time 10:00
T76201 T11
Program 14 T1 Super

	Dilution	Time					Comments
12T76201		10.6	0.4	0.032	0.032	0.032	
13T76201A		29.7	0.7	0.089	0.088	0.089	
14T76202	1/20	23.5	0.5	0.071	0.071	0.071	
15T76202A		43.1	1.2	0.126	0.125	0.127	
16T76202D		23.4	0.4	0.071	0.071	0.071	
17T76202DA		42.7	0.1	0.125	0.125	0.125	
18T76202S		26.1	1.5	0.078	0.078	0.079	
19T76203		28.1	0.1	0.084	0.084	0.084	
20T76203A		47.6	1.3	0.138	0.136	0.139	
21CCV13		42.4	11:44 0.3	0.124	0.124	0.124	
22CCB13		0.8	11:48 85.4	0.002	0.004	0.001	
23T76204		10.3	1.3	0.031	0.031	0.031	
24T76204A		30.1	0.0	0.090	0.090	0.090	
25T76205		3.0	2.8	0.009	0.009	0.009	
26T76205A		23.0	0.1	0.070	0.070	0.070	
27T76206		11.3	3.3	0.034	0.035	0.033	
28T76206A		29.0	0.1	0.087	0.087	0.087	
29T76207		31.3	0.1	0.093	0.094	0.093	
30T76207A		48.3	0.5	0.140	0.140	0.139	
31T76208		13.6	1.7	0.041	0.040	0.041	
32T76208A		31.6	2.0	0.094	0.093	0.096	
33CCV14		42.0	12:32 0.5	0.123	0.122	0.123	
34CCB14		0.7	12:36 5.7	0.002	0.002	0.002	
35T76209		3.0	8.9	0.009	0.010	0.009	
36T76209A		22.6	1.7	0.068	0.068	0.069	
37T76210		2.2	15.1	0.007	0.006	0.007	
38T76210A		22.3	1.0	0.068	0.068	0.067	

SAMPLE	CONC ppb	%RSD	MEAN ABS	READINGS

Cf Powers
10/26/98 Time 10:00
T 7620 T1 1

Program 14 T1 Super

		Dilution	Time					Comments
39T76211	—	18.8		2.8	0.057	0.058	0.056	
40T76211A	—	38.0		2.7	0.112	0.114	0.110	
41T76212	—	0.4		11.1	0.001	0.001	0.001	
42T76212A	—	22.0		0.3	0.067	0.066	0.067	
43CCV15	—	42.1	13:12	1.6	0.123	0.122	0.125	
44CCB15	—	0.2	13:16	99.9	0.001	0.001	0.000	
BLANK		0.0			-0.006	-0.005	-0.007	> Baseline Correction
RESLOPE	3	40.0		0.3	0.121	0.122	0.121	& reslope of 1620
1 CCV16	—	40.7	13:28	0.3	0.124	0.123	0.124	
2 CCB16	—	-0.0	13:32	99.9	-0.000	0.001	-0.001	
3 T76213	—	-0.2		78.4	-0.001	-0.000	-0.001	
4 T76213A	—	18.8		0.4	0.059	0.059	0.059	
5 T76214	—	7.6		1.8	0.024	0.024	0.023	
6 T76214A	—	27.2		1.3	0.084	0.085	0.084	
7 T76215	—	-0.2		99.9	-0.001	-0.001	-0.000	
8 T76215A	—	19.7		0.7	0.062	0.062	0.062	
9 T76216	—	1.5		26.6	0.005	0.006	0.004	
10T76216A	—	20.9		4.1	0.066	0.064	0.068	
11T76217	—	-0.1		99.9	-0.000	0.000	-0.001	
12T76217A	—	20.6		1.3	0.065	0.064	0.065	
13CCV17	—	39.9	14:16	0.7	0.121	0.121	0.122	
14CCB17	—	0.0	14:20	99.9	0.000	0.000	0.000	

STANDARD / MODIFIER FORM

Solution : GFAA Intermediate Stock GIS 100198 Exp. Date 2/11/99
Volume : 500 mls
Date : 10/01/98
Analyst : C. Bourne

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	50.0	✓	10 %
As	CPI	720620	02/25/99	5.0	✓	10.0
Pb	CPI	800712	7/99	5.0	✓	10.0
Se	CPI	8CB063	5/99	5.0	✓	10.0
Tl	CPI	719209	02/11/99	5.0	✓	10.0
Cd	Hi Purity	805543	3/9/99	5.0	✓	10.0

Solution : Working Standard GWS 102698
Volume : 100 mls
Date : 10/26/98
Analyst : C. Bourne

GIS 100198		Aliquot / 100 mls	Check as Added	Concentration (ug/l)
		1 mls	✓	100

Solution : ICV Solution
Volume : 500 mls
Date : 4/14/98
Analyst : Eric Mohn

ICV Solution Exp. Date 2/1/99	Aliquot /500 mls of a 1/200 dilution 5.0 ml	Lot # of IV soln QCP-CICV-3: M-MEB58063	Final Conc in ug/l for As,Pb,Se,Tl = 25 Cd = 12.5

Solution : Palladium Modifier
Volume : 500 mls
Date : 4/22/98
Analyst : C. Bourne

Element	Source	Lot No.	Expiration Date	Aliquot / 500 mls	Check as Added	Conc. (mg/L)
HNO_3	JT Baker	L17543	Opened08/06/98	5.0 mls	✓	1.0%
Pd	IV*	K-PD01075	———	0.500 g	✓	1000

Solution : Magnesium Nitrate Modifier
Volume : 100 mls
Date : 8/22/98
Analyst : C. Bourne

Element	Source	Lot No.	Expiration Date	Aliquot / 100 mls	Check as Added	Conc. (mg/L)
HNO_3	Baker	L17543	Opened 8/6/98	1.0 mls	✓	1.0%
$Mg(NO_3)_2$	EM Science	9266	Opened 3/4/91	0.100 g	✓	1000

As,Se : 50/50 (V/V) mixture of Palladium and Magnesium Nitrate modifiers
Cd,Pb,TL : Palladium Modifier
*Inorganic Ventures

PROGRAM 14 Tl Super 200.9 & 7841

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK AREA
LAMP POSITION	1
LAMP CURRENT (mA)	8
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	276.8
SAMPLE INTRODUCTION	SAMPLER PREMIXED
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	1.0
REPLICATES	2
BACKGROUND CORRECTION	ON
MAXIMUM ABSORBANCE	0.80

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	300	35.0	3.0	ALTERNATE	NO
2	600	10.0	3.0	ALTERNATE	NO
3	1100	10.0	3.0	ALTERNATE	NO
4	1100	5.0	3.0	ALTERNATE	NO
5	2300	1.0	0.0	ALTERNATE	YES
6	2300	2.0	0.0	ALTERNATE	YES
7	2500	1.0	3.0	ALTERNATE	NO
8	100	13.0	3.0	ALTERNATE	NO

SAMPLER PARAMETERS
VOLUMES (fL)

	SOLUTION	BLANK	MODIFIER
BLANK	--	18	8
STANDARD 1	18		8
STANDARD 2	18		8
STANDARD 3	18		8
STANDARD 4	18		8
SAMPLE			8

RECALIBRATION RATE	0
RESLOPE RATE	0

MULTIPLE INJECT	NO	HOT INJECT	YES	PRE INJECT	NO
		TEMPERATURE	120		
		INJECT RATE	2		

Extr/Analysis Lot
MET9816486

COLUMBIA ANALYTICAL SERVICES, INC.
ANALYTICAL WORKSHEET

SAMPLE NUMBER: as listed	SERVICE REQUEST # : K9806762
ANALYSIS FOR: Hg / METHOD: CVAA	

DATA

Sample Pos.	Lab Code	Expected Value	Time of Analysis	Dilution Factor		µg/L measured	% Recovery	Comments
1	ICV	5.0µg/L	18:22			5.14	103%	
2	ICB		18:23			0.00		
3	CCV 11	5.0µg/L	18:24			4.98	100%	
4	CCB 11		18:25			-0.01		
5	CRA	0.2µg/L	18:27			0.21	105%	
6	RBW (D76201)		18:28			0.09		
7	LCSW- ✓		18:30			5.26		
8	D76201		18:31			0.08		
9	D76202	CB 10/19/98	18:33			0.24		
10	D76202D	CB 10/19/98	18:35			0.06		
11	D76202S		18:36			1.04		
12	D76203		18:37			0.17	all reruns	
13	D76204		18:38			0.03		SMA 10/21
14	D76205		18:40			0.72		
15	CCV 12	5.0µg/L	18:41			5.09	102%	
16	CCB 12		18:43			0.02		
17	D76206		18:44			0.25		
18	D76207		18:45			0.27		
19	D76208		18:46			0.04		
20	D76209		18:48			0.43		
21	D76210		18:49			0.51		
22	D76211		18:51			7.60		
23	D76212		18:53			0.26		
24	D76213		18:54			0.09		
25	D76214		18:55			1.09		

COMMENTS:

SPIKE LEVEL:

ANALYST: Chrystal Baird	DATE: 10/19/98	PAGE Number: 1
REVIEWER: [illegible]	DATE: 10/21/98	

[ANALWKS9.FRM]

MET9816486

COLUMBIA ANALYTICAL SERVICES, INC.
ANALYTICAL WORKSHEET

SAMPLE NUMBER: as listed		SERVICE REQUEST # : K9806762
ANALYSIS FOR: Hg	METHOD: CVAA	

DATA

Sample Pos.	Lab Code	Expected Value	Time of Analysis	Dilution Factor	µg/L measured	% Recovery	Comments
26	~~D76215~~		18:56		~~0.16~~		
27	CCV 13	5.0µg/L	18:58		5.14	103%	
28	CCB 13		19:00		0.02		
29	~~D76216~~		19:01		0.11		
30	D76217		19:03		0.02		
31	DBW-(T76201)		19:04		0.01		
32	LCSW- ↓		19:05		5.39		
33	T76201		19:07		4.79		
34	T76202		19:08		0.06		
35	T76202D		19:10		0.03		
36	T76202S		19:12		1.03		
37	T76203		19:13		0.02		
38	T76204		19:14		0.17		
39	CCV 14	5.0µg/L	19:16		5.13	103%	
40	CCB 14		19:17		0.01		
41	T76205		19:19		0.05		
42	T76206		19:20		0.05		
43	T76207		19:22		0.50		
44	T76208		19:23		0.13		
45	T76209		19:25		0.08		
46	T76210		19:26		0.08		
47	T76211		19:27		7.74		
48	T76212		19:29		0.06		
49	T76213		19:30		0.05		
50	T76214		19:32		0.06		

COMMENTS:

SPIKE LEVEL:

ANALYST Chrystal Baile	DATE: 10/19/98	PAGE Number: 2
REVIEWER	DATE:	

[ANALWKS9.FRM]

MET98164486

COLUMBIA ANALYTICAL SERVICES, INC.
ANALYTICAL WORKSHEET

SAMPLE NUMBER: as listed		SERVICE REQUEST # : K9806762
ANALYSIS FOR: Hg	METHOD: CVAA	

DATA

Sample Pos.	Lab Code	Expected Value	Time of Analysis	Dilution Factor		µg/L measured	% Recovery	Comments
51	CCV 15	5.0µg/L	19:33			5.19	104%	
52	CCB 15		19:35			0.02		
53	T76215		19:36			0.08		
54	T76216		19:37			0.17		
55	T76217		19:39			0.02		
56	CCV 16	5.0µg/L	19:40			5.13	103%	
57	CCB 16		19:41			-0.00		
58								
59								
60								
61								
62								
63								

COMMENTS:

SPIKE LEVEL:

ANALYST Crystal Davis	DATE: 10/19/98	PAGE Number: 3
REVIEWER	DATE:	

[ANALWKS9.FRM]

MET98164486

COLUMBIA ANALYTICAL SERVICES, INC.
ANALYTICAL WORKSHEET

PRINTOUT WITH: 6762

Method: (Circle One) 7470A 7471A 245.1	Service Request # : 7162
Analysis For: Hg	

DATA

Pos.	SAMPLE NUMBER	Initial Sample (g) or (mL)	Initial Dilution (mL)	Dilution Factor	(µg/L) Measured	Sample Actual (mg/kg)	Sample Actual (µg/L)
51							
52							
53							
54							
55							
56	CCV 6	5.0µg/L			5.13		103%
57	CCB 6				<0.1		<0.1
58	PBW-(7162)	100ml	100ml		<0.1		<0.2
59	LCSW-				5.19		5.2(104%)
60	7162-1				<0.1		<0.2
61	2				<0.1		<0.2
62	2D				<0.2		<0.2
63	2S				0.79		0.8 (80%)
64	CCV 7	5.0µg/L			4.95		99%
65	CCB 7				<0.1		<0.1
66							
67							

Continue from K980b7162

Comments: Reporting Levels:
Waters - 0.5 µg/L
Soil - 0.2 mg/kg
TCLP - 1 µg/L

Water Spike Level : 1.0 µg/L
Soil Spike Level : 1.0 µg/L = mg/kg
TCLP Spike Level : 10.0 µg/L

Analyst Christal Baird	Date: 10/19/98	Page Number: 4
Reviewer	Date:	

[HGFORM.XLW] HG3.XLS

Varian SpectrAA 10/20 System Report

lumbia Analytical Services
17 South 13th Street P.O. Box 479
Kelso. WA 98626 (206) 577-7222

Crystal Banks

OPERATOR
DATE 10 19 98
BATCH NO.

PROGRAM 22 Hg

SAMPLE	CONC	%RSD	MEAN ABS	READINGS		
BLANK	0.00		-0.001	-0.001	-0.001	18:16
STANDARD 1	0.20	0.0	0.002	0.002	0.002	18:17
STANDARD 2	0.50	1.5	0.006	0.006	0.006	18:18
STANDARD 3	1.00	1.7	0.012	0.012	0.012	18:19
STANDARD 4	5.00	0.4	0.056	0.056	0.056	18:20
STANDARD 5	10.00	0.3	0.111	0.111	0.111	18:21
SAMPLE 1	5.14	0.2	0.057	0.057	0.058	
SAMPLE 2	0.00	99.9	0.000	0.000	-0.000	
SAMPLE 3	4.96	0.6	0.056	0.055	0.056	
SAMPLE 4	-0.01	0.0	-0.000	-0.000	-0.000	
SAMPLE 5	0.21	16.8	0.002	0.003	0.002	
SAMPLE 6	0.09	0.0	0.001	0.001	0.001	
SAMPLE 7	5.26	0.1	0.059	0.059	0.059	
SAMPLE 8	0.08	11.7	0.001	0.001	0.001	
SAMPLE 9	0.24	12.3	0.003	0.003	0.003	
SAMPLE 10	0.06	28.1	0.001	0.001	0.001	
SAMPLE 11	1.04	0.0	0.012	0.012	0.012	
SAMPLE 12	0.17	28.2	0.002	0.002	0.002	
SAMPLE 13	0.03	0.0	0.000	0.000	0.000	
SAMPLE 14	0.72	0.0	0.008	0.008	0.008	
SAMPLE 15	5.09	0.4	0.057	0.057	0.057	
SAMPLE 16	0.02	0.0	0.000	0.000	0.000	
SAMPLE 17	0.25	10.0	0.003	0.003	0.003	
SAMPLE 18	0.27	12.6	0.003	0.003	0.004	
SAMPLE 19	0.04	38.1	0.000	0.001	0.000	
SAMPLE 20	0.43	6.5	0.005	0.005	0.005	
SAMPLE 21	0.51	4.9	0.006	0.006	0.006	
SAMPLE 22	7.80	0.4	0.085	0.085	0.085	
SAMPLE 23	0.28	10.7	0.003	0.003	0.003	
SAMPLE 24	0.09	9.9	0.001	0.001	0.001	
SAMPLE 25	1.09	2.2	0.013	0.013	0.013	
SAMPLE 26	0.16	8.2	0.002	0.002	0.002	
SAMPLE 27	5.14	0.3	0.057	0.057	0.058	
SAMPLE 28	0.02	99.9	0.000	-0.000	0.001	
SAMPLE 29	0.11	10.6	0.001	0.001	0.001	
SAMPLE 30	0.02	29.0	0.000	0.000	0.000	
SAMPLE 31	0.01	0.0	0.000	0.000	0.000	
SAMPLE 32	5.39	0.0	0.060	0.060	0.060	
SAMPLE 33	4.79	0.6	0.054	0.054	0.053	
SAMPLE 34	0.08	0.0	0.001	0.001	0.001	
SAMPLE 35	0.03	36.3	0.000	0.000	0.001	
SAMPLE 36	1.03	0.0	0.012	0.012	0.012	
SAMPLE 37	0.02	99.9	0.000	0.000	0.000	

r=0.999956

00200

Crystal Bair

SAMPLE	CONC	%RSD	MEAN ABS	READINGS	
SAMPLE 38	0.17	9.8	0.002	0.002	0.002
SAMPLE 39	5.18	0.5	0.057	0.058	0.057
SAMPLE 40	0.01	99.9	0.000	-0.000	0.001
SAMPLE 41	0.15	0.0	0.001	0.001	0.001
SAMPLE 42	0.15	14.0	0.001	0.001	0.001
SAMPLE 43	0.50	2.9	0.006	0.006	0.006
SAMPLE 44	0.13	4.0	0.002	0.001	0.002
SAMPLE 45	0.12	0.0	0.001	0.001	0.001
SAMPLE 46	0.08	8.3	0.001	0.001	0.001
SAMPLE 47	7.74	0.2	0.086	0.086	0.086
SAMPLE 48	0.16	45.2	0.001	0.001	0.001
SAMPLE 49	0.15	31.2	0.001	0.001	0.000
SAMPLE 50	0.12	30.1	0.001	0.001	0.001
SAMPLE 51	5.19	0.5	0.058	0.058	0.058
SAMPLE 52	0.12	71.5	0.000	0.000	0.000
SAMPLE 53	0.08	21.6	0.001	0.001	0.001
SAMPLE 54	0.17	7.4	0.002	0.002	0.002
SAMPLE 55	0.02	0.0	0.000	0.000	0.000
SAMPLE 56	5.13	0.9	0.057	0.058	0.057
SAMPLE 57	-0.00	0.0	-0.000	-0.000	-0.000
SAMPLE 58	0.02	99.9	0.000	0.001	-0.000
SAMPLE 59	5.19	0.3	0.058	0.058	0.058
SAMPLE 60	0.15	41.8	0.001	0.001	0.000
SAMPLE 61	0.08	31.5	0.001	0.001	0.001
SAMPLE 62	0.10	10.0	0.001	0.001	0.001
SAMPLE 63	0.79	2.0	0.009	0.009	0.009
SAMPLE 64	4.85	0.3	0.055	0.055	0.055
SAMPLE 65	0.07	45.3	0.001	0.001	0.001

SOLUTION: MERCURY INTERMEDIATE STOCK (Hg S1101998)
MATRIX: 1% HNO3
VOLUME: 100 mL
DATE: 10/19/98
ANALYST: Crystal Baird **SOLUTION EXPIRATION DATE:** 11/2/98

ELEMENT	SOURCE	LOT #	EXPIRATION DATE	ALIQUOT PER 100 mL	CHECK OFF	CONCENTRATION (µg/L)
HNO3	Baker	M22026	-	1.0 mL	✓	1%
Hg	CPI	8EK067	2/1/00	1.0 mL	✓	10000

SOLUTION: MERCURY WORKING SOLUTION (Hg S2 101998)
MATRIX: 1% HNO3
VOLUME: 100 mL
DATE: 10/19/98
ANALYST: Crystal Baird **SOLUTION EXPIRATION DATE:** Made Daily

ELEMENT	SOURCE	LOT #	EXPIRATION DATE	ALIQUOT PER 100 mL	CHECK OFF	CONCENTRATION (µg/L)
HNO3	Baker	M22026	-	1.0 mL	✓	1%
Hg	Hg S1	8EK067	2/1/00	1.0 mL	✓	100

SOLUTION: MERCURY ICV INTERMEDIATE STOCK (HgICV S1092498)
MATRIX: 1% HNO3
VOLUME: 100 mL
DATE: 9/24/98
ANALYST: Crystal Baird **SOLUTION EXPIRATION DATE:** 11/24/98

ELEMENT	SOURCE	LOT #	EXPIRATION DATE	ALIQUOT PER 100 mL	CHECK OFF	CONCENTRATION (µg/L)
HNO3	BAKER	M22026	-	1.0 mL	✓	1%
Hg	I.V.	M-HG02016	7/1/99	0.1 mL	✓	1000

SOLUTION: MERCURY TCLP SPIKE SOLUTION (Hg TCLP S2 (101998)
MATRIX: 1% HNO3
VOLUME: 10.0 mL
DATE: 10/19/98
ANALYST: Crystal Baird **SOLUTION EXPIRATION DATE:** Made Daily

ELEMENT	SOURCE	LOT #	EXPIRATION DATE	ALIQUOT PER 10.0 mL	CHECK OFF	CONCENTRATION (µg/L)
HNO3	Baker	M22026	-	0.1 mL	✓	1%
Hg	Hg S1	8EK067	2/1/00	1.0 mL	✓	1000

Extr/Analysis Lot
MET9814752

Columbia Analaytical Services
Metals Tier IV Digestion Sheet

K9807767	SDG: T76201	Prep Method : ILM04.0									Soil: Dry As received		
SAMPLE		ICP				GFAA							
	jar #	Initial Volume	(g)	(mL)	Final (mL)	Initial Volume	(g)	(mL)	Final (mL)		PREDIGEST APPEARANCE	POSTDIGEST APPEARANCE	Artifacts yes/no
PBS		0.50		1	0.50	0.50		1	0.50		—	—	
LCSW											—	—	
T76201											brown blonde	brown clear	Y
T76202													
T76202D													
T76202S													
T76203													
T76204													
T76205													
T76206													
T76207													
T76208													
T76209													
T76210													
T76211													
T76212													
T76213													
T76214													
T76215													
T76216											yellow	yellow	
T76217		↓		↓	↓	↓		↓	↓		colorless	colorless	↓

TAC 10/23/98 TAC 10/23/98

LCSS (circle appropriate) ERA CLP Soil Lot # 238 EPA Lot # 0287 Other:______________

LCSW SOL'NS	mls. added	SPIKE SOL'NS	Water	Soil	
GFAA - QCPCICV-3 Lot # MMEB58063	0.500	GFAA Lot # SS4-091798	0.500		mls. added
ICP - QCPCICV-1 Lot # N-MEB58076	0.250	ICP Lot # SS1-101398	0.500	TAC	mls. added
ICP - QCPCICV-2 Lot # N-MEB58079	0.250	ICP Lot # SS2-090898	0.500	10/23/98	mls. added
ICP - QCPCICV-3 Lot # M-MEB58063	0.250	ICP Lot # SS3-101398	0.500		mls. added
Additional LCS -	0.500 ml 100 ppm Hg & B	Additional Spike -	0.5 ml 100 ppm Hg & B		

Lot # Acids Used: HNO3 M13026 HCl M17044 H_2O_2 37017714

Comments: ______________________________

Samples Received By: ---------------------------

Analyst:	[signature]	Date:	10/26/98
Reviewer:	[signature]	Date:	10/26/98

clpdig.xls

00203

Columbia Analaytical Services
Metals Tier IV Digestion Sheet

Extr/Analysis Lot
MET9816484

SR : K9806762 | SDG: D76201 | Prep Method: IML04.0 | Soil: Wet Dry

SAMPLE	Hg Initial Volume	(mL)	Hg Final (mL)	Hg Initial Weight	(g)	Final (mL)	
PBW	100	✓	100				
LCSW							
D76201							
D76202							
D76202D							
D76202S							
D76203							
D76204							
D76205							
D76206							
D76207							
D76208							
D76209							
D76210							
D76211							
D76212							
D76213							
D76214							
D76215							
D76216							
D76217							
STD 0	0.0 *						
1	0.2						
2	0.5						
3	1.0						
4	5.0						
5	10.0						
ICV	0.5 **						
ICB	0.0						
		CB 10/19/98					
BATCH #							

LCSS (circle appropriate) ERA CLP Soil Lot # 238 EPA Lot # 0287 Other:_____

TIME STARTED Hg SOIL: 12:00 pm 10/19/98

TIME STARTED Hg WATER:

Hg Soil Spike=

Hg Water Spike= 1.0 ml Hg52101998

Lot # of Reagents Used:

HNO3: M22026 K2S2O8: J03776 NaCl: M06615

H2SO4: 38174 KMnO4: M06635 NH2OH-HCl: M12H06

HCl: K25402903827 SnCl2: M01621

Comments: * Hg52101998 ** HgICVS1101998

Analyst: Christa Baile Date: 10/19/98

Reviewer: Date:

cldig. 6/6/1996

00204

Columbia Analaytical Services
Metals Tier IV Digestion Sheet

SR: K9806762 | SDG: T76201 | Prep Method: IML04.0 | Soil: Wet Dry

SAMPLE	Hg Initial Volume	Hg (mL)	Hg Final (mL)	Hg Initial Weight	Hg (g)	Hg Final (mL)	
MBW	100	✓	100				
LCSW							
T76201							
T76202							
T76202D							
T76202S							
T76203							
T76204							
T76205							
T76206							
T76207							
T76208							
T76209							
T76210							
T76211							
T76212							
T76213							
T76214							
T76215							
T76216							
T76217							
		CB 10/19/98					
BATCH #							

LCSS (circle appropriate) ERA CLP Soil Lot # 238 EPA Lot # 0287 Other:_____

TIME STARTED Hg SOIL: 12:00pm 10/19/98

TIME STARTED Hg WATER:

Hg Soil Spike=

Hg Water Spike= 1.0 ml Hg S2 101998

Lot # of Reagents Used:

HNO3: M22026 K2S2O8: J03776 NaCl: M06615

H2SO4: 38174 KMnO4: M06635 NH2OH-HCl: M12H06

HCl: K25402903827 SnCl2: M01621

Comments: Standard with D76201

Analyst: Crystal Bond Date: 10/19/98

Reviewer: Date:

cldig.xls
6/6/1996

306-176301

Columbia Analytical Services Inc.
1317 South 13th Avenue
Kelso, WA 98626

Metals Spike Form

Additional Spike. ☐

Service Request # K9806763
Q.C. Sample # 176301

Initials Date: 10/18/98

Circle type of digest: GFAA ICP Other:_____
Circle type of sample: Soil Water Other:_____

Solution Name	Element	mls of 1000ppm Std.	Final Volume	Source	Lot#	Exp. Date	Solution Conc. mg/L	Enter mls Added
SS1-101398	HNO3	2.5	500ml	JT BAKER	M22026	-	-	0.5
	Al	100	500ml	CPI	733013	6/3/99	200	
	Ba	100	500ml	IV*	M-BAO1126	5/1/99	200	
	Be	2.5	500ml	IV*	M-BE01001	5/1/99	5	
	Cd	2.5	500ml	HP	805545	3/9/99	5	
	Co	25.0	500ml	CPI	731641	7/5/99	50	
	Cu	12.5	500ml	CPI	802207	9/30/99	25	
	Fe	50.0	500ml	IV*	M-FEO2124	2/1/99	100	
	Pb	25.0	500ml	CPI	800712	7/31/99	50	
	Mn	25.0	500ml	CPI	803426	9/30/99	50	
	Ni	25.0	500ml	IV*	M-NI02004	5/1/99	50	
	V	25.0	500ml	HP	722011	12/31/98	50	
	Zn	25.0	500ml	CPI	804807	10/31/99	50	
SS2-090898	HCl	50.0	500ml	J T BAKER	M13040	-	-	0.5
	Sb	25.0	500ml	CPI	8EK036	12/31/99	50	
	Cr	10.0	500ml	CPI	805606	9/30/99	20	
SS3-107298	HNO3	5.0	500ml	JT BAKER	M22026	-	-	0.5
	Ag	2.5	500ml	IV*	M-AGO1121	5/1/99	5	
SS4-071698	HNO3	5.0	500ml	EM Science	M13025	-	-	
	As	2.0	500ml	CPI	720620	2/25/99	4	
	Cd	0.5	500ml	HP	805545	3/9/99	1	
	Pb	1.0	500ml	CPI	800712	7/31/99	2	
	Se	0.5	500ml	CPI	708605	11/7/98	1	
	Tl	2.5	500ml	CPI	719209	2/11/99	5	
	Cu	2.5	500ml	CPI	802207	9/1/99	5	
SS5-030298	HCL	50.0	500ml	EM Science	37304	-	-	
	As	100.0	500ml	CPI	720620	2/25/99	200	
	Se	50.0	500ml	CPI	708605	11/7/98	100	
SS6-081498	HNO3	2.5	250	JT BAKER	M15032	-	-	0.5
	Mo	25	250	CPI	728311	4/29/99	100	
	B	25	250	CPI	735217	9/30/99	100	

Additional Spikes:

Element	mls of 1000ppm Std.	Source	Lot#	Exp. Date

*IV = Inorganic Ventures
**HP=High Purity

SDG: T76301

Columbia Analytical Services Inc.
1317 South 13th Avenue
Kelso, WA 98626

Metals Spike Form

Additional Spike. ☐

Service Request # K9806763
Q.C. Sample # ~~K9806763~~ T76307

Initials /Date: [illegible] 10/23/98

Circle type of digest: GFAA ICP Other:_____
Circle type of sample: Soil Water Other:_____

Solution Name	Element	mls of 1000ppm Std.	Final Volume	Source	Lot#	Exp. Date	Solution Conc. mg/L	Enter mls Added
SS1-101398	HNO3	2.5	500ml	JT BAKER	M22026	-	-	
	Al	100	500ml	CPI	733013	6/9/99	200	
	Ba	100	500ml	IV*	M-BAO1126	5/1/99	200	
	Be	2.5	500ml	IV*	M-BE01081	5/1/99	5	
	Cd	2.5	500ml	HP	805545	3/9/99	5	
	Co	25.0	500ml	CPI	731641	7/5/99	50	
	Cu	12.5	500ml	CPI	802207	9/30/99	25	
	Fe	50.0	500ml	IV*	M-FEO2124	2/1/99	100	
	Pb	25.0	500ml	CPI	800712	7/31/99	50	
	Mn	25.0	500ml	CPI	803426	9/30/99	50	
	Ni	25.0	500ml	IV*	M-NI02004	2/1/99	50	
	V	25.0	500ml	HP	722011	12/31/98	50	
	Zn	25.0	500ml	CPI	804807	10/31/99	50	
SS2-090898	HCl	50.0	500ml	J T BAKER	M13040	-	-	
	Sb	25.0	500ml	CPI	EEK036	12/31/99	30	
	Cr	10.0	500ml	CPI	805606	9/30/99	20	
SS3-102298	HNO3	5.0	500ml	JT BAKER	M22026	-	-	
	Ag	2.5	500ml	IV*	M-AGO1121	5/1/99	5	
SS4-071498	HNO3	5.0	500ml	EM Science	M13025	-	-	
	As	2.0	500ml	CPI	720620	2/25/99	4	
	Cd	0.5	500ml	HP	805545	3/9/99	1	
	Pb	1.0	500ml	CPI	800712	7/31/99	2	0.5
	Se	0.5	500ml	CPI	708605	11/7/98	1	
	Tl	2.5	500ml	CPI	719209	2/11/99	5	
	Cu	2.5	500ml	CPI	802207	9/1/99	5	
SS5-030298	HCL	50.0	500ml	EM Science	37304	-	-	
	As	100.0	500ml	CPI	720620	2/25/99	200	
	Se	50.0	500ml	CPI	708605	11/7/98	100	
SS6-081498	HNO3	2.5	250	JT BAKER	M15032	-	-	
	Mo	25	250	CPI	728311	4/29/99	100	
	B	25	250	CPI	735217	9/30/99	100	

Additional Spikes: -

Element	mls of 1000ppm Std.	Source	Lot#	Exp. Date

*IV = Inorganic Ventures
**HP=High Purity

lab#	testid	sampleid	average	std	Recovery	% Recovery
	AS	PBW	1.7000	20.0000		
	AS	PBWA	22.2000	20.0000	20.5000	102.5000
	AS	LCSW	28.3000	20.0000		
	AS	LCSWA	49.1000	20.0000	20.8000	104.0000
Pond 2 Surf	AS	T76201	0.0000	20.0000	QC FLAG = E	
Pond 2 Surf	AS	T76201A	0.0000	20.0000	0.0000	0.0000
Pit u Drain	AS	T76202	26.9000	20.0000		
Pit u Drain	AS	T76202A	47.9000	20.0000	21.0000	105.0000
Pit u Drain	AS	T76202D	27.0000	20.0000		
Pit u Drain	AS	T76202DA	47.0000	20.0000	20.0000	100.0000
Adit Drain	AS	T76203	31.9000	20.0000		
Adit Drain	AS	T76203A	51.6000	20.0000	19.7000	98.5000
LCreeK/Delta	AS	T76204	31.1000	20.0000		
LCreeK/Delta	AS	T76204A	51.4000	20.0000	20.3000	101.5000
LAspenCreek	AS	T76205	2.5000	20.0000		
LAspenCreek	AS	T76205A	22.5000	20.0000	20.0000	100.0000
LAspenSeep	AS	T76206	1.8000	20.0000		
LAspenSeep	AS	T76206A	20.8000	20.0000	19.0000	95.0000
ChannUnder	AS	T76207	27.2000	20.0000		
ChannUnder	AS	T76207A	47.7000	20.0000	20.5000	102.5000
LCrK/DivChan	AS	T76208	20.2000	20.0000		
LCrK/DivChan	AS	T76208A	41.5000	20.0000	21.3000	106.5000
Delta Seep	AS	T76209	36.1000	20.0000		
Delta Seep	AS	T76209A	56.0000	20.0000	19.9000	99.5000
ACreek ab LC	AS	T76210	2.2000	20.0000		
ACreek ab LC	AS	T76210A	22.1000	20.0000	19.9000	99.5000
Aspen Seep	AS	T76211	1.3000	20.0000		
Aspen Seep	AS	T76211A	20.7000	20.0000	19.4000	97.0000
Aspen St22	AS	T76212	2.2000	20.0000		
Aspen St22	AS	T76212A	22.4000	20.0000	20.2000	101.0000
DiverChann	AS	T76213	4.1000	20.0000		
DiverChann	AS	T76213A	25.5000	20.0000	21.4000	107.0000
LCreek/Aspen	AS	T76214	45.9000	20.0000	QC FLAG = E	
LCreek/Aspen	AS	T76214A	0.0000	20.0000	-45.9000	-229.5000
Sta1 LCreek	AS	T76215	3.3000	20.0000		
Sta1 LCreek	AS	T76215A	24.8000	20.0000	21.5000	107.5000
Pond 4 Disch	AS	T76216	60.8000	20.0000	QC FLAG = E	
Pond 4 Disch	AS	T76216A	0.0000	20.0000	-60.8000	-304.0000
Upper Trib	AS	T76217	3.4000	20.0000		
Upper Trib	AS	T76217A	23.4000	20.0000	20.0000	100.0000
LCreek/Aspen	AS	T76214	22.2000	20.0000		
LCreek/Aspen	AS	T76214A	42.1000	20.0000	19.9000	99.5000
Pond 4 Disch	AS	T76216	10.3000	20.0000		
Pond 4 Disch	AS	T76216A	29.7000	20.0000	19.4000	97.0000
	PB	PBW	0.0000	20.0000		
	PB	PBWA	21.9000	20.0000	21.9000	109.5000
	PB	LCSW	27.5000	20.0000		
	PB	LCSWA	48.2000	20.0000	20.7000	103.5000
Pond 2 Surf	PB	T76201	9.4000	20.0000		
Pond 2 Surf	PB	T76201A	27.3000	20.0000	17.9000	89.5000

Pit u Drain	PB	T76202	7.0000	20.0000	QC FLAG = W	
Pit u Drain	PB	T76202A	23.2000	20.0000	16.2000	81.0000
Pit u Drain	PB	T76202D	7.2000	20.0000	QC FLAG = W	
Pit u Drain	PB	T76202DA	23.3000	20.0000	16.1000	80.5000
Adit Drain	PB	T76203	8.9000	20.0000	Run MSA	
Adit Drain	PB	T76203A	24.9000	20.0000	16.0000	80.0000
LCreeK/Delta	PB	T76204	1.3000	20.0000		
LCreeK/Delta	PB	T76204A	20.2000	20.0000	18.9000	94.5000
LAspenCreek	PB	T76205	0.0000	20.0000		
LAspenCreek	PB	T76205A	19.2000	20.0000	19.2000	96.0000
LAspenSeep	PB	T76206	0.0000	20.0000		
LAspenSeep	PB	T76206A	18.0000	20.0000	18.0000	90.0000
ChannUnder	PB	T76207	0.0000	20.0000		
ChannUnder	PB	T76207A	18.0000	20.0000	18.0000	90.0000
LCrK/DivChan	PB	T76208	1.1000	20.0000		
LCrK/DivChan	PB	T76208A	20.2000	20.0000	19.1000	95.5000
Delta Seep	PB	T76209	0.0000	20.0000		
Delta Seep	PB	T76209A	19.8000	20.0000	19.8000	99.0000
ACreek ab LC	PB	T76210	0.0000	20.0000		
ACreek ab LC	PB	T76210A	19.3000	20.0000	19.3000	96.5000
Aspen Seep	PB	T76211	1.1000	20.0000		
Aspen Seep	PB	T76211A	20.2000	20.0000	19.1000	95.5000
Aspen St22	PB	T76212	0.0000	20.0000		
Aspen St22	PB	T76212A	20.8000	20.0000	20.8000	104.0000
DiverChann	PB	T76213	0.0000	20.0000		
DiverChann	PB	T76213A	20.9000	20.0000	20.9000	104.5000
LCreek/Aspen	PB	T76214	0.0000	20.0000		
LCreek/Aspen	PB	T76214A	21.0000	20.0000	21.0000	105.0000
Sta1 LCreek	PB	T76215	0.0000	20.0000		
Sta1 LCreek	PB	T76215A	21.0000	20.0000	21.0000	105.0000
Pond 4 Disch	PB	T76216	4.3000	20.0000		
Pond 4 Disch	PB	T76216A	24.3000	20.0000	20.0000	100.0000
Upper Trib	PB	T76217	0.0000	20.0000		
Upper Trib	PB	T76217A	22.1000	20.0000	22.1000	110.5000
	SE	PBW	0.0000	10.0000		
	SE	PBWA	10.2000	10.0000	10.2000	102.0000
	SE	LCSW	24.9000	10.0000		
	SE	LCSWA	34.9000	10.0000	10.0000	100.0000
Pond 2 Surf	SE	T76201	1.5000	10.0000	QC FLAG = E	
Pond 2 Surf	SE	T76201A	2.6000	10.0000	1.1000	11.0000
Pit u Drain	SE	T76202	0.0000	10.0000	QC FLAG = E	
Pit u Drain	SE	T76202A	3.8000	10.0000	3.8000	38.0000
Pit u Drain	SE	T76202D	0.0000	10.0000	QC FLAG = E	
Pit u Drain	SE	T76202DA	3.7000	10.0000	3.7000	37.0000
Adit Drain	SE	T76203	0.0000	10.0000	QC FLAG = W	
Adit Drain	SE	T76203A	4.2000	10.0000	4.2000	42.0000
LCreeK/Delta	SE	T76204	1.3000	10.0000	QC FLAG = W	
LCreeK/Delta	SE	T76204A	7.4000	10.0000	6.1000	61.0000
LAspenCreek	SE	T76205	8.3000	10.0000		
LAspenCreek	SE	T76205A	17.5000	10.0000	9.2000	92.0000
LAspenSeep	SE	T76206	1.2000	10.0000	QC FLAG = W	

LAspenSeep	SE	T76206A	6.6000	10.0000	5.4000	54.0000
ChannUnder	SE	T76207	1.6000	10.0000	QC FLAG = W	
ChannUnder	SE	T76207A	6.4000	10.0000	4.8000	48.0000
L[illegible]/DivChan	SE	T76208	1.2000	10.0000	QC FLAG = W	
L[illegible]/DivChan	SE	T76208A	7.4000	10.0000	6.2000	62.0000
Delta Seep	SE	T76209	0.0000	10.0000	QC FLAG = W	
Delta Seep	SE	T76209A	8.4000	10.0000	8.4000	84.0000
ACreek ab LC	SE	T76210	7.6000	10.0000	Run MSA	
ACreek ab LC	SE	T76210A	16.0000	10.0000	8.4000	84.0000
Aspen Seep	SE	T76211	40.8000	10.0000	Run MSA	
Aspen Seep	SE	T76211A	54.2000	10.0000	13.4000	134.0000
Aspen St22	SE	T76212	1.8000	10.0000	QC FLAG = W	
Aspen St22	SE	T76212A	9.3000	10.0000	7.5000	75.0000
DiverChann	SE	T76213	1.1000	10.0000	QC FLAG = W	
DiverChann	SE	T76213A	7.9000	10.0000	6.8000	68.0000
LCreek/Aspen	SE	T76214	0.0000	10.0000	QC FLAG = W	
LCreek/Aspen	SE	T76214A	8.3000	10.0000	8.3000	83.0000
Sta1 LCreek	SE	T76215	1.6000	10.0000	QC FLAG = W	
Sta1 LCreek	SE	T76215A	8.3000	10.0000	6.7000	67.0000
Pond 4 Disch	SE	T76216	0.0000	10.0000	QC FLAG = E	
Pond 4 Disch	SE	T76216A	0.0000	10.0000	0.0000	0.0000
Upper Trib	SE	T76217	0.0000	10.0000	QC FLAG = W	
Upper Trib	SE	T76217A	7.3000	10.0000	7.3000	73.0000
Pond 2 Surf	SE	T76201	0.0000	10.0000	QC FLAG = W	
Pond 2 Surf	SE	T76201A	7.4000	10.0000	7.4000	74.0000
Pit u Drain	SE	T76202	0.0000	10.0000	QC FLAG = W	
Pit u Drain	SE	T76202A	6.4000	10.0000	6.4000	64.0000
Pit u Drain	SE	T76202D	0.0000	10.0000	QC FLAG = W	
Pit u Drain	SE	T76202DA	6.2000	10.0000	6.2000	62.0000
P[illegible] 4 Disch	SE	T76216	2.8000	10.0000	QC FLAG = E	
P[illegible] 4 Disch	SE	T76216A	6.0000	10.0000	3.2000	32.0000
Pond 4 Disch	SE	T76216	0.0000	10.0000	QC FLAG = W	
Pond 4 Disch	SE	T76216A	6.5000	10.0000	6.5000	65.0000
Aspen Seep	SE	T76211	18.6000	10.0000	Run MSA	
Aspen Seep	SE	T76211A	26.6000	10.0000	8.0000	80.0000
	TL	PBW	0.0000	20.0000		
	TL	PBWA	21.8000	20.0000	21.8000	109.0000
	TL	LCSW	26.8000	20.0000		
	TL	LCSWA	48.1000	20.0000	21.3000	106.5000
Pond 2 Surf	TL	T76201	10.6000	20.0000		
Pond 2 Surf	TL	T76201A	29.7000	20.0000	19.1000	95.5000
Pit u Drain	TL	T76202	23.5000	20.0000		
Pit u Drain	TL	T76202A	43.1000	20.0000	19.6000	98.0000
Pit u Drain	TL	T76202D	23.4000	20.0000		
Pit u Drain	TL	T76202DA	42.7000	20.0000	19.3000	96.5000
Adit Drain	TL	T76203	28.1000	20.0000		
Adit Drain	TL	T76203A	47.6000	20.0000	19.5000	97.5000
LCreeK/Delta	TL	T76204	10.3000	20.0000		
LCreeK/Delta	TL	T76204A	30.1000	20.0000	19.8000	99.0000
LAspenCreek	TL	T76205	3.0000	20.0000		
LAspenCreek	TL	T76205A	23.0000	20.0000	20.0000	100.0000

LAspenSeep	TL	T76206	11.3000	20.0000		
LAspenSeep	TL	T76206A	29.0000	20.0000	17.7000	88.5000
ChannUnder	TL	T76207	31.3000	20.0000		
ChannUnder	TL	T76207A	48.3000	20.0000	17.0000	85.0000
[illegible]/DivChanTL		T76208	13.6000	20.0000		
[illegible]rk/DivChanTL		T76208A	31.6000	20.0000	18.0000	90.0000
Delta Seep	TL	T76209	3.0000	20.0000		
Delta Seep	TL	T76209A	22.6000	20.0000	19.6000	98.0000
ACreek ab LCTL		T76210	2.2000	20.0000		
ACreek ab LCTL		T76210A	22.3000	20.0000	20.1000	100.5000
Aspen Seep	TL	T76211	18.8000	20.0000		
Aspen Seep	TL	T76211A	38.0000	20.0000	19.2000	96.0000
Aspen St22	TL	T76212	0.0000	20.0000		
Aspen St22	TL	T76212A	22.0000	20.0000	22.0000	110.0000
DiverChann	TL	T76213	0.0000	20.0000		
DiverChann	TL	T76213A	18.8000	20.0000	18.8000	94.0000
LCreek/AspenTL		T76214	7.6000	20.0000		
LCreek/AspenTL		T76214A	27.2000	20.0000	19.6000	98.0000
Sta1 LCreek	TL	T76215	0.0000	20.0000		
Sta1 LCreek	TL	T76215A	19.7000	20.0000	19.7000	98.5000
Pond 4 DischTL		T76216	1.5000	20.0000		
Pond 4 DischTL		T76216A	20.9000	20.0000	19.4000	97.0000
Upper Trib	TL	T76217	0.0000	20.0000		
Upper Trib	TL	T76217A	20.6000	20.0000	20.6000	103.0000

sampleid	testid	average	std			
T762030	PB	0.0220	0.0000	STD ADDNS RESULT =		10.4566
T762031	PB	0.0460	10.0000	slope(m)	y-int(b)	correl(r)
T762032	PB	0.0670	20.0000	0.0022	0.0229	0.9994
T762033	PB	0.0880	30.0000			
T762100	SE	0.0190	0.0000	STD ADDNS RESULT =		7.3029
T762101	SE	0.0410	10.0000	slope(m)	y-int(b)	correl(r)
T762102	SE	0.0630	20.0000	0.0024	0.0176	0.9975
T762103	SE	0.0920	30.0000			
T762110	SE	0.0560	0.0000	STD ADDNS RESULT =		26.2037
T762111	SE	0.0800	10.0000	slope(m)	y-int(b)	correl(r)
T762112	SE	0.0980	20.0000	0.0022	0.0566	0.9985
T762113	SE	0.1220	30.0000			

sampleid	testid	average	std			
D762020	SE	0.0060	0.0000	STD ADDNS RESULT =		7.8022
D762021	SE	0.0170	10.0000	slope(m)	y-int(b)	correl(r)
D762022	SE	0.0270	20.0000	0.0009	0.0071	0.9920
D762023	SE	0.0330	30.0000			
D76202D0	SE	0.0050	0.0000	STD ADDNS RESULT =		5.0495
D76202D1	SE	0.0160	10.0000	slope(m)	y-int(b)	correl(r)
D76202D2	SE	0.0240	20.0000	0.0010	0.0051	0.9974
D76202D3	SE	0.0360	30.0000			
D76202S0	SE	0.0140	0.0000	STD ADDNS RESULT =		14.4554
D76202S1	SE	0.0260	10.0000	slope(m)	y-int(b)	correl(r)
D76202S2	SE	0.0340	20.0000	0.0010	0.0146	0.9974
D76202S3	SE	0.0450	30.0000			
D762030	SE	0.0050	0.0000	STD ADDNS RESULT =		4.4444
D762031	SE	0.0150	10.0000	slope(m)	y-int(b)	correl(r)
D762032	SE	0.0270	20.0000	0.0011	0.0048	0.9993
D762033	SE	0.0370	30.0000			
D762100	SE	0.0120	0.0000	STD ADDNS RESULT =		5.7944
D762101	SE	0.0320	10.0000	slope(m)	y-int(b)	correl(r)
D762012	SE	0.0600	20.0000	0.0021	0.0124	0.9928
D762013	SE	0.0740	30.0000			
D762110	SE	0.0520	0.0000	STD ADDNS RESULT =		37.5510
D762111	SE	0.0760	10.0000	slope(m)	y-int(b)	correl(r)
D762112	SE	0.0820	20.0000	0.0015	0.0552	0.9758
D762113	SE	0.0990	30.0000			
D762020	SE	0.0100	0.0000	STD ADDNS RESULT =		10.0000
D762021	SE	0.0170	10.0000	slope(m)	y-int(b)	correl(r)
D762022	SE	0.0310	20.0000	0.0010	0.0095	0.9875
D762023	SE	0.0370	30.0000			
D762100	SE	0.0150	0.0000	STD ADDNS RESULT =		8.3696
D762101	SE	0.0340	10.0000	slope(m)	y-int(b)	correl(r)
D762012	SE	0.0530	20.0000	0.0018	0.0154	0.9996
D762013	SE	0.0700	30.0000			
D762110	SE	0.0440	0.0000	STD ADDNS RESULT =		25.6805
D762111	SE	0.0590	10.0000	slope(m)	y-int(b)	correl(r)
D762112	SE	0.0780	20.0000	0.0017	0.0434	0.9991
D762113	SE	0.0940	30.0000			
D762070	TL	0.0840	0.0000	STD ADDNS RESULT =		43.9378
D762071	TL	0.1040	10.0000	slope(m)	y-int(b)	correl(r)
D762072	TL	0.1260	20.0000	0.0019	0.0848	0.9972
D762073	TL	0.1410	30.0000			

APPENDIX A

CHAIN OF CUSTODY INFORMATION

COMPUCHEM LABORATORIES
WESTERN DIVISION

Chain of Custody Record

CW ID: A100070A

SRK 5250 Neil #300 Reno NV 89502 Date 9-29-98 Page 1 of 3

PROJECT NAME: LEVIATHAN-ARCO
PROJECT NO.: 19333
PROJECT CONTACT: Terry Brown
SAMPLERS (SIGNATURE): DANA BROWN (702) 828-6800 or 742-9224
SAMPLERS PRINTED NAME:

SAMPLE NO.	DATE	TIME	LOCATION	TPH/EXTN	BTEX/TFH	601/8010	602/8020	608/8080	PCB'S	624-8240	625-8270	2,3,7,8-TCDD	CL4 - CL8	METALS	WET CHEM	NUMBER OF CONTAINERS	REMARKS
POND 2 Surface Drainage	9-24	16:10														4	
Pit Under Drain	9-25	10:30														4	
Adit Drainage	9-25	10:00														4	
Leviathan Creek Below Delta Seep	9-25	13:40														4	
Lower Aspen Creek	9-24	15:00														4	
Lower Aspen Seep	9-24	13:30														4	
Underdrain (channel Underdrain)	9-24	11:00														4	
Leviathan Creek below Diversion Channel	9-24	10:30														4	

CALL DANA BROWN (702) 828-6800 or 742-9224 for Analytical Parameters

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature: DANA BROWN	9-29	Signature: [illegible]	9/30/98	Signature		Signature	
Printed Name: SRK	TIME 9:00	Printed Name: [illegible]	TIME 1030	Printed Name	TIME	Printed Name	TIME
Company		Company: AS 9/30/98		Company		Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	REC'D BY (LABORATORY)	DATE
Signature		Signature		Signature		Signature	
Printed Name	TIME	Printed Name	TIME	Printed Name	TIME	Printed Name	TIME
Company		Company		Company		Company	

TOTAL NUMBER OF CONTAINERS: 68 (3 coolers)
METHOD OF SHIPMENT: Fed-X 1 Day
SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COMPUCHEM LABORATORIES
WESTERN DIVISION SRK 5250 Neil #300 Reno NV 89502

Chain of Custody Record

CW ID

Date 9-24-98 Page 2 Of 3

PROJECT NAME Leviathan - Arco

PROJECT NO. 19333

PROJECT CONTACT: Terry Brown

SAMPLERS (SIGNATURE) (702) 828-6800 or 742-9224

SAMPLERS PRINTED NAME Dana Brown

SAMPLE NO.	DATE	TIME	LOCATION	GC: TPH/EXTN	GC: BTEX/TFH	GC: 601/8010	GC: 602/8020	GC: 608/8080	GC: PCB'S	GC/MS: 624-8240	GC/MS: 625-8270	GC/MS: 2,3,7,8-TCDD	GC/MS: CL4 - CL8	INORGANICS: METALS	INORGANICS: WET CHEM	OTHER	NUMBER OF CONTAINERS	REMARKS
Delta Seep	9-25	13:00															4	
Aspen Creek Above Leviathan Creek	9-23	11:30															4	
Aspen Wetland Spring / Seep	9-23	14:00															4	
Aspen Creek Station #22	9-23	13:00															4	
Diversion Channel	9-23	17:00															4	
Leviathan Creek Above Aspen Creek	9-23	12:00															4	Only rec'd T Metals
Station #1 Leviathan Creek	9-23	15:00															4	
Pond 4 Discharge	9-25	11:15															4	

CALL DANA BROWN (702) 828-6800 or 742-9224 for Analytical Parameters

0046

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature: Dana Brown	9-29	Signature: [illegible]	9/30/98	Signature		Signature	
Printed Name: SRK	TIME 9:00	Printed Name: Sam Adams	TIME 1030	Printed Name	TIME	Printed Name	TIME
Company		Company: CAS		Company		Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	REC'D BY (LABORATORY)	DATE
Signature		Signature		Signature		Signature	
Printed Name	TIME	Printed Name	TIME	Printed Name	TIME	Printed Name	TIME
Company		Company		Company		Company	

TOTAL NUMBER OF CONTAINERS 68 (3 Coolers)

METHOD OF SHIPMENT Fed-X 1day

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS

COMPUCHEM LABORATORIES
WESTERN DIVISION SRK 5250 Neil #300 Reno NV 89502

Chain of Custody Record

CW ID: _____

Date 9-24-98 Page 3 of 3

PROJECT NAME: Leviathan - Arco
PROJECT NO. 19333
PROJECT CONTACT: Terry Brown
SAMPLERS (SIGNATURE) (702) 828-6800 or 742-9224
SAMPLERS PRINTED NAME: DANA BROWN

SAMPLE NO.	DATE	TIME	LOCATION	TPH/EXTN	BTEX/TFH	601/8010	602/8020	608/8080	PCB'S	624-8240	625-8270	2,3,7,8-TCDD	CL4 - CL8	METALS	WET CHEM	NUMBER OF CONTAINERS	REMARKS
Upper Tributary	9-25	12:00														4	

GC | GC/MS | INORGANICS | OTHER

CALL DANA BROWN (702) 828-6800 for Analytical Parameters

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature: DANA BROWN	9-24	Signature: [illegible]	9/30/98	Signature		Signature	
Printed Name: SRK	TIME 9:00	Printed Name: [illegible] CES	TIME 1030	Printed Name	TIME	Printed Name	TIME
Company		Company		Company		Company	
RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	REC'D BY (LABORATORY)	DATE
Signature		Signature		Signature		Signature	
Printed Name	TIME	Printed Name	TIME	Printed Name	TIME	Printed Name	TIME
Company		Company		Company		Company	

TOTAL NUMBER OF CONTAINERS 68 (3 Coolers)
METHOD OF SHIPMENT: Fed-X 1 Day
SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS

Columbia Analytical Services Inc.
Cooler Receipt And Preservation Form

Project/Client Leviathan Work Order K98 01762

Cooler received on 9/30/98 and opened on 9/30/98 by RA

1. Were custody seals on outside of cooler? **YES** NO
   If yes, how many and where? front
2. Were seals intact and signature & date correct? **YES** NO
3. COC #

Temperature of cooler(s) upon receipt:	4.6	5.7	5.3		
Temperature Blank:	3.8	5.4	5.8		

4. Were custody papers properly filled out (ink, signed, etc.)? **YES** NO
5. Type of packing material present ice
6. Did all bottles arrive in good condition (unbroken)? **YES** NO
7. Were all bottle labels complete (*i.e.* analysis, preservation, etc.)? **YES** NO
8. Did all bottle labels and tags agree with custody papers? YES **NO**
9. *Were the correct types of bottles used for the tests indicated?* **YES** NO
10. Were all of the preserved bottles received at the lab with the appropriate pH? YES NO
11. Were VOA vials checked for absence of air bubbles, and if present, noted below? ~~YES NO~~
12. Did the bottles originate from CAS/K or a branch laboratory? **YES** NO

Explain any discrepancies 1 Metals BTL labeled Lower Aspen Creek instead of Lower Aspen Seep - Time was 1330 as on Lower Aspen Creek.
Did not rec a Diss Metals for Leviathan

Samples that required preservation or received outside of temperature range at the lab(circle)

Sample ID	Reagent	Volume	Lot Number	Initials

Talked to M. Hanneman SRK 10/1/98. TSS/TDS past hold. Try to make DisMetals sample from unpres. bottle.
TD 10/1/98

00408

Appendix E
Climate Data, Fall/Winter 1998, Summer 1999

MONTHLY CLIMATOLOGICAL SUMMARY for SEP. 1999

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	50.1	82.5	8:00p	29.9	8:00a	8.8	0.0	0.00	3.9	17.0	10:00p	N
2	48.5	75.1	4:00p	30.9	8:00a	12.0	0.0	0.00	3.9	19.0	2:00p	N
3	49.6	74.0	6:00p	33.5	8:00a	11.3	0.0	0.00	4.4	15.0	6:00p	N
4	52.8	79.5	8:00p	33.3	8:00a	8.6	0.0	0.00	4.9	16.0	8:00p	N
5	54.3	83.6	8:00p	33.4	8:00a	6.5	0.0	0.00	4.8	16.0	4:00p	N
6	59.6	90.0	6:00p	37.5	6:00a	1.3	0.0	0.00	4.8	20.0	2:00p	SSE
7	64.3	93.6	6:00p	44.5	4:00a	0.0	4.0	0.00	5.5	20.0	6:00p	SSE
8	62.3	90.0	8:00p	43.1	8:00a	0.0	1.5	0.00	5.1	15.0	4:00p	SSE
9	61.8	87.8	4:00p	42.7	8:00a	0.0	0.3	0.00	4.3	17.0	4:00p	SSE
10	55.2	81.4	2:00p	44.0	8:00a	2.3	0.0	0.00	5.7	15.0	4:00a	SE
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
	55.9	93.6	7	29.9	1	50.7	5.9	0.00	4.7	20.0	6	N

Max >= 90.0: 3
Max <= 32.0: 0
Min <= 32.0: 2
Min <= 0.0: 0
Max Rain: 0.00 ON 9/01/99
Days of Rain: 0 (>.01 in) 0 (>.1 in) 0 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

MONTHLY CLIMATOLOGICAL SUMMARY for AUG. 1999

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	63.8	93.7	4:00p	46.4	6:00a	0.0	5.0	0.10	4.4	21.0	8:00p	N
2	65.7	96.9	8:00p	43.8	8:00a	0.0	5.4	0.00	5.0	25.0	6:00p	SSE
3	64.7	96.6	6:00p	37.0	6:00a	0.0	1.8	0.00	5.7	25.0	6:00p	N
4	59.7	84.2	2:00p	42.0	6:00a	1.9	0.0	0.30	4.5	15.0	8:00a	SSE
5	59.0	86.3	2:00p	43.5	6:00a	0.1	0.0	0.10	5.2	26.0	10:00p	SE
6	63.1	90.0	4:00p	41.5	8:00a	0.0	0.8	0.00	5.6	23.0	4:00p	SSE
7	57.7	86.6	6:00p	43.1	12:00m	0.2	0.0	0.10	4.6	27.0	4:00p	SSE
8	55.6	82.9	6:00p	35.3	8:00a	5.9	0.0	0.70	3.3	18.0	4:00p	N
9	57.2	84.3	8:00p	37.7	8:00a	4.0	0.0	0.00	4.3	16.0	6:00p	N
10	56.6	81.1	4:00p	41.1	8:00a	3.9	0.0	0.20	4.8	20.0	8:00p	SE
11	48.6	58.8	2:00p	39.2	12:00m	16.0	0.0	2.50	3.8	19.0	6:00a	S
12	54.5	80.5	8:00p	36.0	6:00a	6.8	0.0	0.00	4.8	22.0	10:00a	SSE
13	61.7	94.0	6:00p	40.0	8:00a	0.0	2.0	0.00	4.8	24.0	6:00p	SE
14	61.1	91.3	6:00p	40.9	8:00a	0.0	1.1	0.00	5.8	28.0	6:00p	SSE
15	58.9	89.3	6:00p	37.9	8:00a	1.4	0.0	0.00	5.9	26.0	6:00p	SSE
16	57.7	90.6	8:00p	33.9	8:00a	2.8	0.0	0.00	4.8	15.0	12:00p	N
17	63.7	94.4	8:00p	40.5	8:00a	0.0	2.5	0.20	5.4	18.0	6:00p	SE
18	66.5	96.2	6:00p	39.6	8:00a	0.0	2.9	0.10	5.5	22.0	4:00p	SSE
19	69.5	94.0	8:00p	50.2	8:00a	0.0	7.1	0.00	6.6	44.0	6:00p	SSE
20	67.1	97.6	6:00p	44.5	8:00a	0.0	6.0	0.70	5.3	21.0	6:00p	N
21	68.3	94.0	6:00p	46.4	8:00a	0.0	5.2	0.00	6.8	27.0	4:00p	SSE
22	66.6	93.5	8:00p	47.9	8:00a	0.0	5.7	0.00	4.3	17.0	6:00p	N
23	62.3	89.6	4:00p	45.9	8:00a	0.0	2.8	0.30	4.8	17.0	6:00p	SE
24	65.5	96.0	8:00p	45.5	8:00a	0.0	5.8	0.00	5.1	24.0	6:00p	SE
25	66.7	96.5	6:00p	45.0	8:00a	0.0	5.8	0.00	5.5	23.0	4:00p	SSE
26	67.2	94.1	6:00p	45.9	8:00a	0.0	5.0	0.00	4.5	18.0	4:00p	SSE
27	62.1	81.1	12:00p	52.1	12:00m	0.0	1.6	2.30	5.3	30.0	6:00p	SSE
28	61.3	90.7	8:00p	42.5	8:00a	0.0	1.6	0.10	4.3	23.0	6:00p	SSE
29	63.6	98.0	6:00p	41.3	8:00a	0.0	4.6	0.00	4.7	20.0	4:00p	SSE
30	65.4	93.2	6:00p	41.0	2:00a	0.0	2.1	0.00	6.2	28.0	2:00p	SSE
31	57.9	74.3	6:00p	36.5	12:00m	9.6	0.0	0.00	7.3	38.0	4:00p	S
	61.9	98.0	29	33.9	16	52.4	74.6	7.70	5.1	44.0	19	SSE

Max >= 90.0: 19
Max <= 32.0: 0
Min <= 32.0: 0
Min <= 0.0: 0
Max Rain: 2.50 ON 8/11/99
Days of Rain: 13 (>.01 in) 8 (>.1 in) 2 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

MONTHLY CLIMATOLOGICAL SUMMARY for JUL. 1999

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28	79.7	99.4	6:00p	57.6	12:00m	0.0	13.5	0.00	4.0	18.0	4:00p	N
29	70.5	99.6	6:00p	49.3	8:00a	0.0	9.4	0.00	6.3	21.0	4:00p	SSE
30	68.7	93.6	6:00p	48.0	12:00m	0.0	5.8	0.00	5.6	24.0	4:00p	SSE
31	62.8	85.0	4:00p	42.5	8:00a	1.3	0.0	0.00	4.4	16.0	2:00p	N
	70.4	99.6	29	42.5	31	1.3	28.7	0.00	5.1	24.0	30	SSE

Max >= 90.0: 3
Max <= 32.0: 0
Min <= 32.0: 0
Min <= 0.0: 0
Max Rain: 0.00 ON 7/01/99
Days of Rain: 0 (>.01 in) 0 (>.1 in) 0 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

MONTHLY CLIMATOLOGICAL SUMMARY for JAN. 1999

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	31.9	63.1	4:00p	19.2	2:00a	23.9	0.0	0.00	7.5	17.0	4:00a	SE
2	32.1	61.9	4:00p	22.2	8:00a	22.9	0.0	0.00	6.9	17.0	8:00a	SE
3	30.0	59.0	4:00p	18.4	8:00a	26.3	0.0	0.00	5.0	14.0	10:00a	SE
4	37.7	62.8	2:00p	26.7	6:00a	20.3	0.0	0.00	9.0	18.0	8:00a	ESE
5	38.7	67.3	4:00p	29.1	6:00a	16.8	0.0	0.00	8.5	17.0	2:00a	ESE
6	42.1	58.3	4:00p	31.3	2:00a	20.2	0.0	0.00	6.8	21.0	10:00p	SSE
7	40.6	45.6	10:00a	35.4	8:00a	0.0	0.0	0.00	7.6	26.0	6:00a	SSE
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
	36.2	67.3	5	18.4	3	130.3	0.0	0.00	7.3	26.0	7	SE

Max >= 90.0: 0
Max <= 32.0: 0
Min <= 32.0: 6
Min <= 0.0: 0
Max Rain: 0.00 ON 1/01/99
Days of Rain: 0 (>.01 in) 0 (>.1 in) 0 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

MONTHLY CLIMATOLOGICAL SUMMARY for DEC. 1998

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	32.8	56.1	4:00p	23.8	12:00m	25.1	0.0	0.37	4.7	15.0	12:00m	S
2	38.8	56.6	2:00p	25.6	2:00a	23.9	0.0	0.01	8.9	30.0	12:00m	SE
3	32.2	41.9	12:00p	14.8	12:00m	36.6	0.0	0.02	8.1	40.0	8:00a	WNW
4	20.6	44.3	2:00p	9.3	8:00a	38.2	0.0	0.14	4.3	19.0	2:00a	WNW
5	17.9	35.9	2:00p	2.3	8:00a	45.9	0.0	0.01	8.3	35.0	6:00p	S
6	18.5	41.5	4:00p	6.9	10:00p	40.8	0.0	0.02	5.1	19.0	2:00a	N
7	26.4	53.2	2:00p	7.3	2:00a	34.8	0.0	0.01	7.0	19.0	6:00p	SE
8	30.7	51.5	4:00p	14.3	12:00m	32.1	0.0	0.01	5.6	23.0	12:00p	SE
9	20.9	50.0	4:00p	10.4	8:00a	34.8	0.0	0.00	4.5	14.0	12:00m	SE
10	32.6	63.9	2:00p	15.1	2:00a	25.5	0.0	0.00	5.8	16.0	12:00m	SE
11	39.3	53.2	4:00p	31.3	2:00a	22.8	0.0	0.00	7.3	19.0	4:00p	ESE
12	39.4	64.6	4:00p	29.1	8:00a	18.2	0.0	0.00	6.4	17.0	2:00a	SE
13	42.1	53.0	4:00p	25.8	12:00m	25.6	0.0	0.00	9.3	42.0	2:00p	S
14	26.0	54.4	4:00p	16.7	8:00a	29.4	0.0	0.05	4.6	15.0	2:00a	SE
15	30.2	55.8	2:00p	20.5	8:00a	26.9	0.0	0.01	3.6	12.0	6:00a	SE
16	34.4	63.7	4:00p	23.2	4:00a	21.5	0.0	0.00	4.4	15.0	12:00m	SE
17	39.5	68.3	4:00p	29.2	4:00a	16.2	0.0	0.00	8.9	19.0	12:00m	SE
18	41.3	61.2	4:00p	29.2	4:00a	19.8	0.0	0.00	8.6	30.0	12:00m	S
19	21.9	36.9	2:00a	12.1	6:00p	40.5	0.0	0.00	6.1	30.0	4:00a	NNW
20	12.5	22.2	4:00p	5.7	12:00m	51.0	0.0	0.00	6.3	32.0	10:00a	N
21	7.9	42.6	4:00p	-5.2	6:00a	46.3	0.0	0.17	2.8	13.0	8:00a	ESE
22	5.9	31.5	4:00p	-5.0	10:00p	51.8	0.0	0.00	4.2	15.0	12:00m	ESE
23	16.6	50.0	4:00p	-4.1	2:00a	42.0	0.0	0.00	8.4	21.0	10:00p	ESE
24	29.8	44.2	2:00p	17.4	2:00a	34.2	0.0	0.00	8.2	21.0	2:00a	ESE
25	37.4	52.8	4:00p	26.6	2:00a	25.3	0.0	0.00	7.0	24.0	12:00p	SE
26	39.3	58.7	4:00p	28.1	10:00p	21.6	0.0	0.00	6.3	24.0	6:00a	SSW
27	39.1	55.6	4:00p	27.2	4:00a	23.6	0.0	0.00	9.6	34.0	6:00p	S
28	42.3	69.6	4:00p	30.9	12:00m	14.8	0.0	0.00	9.5	26.0	4:00a	SSE
29	39.1	69.9	4:00p	30.0	8:00a	15.0	0.0	0.00	9.0	19.0	6:00a	ESE
30	40.9	65.5	4:00p	30.6	8:00a	17.0	0.0	0.00	6.8	30.0	12:00m	SE
31	36.3	53.9	4:00p	20.3	12:00m	27.9	0.0	0.00	7.4	39.0	6:00a	SE
	30.1	69.9	29	-5.2	21	929.0	0.0	0.82	6.7	42.0	13	SE

Max >= 90.0: 0
Max <= 32.0: 2
Min <= 32.0: 31
Min <= 0.0: 3
Max Rain: 0.37 ON 12/01/98
Days of Rain: 6 (>.01 in) 3 (>.1 in) 0 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

MONTHLY CLIMATOLOGICAL SUMMARY for NOV. 1998

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), RAIN (in), WIND SPEED (mph)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1												
2												
3												
4	41.4	48.6	6:00p	38.3	12:00m	0.0	0.0	0.00	7.0	28.0	12:00m	S
5	34.9	53.3	4:00p	21.6	12:00m	27.5	0.0	0.00	5.4	25.0	2:00a	N
6	29.9	36.1	12:00p	21.6	2:00a	36.2	0.0	0.00	7.2	27.0	10:00a	S
7	34.3	45.4	4:00p	28.5	2:00a	28.0	0.0	0.02	10.6	55.0	4:00p	SE
8	29.8	39.0	2:00p	23.8	12:00m	33.6	0.0	0.00	5.5	27.0	2:00p	S
9	30.3	53.9	4:00p	19.3	8:00a	28.4	0.0	0.02	2.5	13.0	12:00m	N
10	32.6	46.1	2:00p	26.2	2:00a	28.9	0.0	0.00	6.5	34.0	8:00a	SSE
11	29.4	38.3	2:00p	20.4	8:00p	35.7	0.0	0.13	1.5	11.0	8:00p	N
12	31.9	65.7	4:00p	16.3	4:00a	24.0	0.0	0.25	6.2	16.0	8:00a	SE
13	42.7	74.5	4:00p	27.4	2:00a	14.1	0.0	0.00	8.0	21.0	12:00m	SE
14	47.4	76.2	4:00p	35.7	8:00a	9.1	0.0	0.00	7.5	26.0	10:00p	S
15	42.8	70.1	4:00p	30.3	12:00m	14.8	0.0	0.00	6.7	28.0	2:00a	SE
16	42.9	65.5	4:00p	30.0	2:00a	17.3	0.0	0.00	7.6	39.0	12:00m	SE
17	30.9	42.0	2:00p	20.7	12:00m	33.7	0.0	0.01	9.2	44.0	2:00a	SSE
18	29.9	52.6	4:00p	18.8	8:00a	29.3	0.0	0.00	4.9	16.0	4:00p	SE
19	31.2	62.8	4:00p	17.3	8:00a	25.0	0.0	0.01	6.5	15.0	10:00p	SE
20	39.3	55.9	4:00p	24.6	8:00a	24.8	0.0	0.00	8.8	30.0	2:00p	ESE
21	45.1	57.1	4:00p	40.2	8:00p	16.4	0.0	0.00	12.0	47.0	10:00p	SSE
22	38.8	53.9	2:00p	29.6	8:00a	23.3	0.0	0.11	7.2	36.0	2:00a	S
23	39.0	48.3	12:00p	30.9	12:00m	25.4	0.0	0.22	12.5	49.0	2:00p	SSE
24	32.9	44.1	2:00p	28.4	8:00a	28.8	0.0	0.06	8.7	35.0	2:00p	SSE
25	40.7	61.6	4:00p	29.5	2:00a	19.5	0.0	0.00	8.2	27.0	2:00p	SSE
26	43.6	63.7	4:00p	34.3	12:00m	16.0	0.0	0.00	6.7	29.0	12:00p	S
27	39.1	49.4	12:00p	32.2	12:00m	24.2	0.0	0.00	8.8	40.0	2:00p	SE
28	33.5	38.8	2:00p	30.2	12:00m	30.5	0.0	0.02	4.4	37.0	10:00p	E
29	35.5	42.6	2:00p	28.5	6:00a	29.5	0.0	0.13	10.9	42.0	2:00a	SSE
30	36.1	45.6	2:00p	30.7	12:00m	26.9	0.0	0.19	7.0	31.0	4:00a	SSE
	36.5	76.2	14	16.3	12	650.2	0.0	1.17	7.3	55.0	7	S

Max >= 90.0: 0
Max <= 32.0: 0
Min <= 32.0: 22
Min <= 0.0: 0
Max Rain: 0.25 ON 11/12/98
Days of Rain: 10 (>.01 in) 6 (>.1 in) 0 (>1 in)
Heat Base: 65.0 Cool Base: 65.0 Method: (High + Low) / 2

ANNUAL CLIMATOLOGICAL SUMMARY

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), HEAT BASE 65.0, COOL BASE 65.0

YR	MO	MEAN MAX	MEAN MIN	MEAN	DEP. FROM NORM	HEAT DEG DAYS	COOL DEG DAYS	HI	DATE	LOW	DATE	MAX >=90	MAX <=32	MIN <=32	MIN <=0
99	1	59.7	26.0	36.2	0.0	130	0	67.3	5	18.4	3	0	0	6	0
99	2														
99	3														
99	4														
99	5														
99	6														
99	7	94.4	49.3	70.4	0.0	1	29	99.6	29	42.5	31	3	0	0	0
99	8	89.4	42.1	61.9	0.0	52	75	98.0	29	33.9	16	19	0	0	0
99	9	83.8	37.3	55.9	0.0	51	6	93.6	7	29.9	1	3	0	2	0
99	10														
99	11														
99	12														
		84.7	39.6	57.9	0.0	235	109	99.6	JUL	18.4	JAN	25	0	8	0

PRECIPITATION (in)

YR	MO	TOTAL	DEP. FROM NORM	MAX OBS. DAY	DATE	DAYS OF RAIN OVER .01	.1	1
99	1	0.00	0.00	0.00	1	0	0	0
99	2	0.00	0.00	0.00	1	0	0	0
99	3	0.00	0.00	0.00	1	0	0	0
99	4	0.00	0.00	0.00	1	0	0	0
99	5	0.00	0.00	0.00	1	0	0	0
99	6	0.00	0.00	0.00	1	0	0	0
99	7	0.00	0.00	0.00	1	0	0	0
99	8	7.70	0.00	2.50	11	13	8	2
99	9	0.00	0.00	0.00	1	0	0	0
99	10	0.00	0.00	0.00	1	0	0	0
99	11	0.00	0.00	0.00	1	0	0	0
99	12	0.00	0.00	0.00	1	0	0	0
		7.70	0.00	2.50	AUG	13	8	2

WIND SPEED (mph)

YR	MO	AVG.	HI	DATE	DOM DIR
99	1	7.3	26.0	7	SE
99	2				
99	3				
99	4				
99	5				
99	6				
99	7	5.1	24.0	30	SSE
99	8	5.1	44.0	19	SSE
99	9	4.7	20.0	6	N
99	10				
99	11				
99	12				
		5.3	44.0	AUG	SSE

19333

DATA -

ANNUAL CLIMATOLOGICAL SUMMARY

NAME: LEVIATHAN CITY: STATE:
ELEV: LAT: LONG:

TEMPERATURE (°F), HEAT BASE 65.0, COOL BASE 65.0

YR	MO	MEAN MAX	MEAN MIN	MEAN	DEP. FROM NORM	HEAT DEG DAYS	COOL DEG DAYS	HI	DATE	LOW	DATE	MAX >=90	MAX <=32	MIN <=32	MIN <=0
98	1														
98	2														
98	3														
98	4														
98	5														
98	6														
98	7														
98	8														
98	9														
98	10														
98	11	53.0	27.2	36.5	0.0	650	0	76.2	14	16.3	12	0	0	22	0
98	12	52.3	17.7	30.1	0.0	929	0	69.9	29	-5.2	21	0	2	31	3
		52.6	22.2	33.1	0.0	1579	0	76.2	NOV	-5.2	DEC	0	2	53	3

PRECIPITATION (in)

YR	MO	TOTAL	DEP. FROM NORM	MAX OBS. DAY	DATE	DAYS OF RAIN .01	OVER .1	1
98	1	0.00	0.00	0.00	1	0	0	0
98	2	0.00	0.00	0.00	1	0	0	0
98	3	0.00	0.00	0.00	1	0	0	0
98	4	0.00	0.00	0.00	1	0	0	0
98	5	0.00	0.00	0.00	1	0	0	0
98	6	0.00	0.00	0.00	1	0	0	0
98	7	0.00	0.00	0.00	1	0	0	0
98	8	0.00	0.00	0.00	1	0	0	0
98	9	0.00	0.00	0.00	1	0	0	0
98	10	0.00	0.00	0.00	1	0	0	0
98	11	1.17	0.00	0.25	12	10	6	0
98	12	0.82	0.00	0.37	1	6	3	0
		1.99	0.00	0.37	DEC	16	9	0

WIND SPEED (mph)

YR	MO	AVG.	HI	DATE	DOM DIR
98	1				
98	2				
98	3				
98	4				
98	5				
98	6				
98	7				
98	8				
98	9				
98	10				
98	11	7.3	55.0	7	S
98	12	6.7	42.0	13	SE
		7.0	55.0	NOV	SE

Appendix F
1998 Geotechnical Testing Data

TEST PIT LTP-1

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 6965 ft. MSL

SampNo	WD (pcf)	DD (pcf)	MC (%)
T1,T1A,B1	105.6	83.3	26.8
T3,T4			
T2,B2			

SAMPLES | GRAPHIC LOG

DESCRIPTION

0–1.5: SILTY TO CLAYEY SAND (SM/SC),
trace of fine gravel with more fine/coarse gravel float at surface, predominantly well graded, low plasticity, light brown, slightly moist, loose to very loose
note: angular gravel
note: no dessication observed at surface, dry to ~1" at depth

1.5–6: SILTY GRAVEL (GM),
trace/some clay, some sand, predominantly well graded, angular, low plasticity, red-orange, dense, moist

note: increase in gravel below 4'

Stopped backhoe at 6'
Tube samples (1.92" I.D.) taken at 0.5-1' and 5.5-6'
Bulk samples taken at 0.5'-1' and 5.5-6'
note: nuclear density gauge data indicated to left
note: groundwater not encountered
note: hand dug complimentary test pit 5' to east on 10/9/98 to collect additional tube samples (T3 & T4 (1-1.5'))

TEST PIT LTP-2

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 6915 ft. MSL

SampNo	WD (pcf)	DD (pcf)	MC (pcf)
T1,T1A,B1	105.6	78.3	34.9
T4			
T3			
T2,B2			

SAMPLES | GRAPHIC LOG

DESCRIPTION

0–6.5: CLAYEY SAND (SC),
some fine gravel, trace coarse gravel, predominantely well graded, medium to high plasticity, brown with multi colored mottling (red/orange/yellow), moist, loose
note: upper 1-2" dry, no evident dessication at surface
note: becomes coarser with more gravel and some cobbles below 1'

increasing clay content and color change to gray with lower moisture content below 4'

Stopped backhoe at 6.5'
Tube samples (1.92 I.D.) taken at 0.5-1' and 6-6.5'
Bulk samples taken at 0.5-1' and 6-6.5'
note: nuclear density gauge data indicated to left
note: groundwater not encountered
note: excavated complimentary test pit 10'to east on 10/9/98 to collect additional tube samples (T3 (2-2.5') & T4 (0.9-1.4'))

SRK Consulting Engineers and Scientists 5250 Neil Road Suite 300 Reno, NV 89502	LOG OF TEST PITS LTP-1 AND LTP-2 Geotechnical Investigation Leviathan Mine, CA	TEST PIT REPORT

TEST PIT LTP-3

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 6945 ft. MSL

SampNo	SAMPLES	GRAPHIC LOG	DESCRIPTION
T1,B1			SILTY CLAYEY SAND (SC), some gravel, medium plasticity, orange brown, moist, loose to medium dense
			note: changes color to gray, increase in gravel, sulfur odor at 3'
			SILTY SAND (SM), some clay, low plasticity, gray, slightly moist, medium dense
T2,B2			Stopped backhoe at 7' Tube samples (1.92 I.D.) taken at 0.5-1' and 6-6.5' Bulk samples taken at 0.5'-1' and 6-6.5' note: groundwater not encountered

0 2 4 6 8 10

TEST PIT LTP-4

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310_E 4X4 DEERE Backh
LOGGED BY: KDW
SURFACE ELEVATION: 7082 ft. MSL

SampNo	SAMPLES	GRAPHIC LOG	DESCRIPTION
T1,B1			CLAYEY SAND WITH GRAVEL (SC), predominantely medium grained, non-plastic, brown, slightly moist, loose
			SILTY SAND (SM), some gravel, medium grained, low plasticity, brown, slightly moist, medium dense
T2,B2			Stopped backhoe at 6' Tube samples (1.92 I.D.) taken at 0.5-1' and 5.5-6' Bulk samples taken at 0.5-1' and 5.5-6' note: groundwater not encountered

0 2 4 6 8 10

SRK Consulting Engineers and Scientists 5250 Neil Road Suite 300 Reno, NV 89502	**LOG OF TEST PITS LTP-3 AND LTP-4** Geotechnical Investigation Leviathan Mine, CA	TEST PIT REPORT

TEST PIT LTP-5

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 7071 ft. MSL

SampNo	SAMPLES	GRAPHIC LOG	DESCRIPTION
B1, T1, T5	0–2		SILTY CLAY to CLAYEY SAND (SC/CH), trace to some gravel, predominantly well graded angular sand, medium to high plasticity, weakly stratified as exhibited by horizontal fracturing (preferred) in stratum, brown-gray to red-orange and green (mottled), moist, loose to medium dense (soft to medium stiff in clay-rich zones: qu = 2.5-3.2 tsf from 1.5-4.5')
T6	2–4		note: lense of orange clayey sand (SC) with lower plasticity from about 2.9-3.6'; indistinct lense definition except for color and plasticity; likely local (thins out) and encountered deeper in original test pit (5-6')
T3,T4	4–6		note: some cobbles at depth and within lower plasticity clayey sand lenses
T2,B2, T7	6–8		CLAYEY SAND (SC), some gravel, medium plasticity, brown-gray, slightly moist to moist, loose to medium dense (soft in clay-rich zones: qu= 2.0 tsf)
B3	8–9		
	9–14		**Backhoe refusal at 9'** Tube samples (1.92 I.D.) taken at 1-1.5' and 5.5-6' Bulk Samples taken at 0.5-1', 6-6.5' and 8.5-9'. Bulk sample taken at 8.5-9' was split and delivered to Chris Stetler (Water Quality Control Board) note: groundwater not encountered note: excavated complimentary test pit 25' to east on 10/9/98 to collect additional tube samples (T3 & T4 (4-4.5'), T5 (1.5-2'), T6 (2.9-3.4') and T7 (5.9-6.4)

TEST PIT LTP-6

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 7115 ft. MSL

SampNo	SAMPLES	GRAPHIC LOG	DESCRIPTION
T1,B1	0–2		SILTY CLAY to CLAYEY SAND (CH/SC), trace of cobbles, some gravel, predominantly well graded sand, medium to high plasticity, brown, moist, loose (soft to medium stiff in clay-rich zones: qu = 0.7-2.0 tsf from 3.8-4.3' and 2.5+ tsf from 1.5-2')
T4	2–4		note: no apparent moisture change or dessication zone below surficial soils, possibly due to recent precipitation
T3, T2, B2	4–6		note: color change varies in upper part of stratum fro orange to gray (mottled), distinct color change from orange to gray at about 1.5'
	6–8		note: strong sulfur odor and changes color to dark gray and some red below 4' (mottled), also trace to some subrounded to subangular cobbles and boulders (predominantly orange (soft-weathered) to gray/black (moderately hard to hard))
	8–9		note: increase in boulders below 7' (sulfur odor)
B3	9–10		
	10–14		**Stopped backhoe at 10'** Tube sample (1.92 I.D.) taken at 0.5-1' Bulk Samples taken at 0.5-1', 5.5-6' and 9.5-10'. Bulk sample taken at 9.5-10' was split and delivered to Chris Stetler (Water Quality Control Board) note: groundwater not encountered note: excavated complimentary test pit 8' to west on 10/9/98 to collect additional tube samples (T2 (4-4.5'), T3 (3.8-4.3') and T4 (1.5-2')

SRK Consulting
Engineers and Scientists
5250 Neil Road Suite 300
Reno, NV 89502

LOG OF TEST PITS LTP-5 AND LTP-6
Geotechnical Investigation
Leviathan Mine, CA

TEST PIT REPORT

REQUEST FOR LABORATORY SERVICES

STEFFEN, ROBERTSON AND KIRSTEN
Consulting Engineers and Scientists

LABORATORY SERVICES
4111 S. Natches Court, Unit D, Englewood CO 80110
Tel (303) 783-3609 Fax (303) 783-3610

Project: Laviathan Project Number: 19333
Date: 10/07/98 Client:
Project Manager: Gene Muller Requested By:
Results Required By: Page 1 of 2

SAMPLE ID	DEPTH	Sample Type	GRADATION			LIMITS		MOIST/DEN			PROCTOR		PERMEABILITY					TRIAXIAL SHEAR					OTHER TESTING REQUESTED								Remarks
			Fine / Coarse	Hydrometer	Minus 200	One Pt.	Three Pt.	Moisture	Density	Irreg. Shape	Std. Proctor	Mod. Proctor	Flex Wall	Conf. Pressure	Rigid Wall	Mold Size	Load (Specify)	QUU	RCTU	SCID	Stage Test	High Pressure	Sp. Gravity	Cap Moist Ret	1-D Consol	Direct Shear	Time Consol	Unconfined			
LTP-1, (S-3)	0.5-1.0	LD																													
LTP-1, top	0-0.5'	LD	X			X		X			X													X							
LTP-1, (S-1)	0-0.5'	SD																													
LTP-1, bottom		LD																													
LTP-2, top		LD																													
LTP-2, bottom		LD																													
LTP-2, (S-3)	0.5-1.0'	LD																													
LTP-2, (S-1)	0-0.5'	SD																													
LTP-3, top		LD	X			X		X			X													X							
LTP-3, bottom		LD																													
LTP-4, top		LD																													
LTP-4, bottom		LD	X			X		X																X							
LTP-5, top	0.5'-1	LD																													
LTP-5	6.0'	LD	X			X		X																X							
LTP-5 screened	8.0-9.0'	LD																													w QCB sample

General Notes: SD - Small Disturbed, LD - Large Disturbed, Cal - California Liner, ST - Shelby Tube
Maximum Effective Confining Stress = 160 psi - Indicate Confining Stress(es) & Normal Loads

Comments:

SAMPLE DISPOSAL OPTIONS: Please Complete This Section

Proper charges will be assessed.

1. Long-Term Storage

Hold until (date) for long term storage.

2. If Sample is Non-Hazardous

Local Disposal ____

Return to Client ____

RCRA-Permitted Facility

REQUEST FOR LABORATORY

STEFFEN, ROBERTSON AND KIRSTEN
Consulting Engineers and Scientists

LABORATORY SERVICES
4111 S. Natches Court, Unit D, Englewood CO 80110
Tel (303) 783-3609 Fax (303) 783-3610

Project: Laviathan
Project Number: 19333
Date: 10/07/98
Client: ARCO
Project Manager: Gene Muller
Requested By: GM
Results Required By:
Page 2 of 2

SAMPLE ID	DEPTH	Sample Type	GRADATION: Fine / Coarse	Hydrometer	Minus 200	LIMITS: One Pt.	Three Pt.	MOIST/DEN: Moisture	Density	Irreg. Shape	PROCTOR: Std. Proctor	Mod. Proctor	PERMEABILITY: Flex Wall	Conf. Pressure	Rigid Wall	Mold Size	Load (Specify)	TRIAXIAL SHEAR: QUU	RCTU	SCID	Stage Test	High Pressure	OTHER TESTING REQUESTED: Sp. Gravity	Cap Moist Ret.	1-D Consol	Direct Shear	Time Consol	Unconfined			Remarks
LTP-6, top	0.5-1	LD	X			X		X			X													X							
LTP-6	5.5-6.0'	LD																													
LTP-6, bottom	~~0.0-5~~ 9.5-10	SD																													U)QCB Angle
LTP-1, top	0.5-1.1'	CAL																													
LTP-1	0.5-1.0'	CAL							X				X																		See Note 1
LTP-1	5.5-6.0'	CAL																													
LTP-2, top (S-2)	0.5-1.0'	CAL																													
LTP-2	0.5-1.0'	CAL							X				X																		See Note 1
LTP-2	6.0-6.5'	CAL																													
LTP-3	0.5-1.0'	CAL																													
LTP-3	6.0-6.5'	CAL																													
LTP-4	0.5-1.0'	CAL																													
LTP-4	5.5-6.0'	CAL							X				X																		See Note 1
LTP-5	0.5-1.0'	CAL																													
LTP-5	5.5-6.0'	CAL							X				X																		See Note 1
LTP-6	0.5-1.0'	CAL							X				X																		See Note 1

General Notes: SD - Small Disturbed, LD - Large Disturbed, Cal - California Liner, ST - Shelby Tube

Maximum Effective Confining Stress = 160 psi - Indicate Confining Stress(es) & Normal Loads

Comments: 1) Get Volume & weight on undisturbed tube samples — get MC from LPT-6 calc dry density after perm test is complete and sample is dried. Record wet weight get tare weight after tube removed.
2) All perm tests at min confining pressure

SAMPLE DISPOSAL OPTIONS: Please Complete This Section

Proper charges will be assessed.

1. Long-Term Storage

Hold until _____ (date) for long term storage.

2. If Sample is Non-Hazardous

Local Disposal _____

Return to Client _____

RCRA-Permitted Facility

STEFFEN, ROBERTSON AND KIRSTEN
Consulting Engineers and Scientists

LABORATORY SERVICES
4111 S. Natches Court, Unit D, Englewood CO 80110
Tel (303) 783-3609 Fax (303) 783-3610

Project: LEVIATHAN Project Number: 19333
Date: 10/12/98 Client: ARCO
Project Manager: Requested By: GM
Results Required By:

SAMPLE ID	DEPTH	Sample Type	GRADATION: Fine / Coarse	Hydrometer	Minus 200	LIMITS: One Pt.	Three Pt.	MOIST/DEN: Moisture	Density	Irreg. Shape	PROCTOR: Std. Proctor	Mod. Proctor	PERMEABILITY: Flex Wall	Conf. Pressure	Rigid Wall	Mold Size	Load (Specify)	TRIAXIAL SHEAR: QUU	RCIU	SCID	Stage Test	High Pressure	OTHER TESTING REQUESTED: Sp. Gravity	Cap Moist Ret	1-D Consol	Direct Shear	Time Consol	Unconfined			Remarks
LTP-1, T3	1-1.5	CAL							X				X																		
LTP-1, T4	1-1.5	CAL																													
LTP-2, T3	2-2.5	CAL																													
LTP-2, T4	0.9-1.4	CAL							X				X																		
LTP-5, T3	4-4.5	CAL																													
T4	4-4.5	CAL																													
T5	1.5-2	CAL																													
T6	2.9-3.4	CAL																													
T7	5.9-6.4	CAL							X				X																		
LTP-6 T2	4-4.5	CAL																													
T3	3.8-4.3	CAL																													
T4	1.5-2	CAL																													
FR-S ①		SD																													
R-North ④		SD																													
FR-No ②		SD																													
③		SD																													

SAMPLE: SD - Small Disturbed, LD - Large Disturbed, Cal - California Liner, ST - Shelby Tube

Proper charges will be [illegible] Stress = 160 psi - Indicate Confining Stress(es) & Normal Loads

Hold until _____ (date)

Complete This Section

2. If Sample is Non-Hazardous

Local Disposal _____

Comments:

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-5, T7	Tested By	SDD
Description	5.9-6.4'	Checked By	GM
Sample Type	California Liner	Date	10/28/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.72	Specific Gravity	2.65
Init. Ht. (cm)	11.18	Assumed?	Yes
Init. Vol (cm³)	195.55	Init. Void Ratio	1.183
Init. Sample Wet Wt. (g)	335.39	Initial Porosity	0.542
Init. Moisture Content	41.3%	Init. Dry Density (pcf)	75.7
		Initial Calculated Saturation	92.6%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm²)	17.12
Confining Pressure (psi)	2.0	Height Change (cm)	0.06
Volume Change (cc)	5.01	Final Ht. (cm)	11.13
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	580.00	Final Void Ratio	1.127
Final Dry Wt. + Pan (g)	465.75	Final Volume (cm³)	190.55
Pan Wt. Only (g)	228.47	Final Dry Density (pcf)	77.7
Final Moisture Content	48.1%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	1.00	Final Porsity	0.530

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	4.8	43.9				
8	6.0	42.6	1.1	108.15	1.54	1.4E-05
8	7.1	41.5	1.0	105.80	1.50	1.3E-05
8	8.2	40.4	1.0	103.60	1.47	1.3E-05
8	9.2	39.4	0.9	101.50	1.44	1.2E-05
					Average =	1.3E-05

REMARKS: Sample was not homogenous, scattered gravel within clay. A large void was located in the central portion of the sample.

10-28-98 05:02PM FROM SRK LABORATORY TO SRK DENVER P02

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-1, T3	Tested By	SDD
Description	1.0-1.5'	Checked By	GM
Sample Type	California Liner	Date	10/14/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.91	Specific Gravity	2.65
Init. Ht. (cm)	10.10	Assumed?	Yes
Init. Vol (cm³)	191.57	Init. Void Ratio	1.582
Init. Sample Wet Wt. (g)	297.19	Initial Porosity	0.613
Init. Moisture Content	51.2%	Init. Dry Density (pcf)	64.0
		Initial Calculated Saturation	85.8%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm²)	18.83
Confining Pressure (psi)	2.0	Height Change (cm)	0.02
Volume Change (cc)	1.73	Final Ht. (cm)	10.08
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	511.85	Final Void Ratio	1.559
Final Dry Wt. + Pan (g)	389.01	Final Volume (cm³)	189.84
Pan Wt. Only (g)	192.47	Final Dry Density (pcf)	64.6
Final Moisture Content	62.5%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	1.00	Final Porsity	0.609

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	0.9	47.2				
20	3.0	45.2	1.9	114.55	1.63	7.3E-06
20	5.0	43.3	1.8	110.55	1.57	7.2E-06
20	6.9	41.4	1.7	106.70	1.52	7.2E-06
20	8.8	39.6	1.7	102.95	1.46	7.3E-06
					Average =	7.2E-06

REMARKS: Sample was homogenous.

10-15-98 04:58PM FROM SRK LABORATORY TO SRK TUCSON P02

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-2, T4	Tested By	SDD
Description	0.9-1.4'	Checked By	GM
Sample Type	California Liner	Date	10/15/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.81	Specific Gravity	2.65
Init. Ht. (cm)	10.25	Assumed?	Yes
Init. Vol (cm³)	186.58	Init. Void Ratio	1.136
Init. Sample Wet Wt. (g)	320.86	Initial Porosity	0.532
Init. Moisture Content	38.6%	Init. Dry Density (pcf)	77.4
		Initial Calculated Saturation	90.2%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm²)	15.62
Confining Pressure (psi)	2.0	Height Change (cm)	0.04
Volume Change (cc)	27.03	Final Ht. (cm)	10.22
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	565.46	Final Void Ratio	0.826
Final Dry Wt. + Pan (g)	459.87	Final Volume (cm³)	159.55
Pan Wt. Only (g)	228.43	Final Dry Density (pcf)	90.5
Final Moisture Content	45.6%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	2.00	Final Porsity	0.452

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	12.9	25.3				
30	14.1	23.9	1.2	151.70	2.16	2.8E-06
30	15.3	22.5	1.2	149.10	2.12	2.9E-06
30	16.5	21.0	1.2	146.45	2.08	3.0E-06
30	17.7	19.5	1.2	143.75	2.04	3.1E-06
					Average =	3.0E-06

REMARKS: Sample was not homogenous. Clayey sand top w/scattered gravel lenses bottom.

10-15-98 04:58PM FROM SRK LABORATORY TO SRK TUCSON P03

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-4	Tested By	SDD
Description	5.5-6'	Checked By	GM
Sample Type	California Liner	Date	10/13/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.82	Specific Gravity	2.65
Init. Ht. (cm)	9.82	Assumed?	Yes
Init. Vol (cm^3)	178.98	Init. Void Ratio	1.369
Init. Sample Wet Wt. (g)	258.06	Initial Porosity	0.578
Init. Moisture Content	28.9%	Init. Dry Density (pcf)	69.8
		Initial Calculated Saturation	56.0%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm^2)	14.08
Confining Pressure (psi)	2.0	Height Change (cm)	0.17
Volume Change (cc)	43.13	Final Ht. (cm)	9.65
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	466.34	Final Void Ratio	0.798
Final Dry Wt. + Pan (g)	391.88	Final Volume (cm^3)	135.85
Pan Wt. Only (g)	191.69	Final Dry Density (pcf)	92.0
Final Moisture Content	37.2%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	0.40	Final Porsity	0.444

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	5.4	40.2				
1	6.7	38.8	1.2	61.57	0.88	2.3E-04
1	8.0	37.5	1.2	58.92	0.84	2.3E-04
1	9.3	36.3	1.1	56.37	0.80	2.3E-04
1	10.4	35.1	1.0	53.97	0.77	2.2E-04
					Average =	2.3E-04

REMARKS: Sample was not homogenous. Clayey sand top w/gravel lense on bottom of sample.

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-6	Tested By	SDD
Description	0.5-1'	Checked By	GM
Sample Type	California Liner	Date	10/13/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.83	Specific Gravity	2.65
Init. Ht. (cm)	9.18	Assumed?	Yes
Init. Vol (cm^3)	167.98	Init. Void Ratio	1.271
Init. Sample Wet Wt. (g)	284.17	Initial Porosity	0.560
Init. Moisture Content	45.0%	Init. Dry Density (pcf)	72.8
		Initial Calculated Saturation	93.8%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm^2)	17.49
Confining Pressure (psi)	2.0	Height Change (cm)	0.16
Volume Change (cc)	10.28	Final Ht. (cm)	9.02
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	474.52	Final Void Ratio	1.132
Final Dry Wt. + Pan (g)	379.02	Final Volume (cm^3)	157.69
Pan Wt. Only (g)	183.03	Final Dry Density (pcf)	77.6
Final Moisture Content	48.7%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	1.00	Final Porsity	0.531

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	10.3	37.9				
20	11.8	36.5	1.3	96.45	1.37	5.9E-06
20	13.1	35.1	1.2	93.65	1.33	5.6E-06
20	14.5	33.8	1.2	90.95	1.29	5.8E-06
20	15.8	32.5	1.2	88.30	1.26	5.8E-06
					Average =	5.8E-06

REMARKS: Sample was homogenous.

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-5	Tested By	SDD
Description	5.5-6'	Checked By	GM
Sample Type	Catifornia Liner	Date	10/13/98

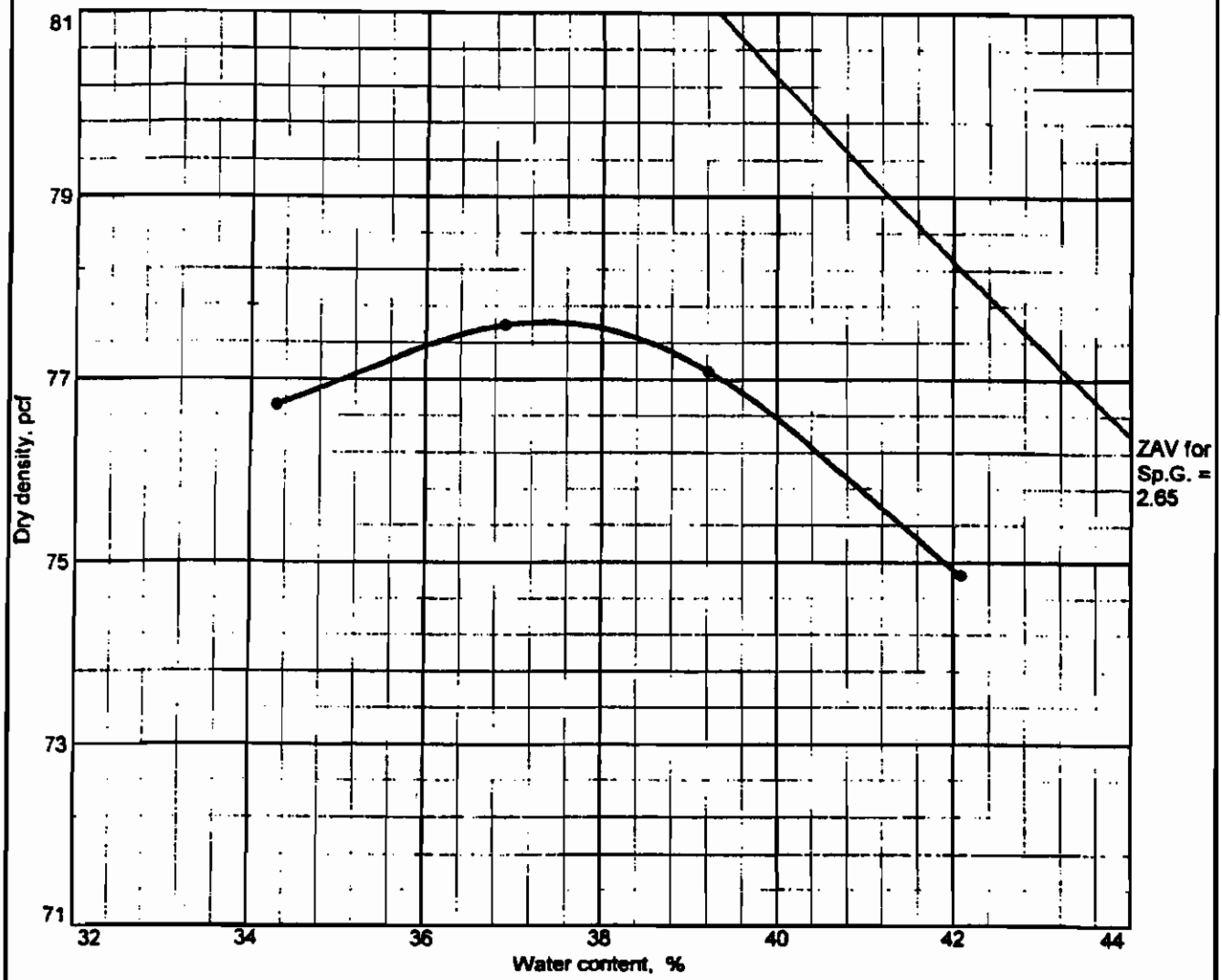
INITIAL SAMPLE DATA			
Sample Dia (cm)	4.83	Specific Gravity	2.65
Init. Ht. (cm)	9.13	Assumed?	Yes
Init. Vol (cm³)	167.41	Init. Void Ratio	1.285
Init. Sample Wet Wt. (g)	258.28	Initial Porosity	0.562
Init. Moisture Content	33.1%	Init. Dry Density (pcf)	72.4
		Initial Calculated Saturation	68.2%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm²)	17.60
Confining Pressure (psi)	2.0	Height Change (cm)	0.12
Volume Change (cc)	8.92	Final Ht. (cm)	9.00
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	387.42	Final Void Ratio	1.163
Final Dry Wt. + Pan (g)	303.79	Final Volume (cm³)	158.49
Pan Wt. Only (g)	109.67	Final Dry Density (pcf)	76.5
Final Moisture Content	43.1%	Final Calculated Saturation	98.2%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	0.40	Final Porsity	0.538

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	11.3	35.6				
1	12.7	34.2	1.3	51.02	0.73	2.1E-04
1	14.0	32.9	1.2	48.32	0.69	2.1E-04
1	15.2	31.6	1.1	45.77	0.65	2.1E-04
1	16.3	30.4	1.0	43.37	0.62	2.1E-04
					Average =	2.1E-04

REMARKS: Sample was not homogenous. A large gravel (1 1/2") was located in the central portion of the sample.

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure B Standard
Oversize correction applied to final results

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
0.0-0.5'	MH		43.5%	2.65	77	39	18.0	55.2

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 85.8 pcf	77.6 pcf	sandy elastic SILT w/gravel, mixed browns
Optimum moisture = 30.6 %	37.3 %	

Project No. 19333.1401 **Client:** ARCO
Project: Leviathan

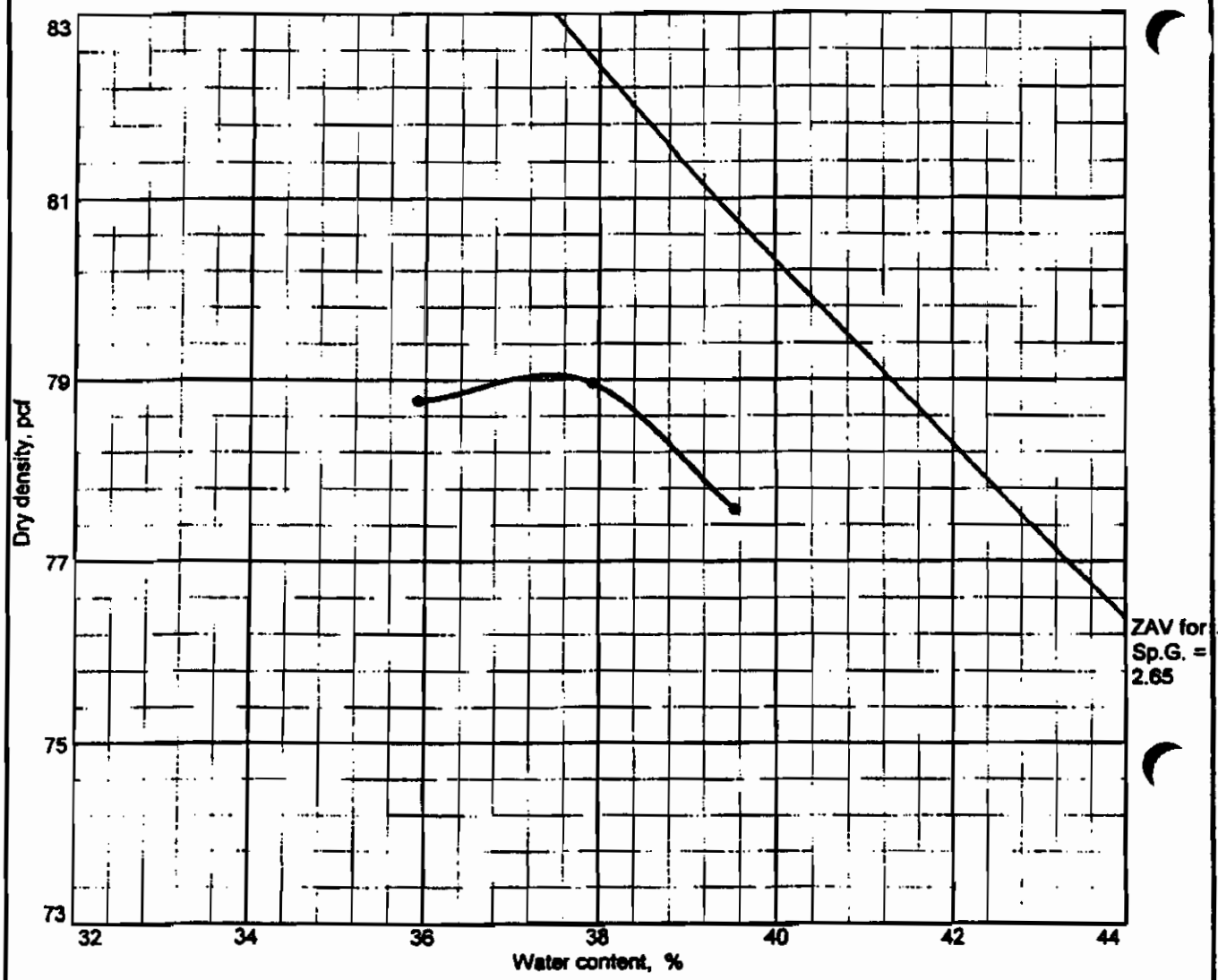
● **Source:** LTP-1 **Sample No.:** TOP **Elev./Depth:** 0.0-0.5'

Remarks:

COMPACTION TEST REPORT

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard
Oversize correction applied to final results

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH		38.2%	2.65	75	41	17.2	52.3

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 86.9 pcf	79.1 pcf	sandy fat CLAY w/gravel, mixed browns
Optimum moisture = 31.0 %	37.4 %	

Project No. 19333.1401 **Client:** ARCO
Project: Leviathan

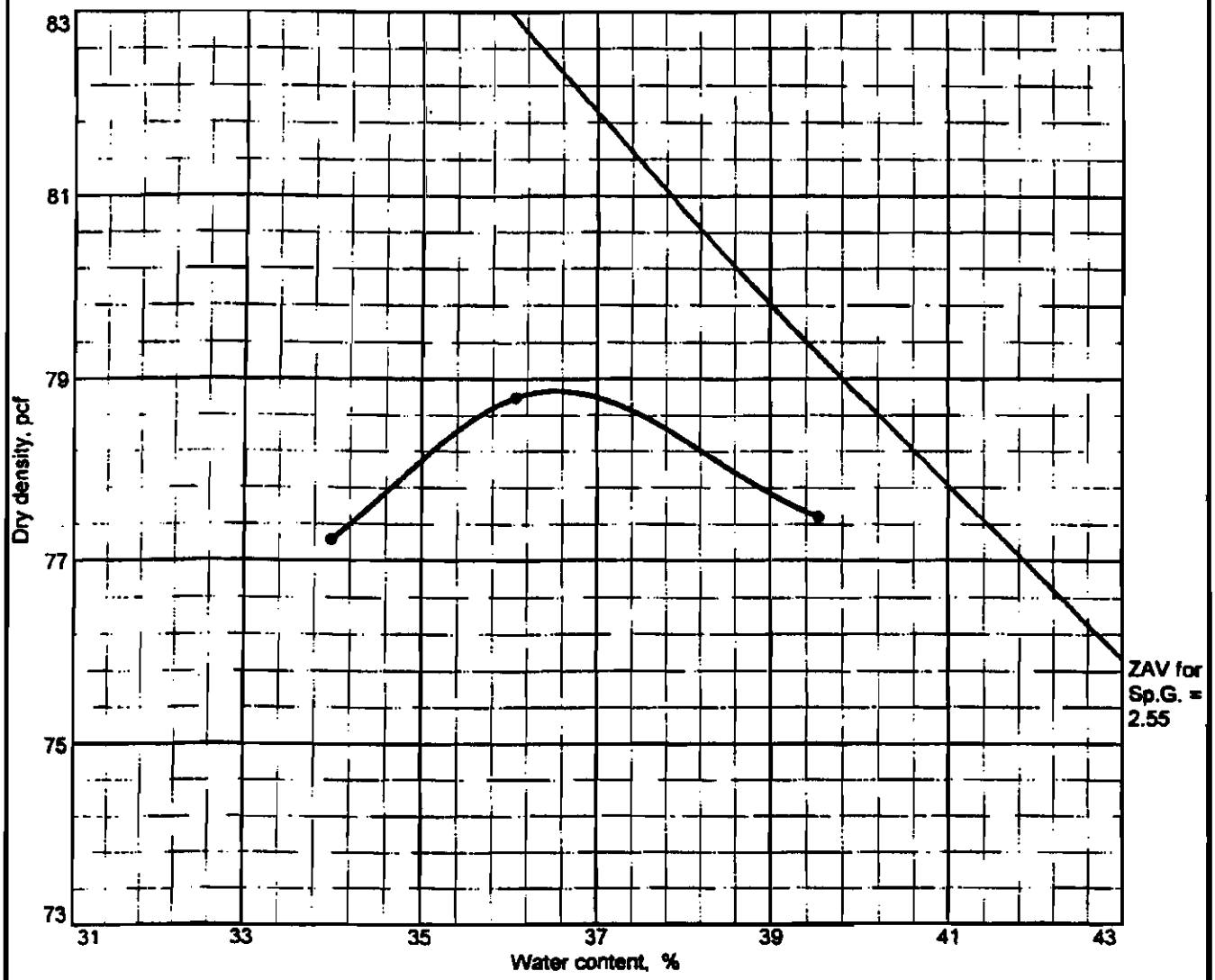
● **Source:** LTP-3 **Sample No.:** Top

Remarks:

COMPACTION TEST REPORT

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard
Oversize correction applied to final results

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CH		48.0%	2.55	78	44	10.8	51.9

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 83.4 pcf	78.9 pcf	sandy fat CLAY, mixed browns
Optimum moisture = 32.6 %	36.5 %	

Project No. 19333.1401 **Client:** ARCO
Project: Leviathan

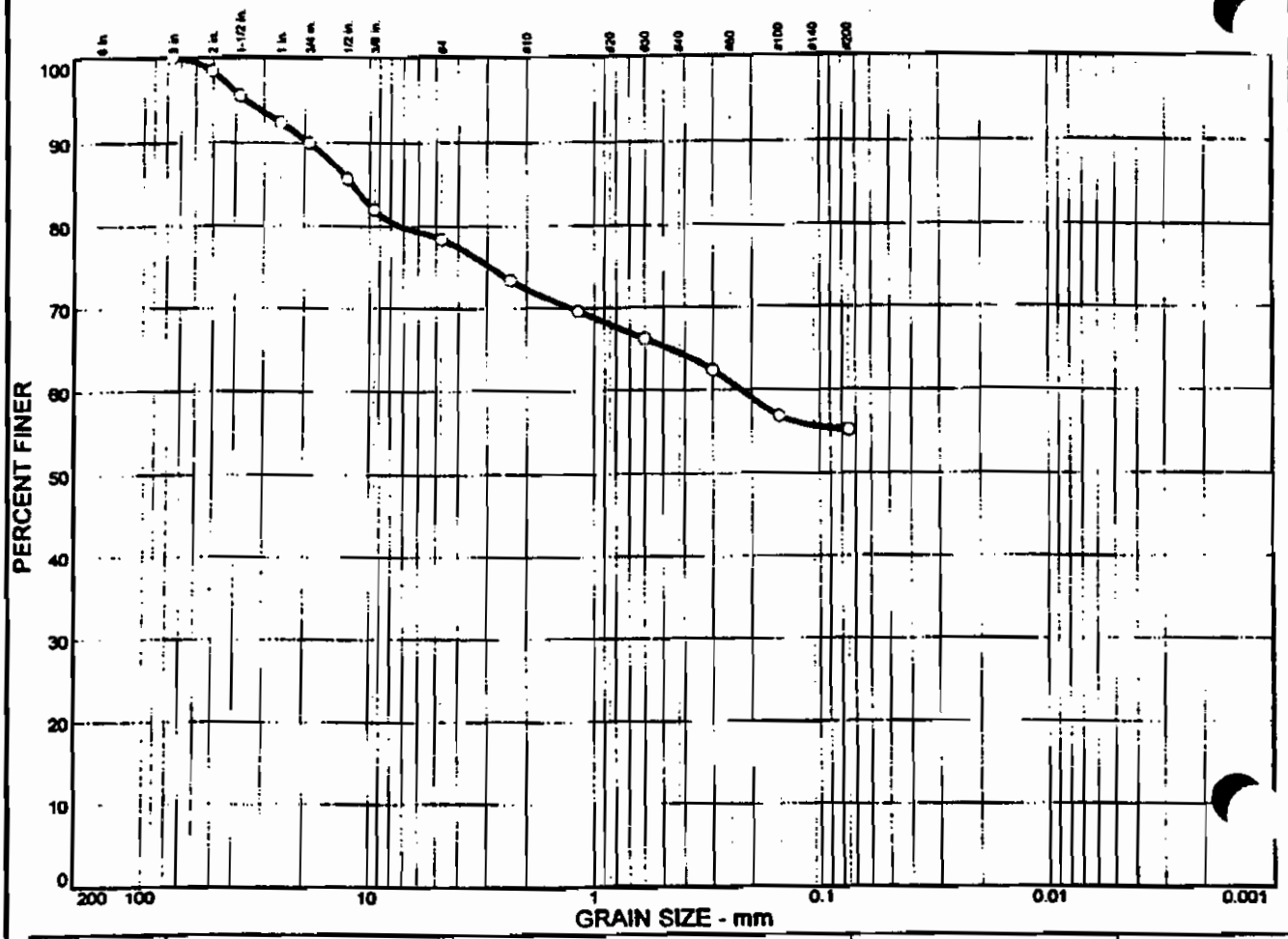
● **Source:** LTP-6 **Sample No.:** TOP

Remarks:

COMPACTION TEST REPORT

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	21.6	23.2	55.2	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
77	38	12.0	0.225						

MATERIAL DESCRIPTION	USCS	AASHTO
sandy elastic SILT w/gravel, mixed browns	MH	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-1 **Sample No.:** TOP **Elev./Depth:** 0.0-0.5'

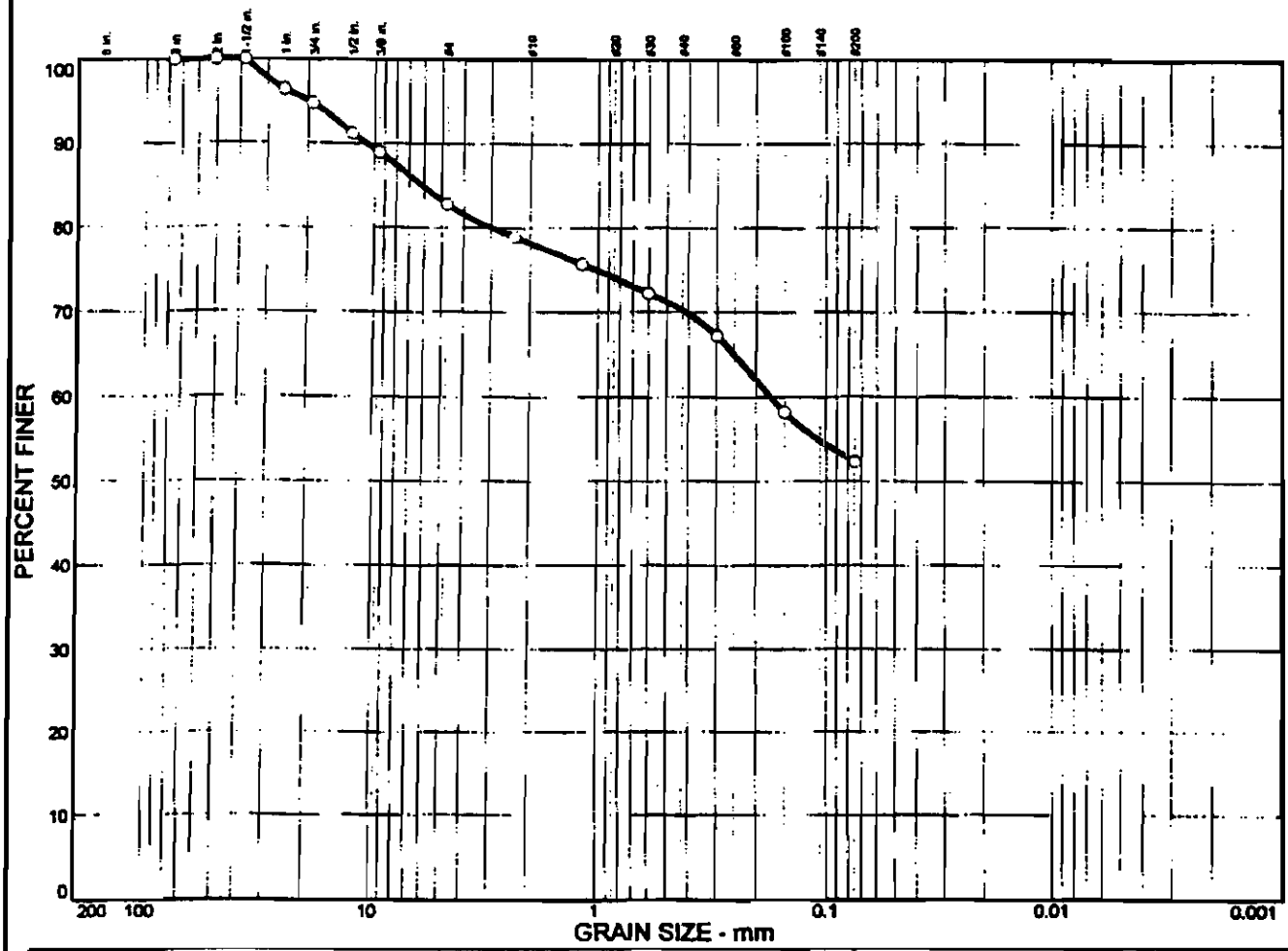
Remarks:

Natural moisture - 43.5%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	17.2	30.5	52.3	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
75	34	6.12	0.173						

MATERIAL DESCRIPTION	USCS	AASHTO
sandy fat CLAY w/gravel, mixed browns	CH	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-3 **Sample No.:** Top

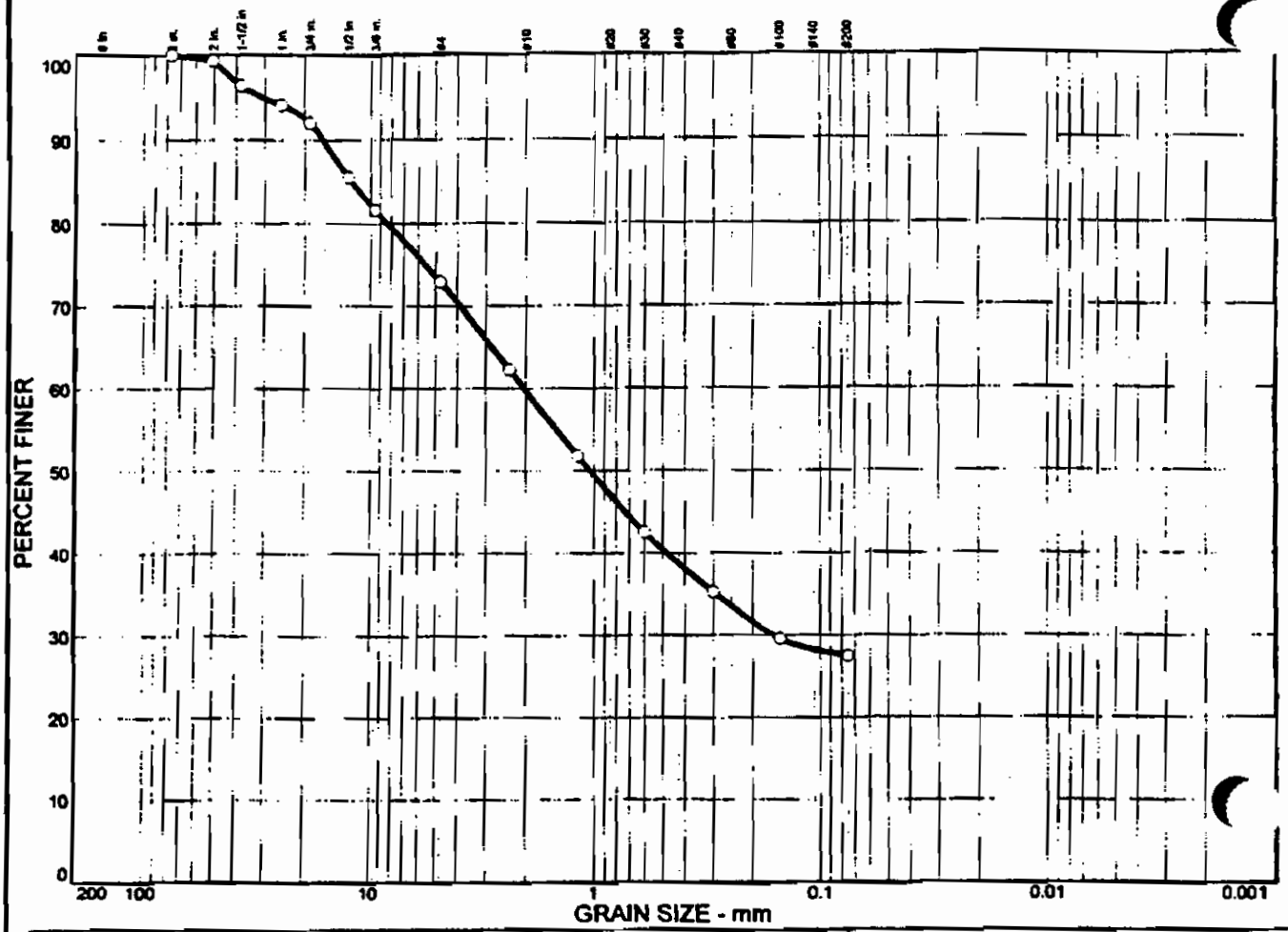
Remarks:

Natural moisture - 38.2%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	27.1	45.4	27.5	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
NV	NP	12.2	2.03	1.04	0.160				

MATERIAL DESCRIPTION	USCS	AASHTO
silty SAND w/gravel, mixed browns	SM	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-4 **Sample No.:** bottom

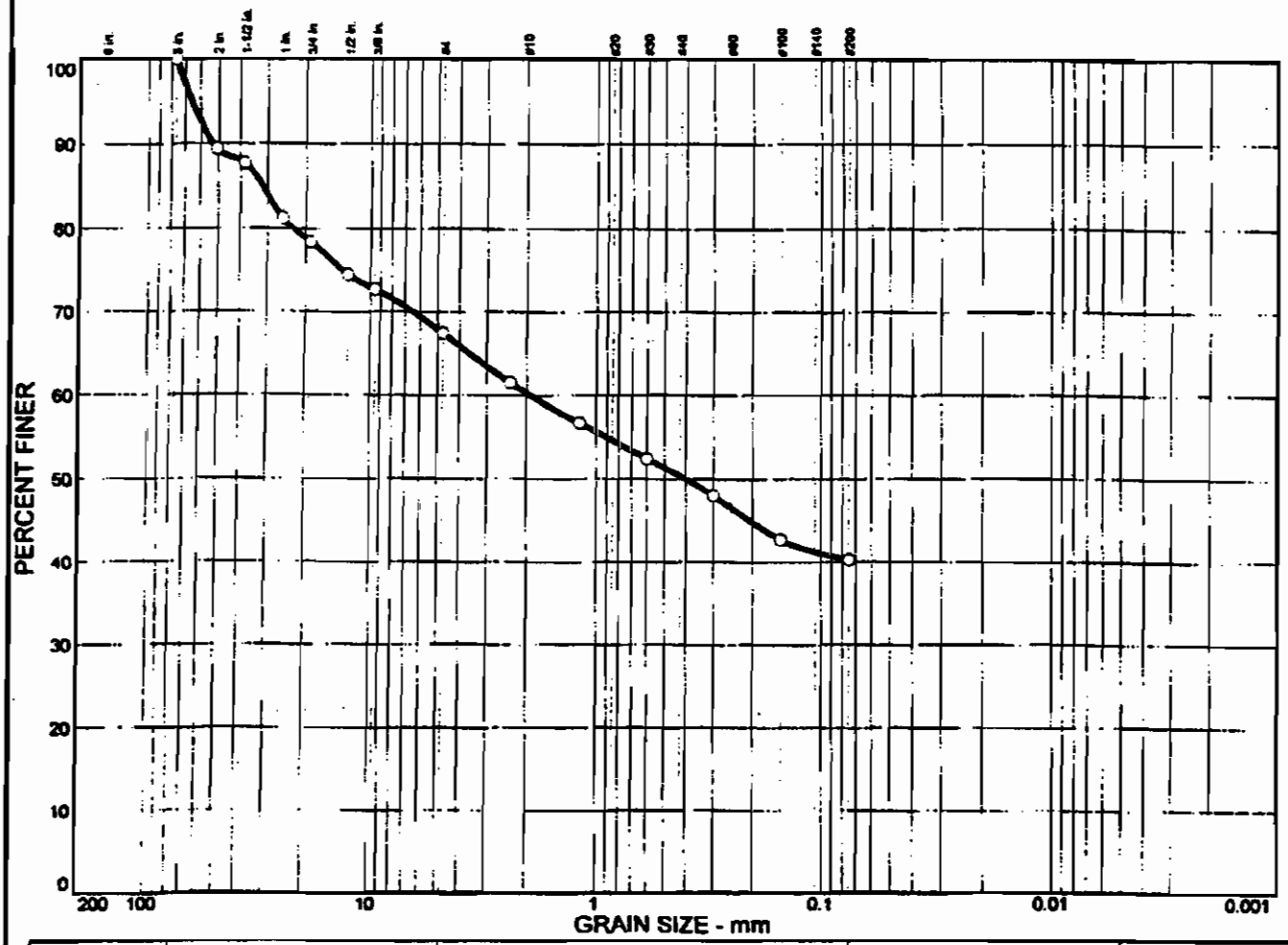
Remarks:

Natural moisture - 32.8%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	32.6	27.1	40.3	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
72	40	31.6	1.93	0.402					

MATERIAL DESCRIPTION	USCS	AASHTO
silty, clayey GRAVEL w/sand, mixed browns	GC-GM	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-5 **Elev./Depth:** 6.0'

Remarks:

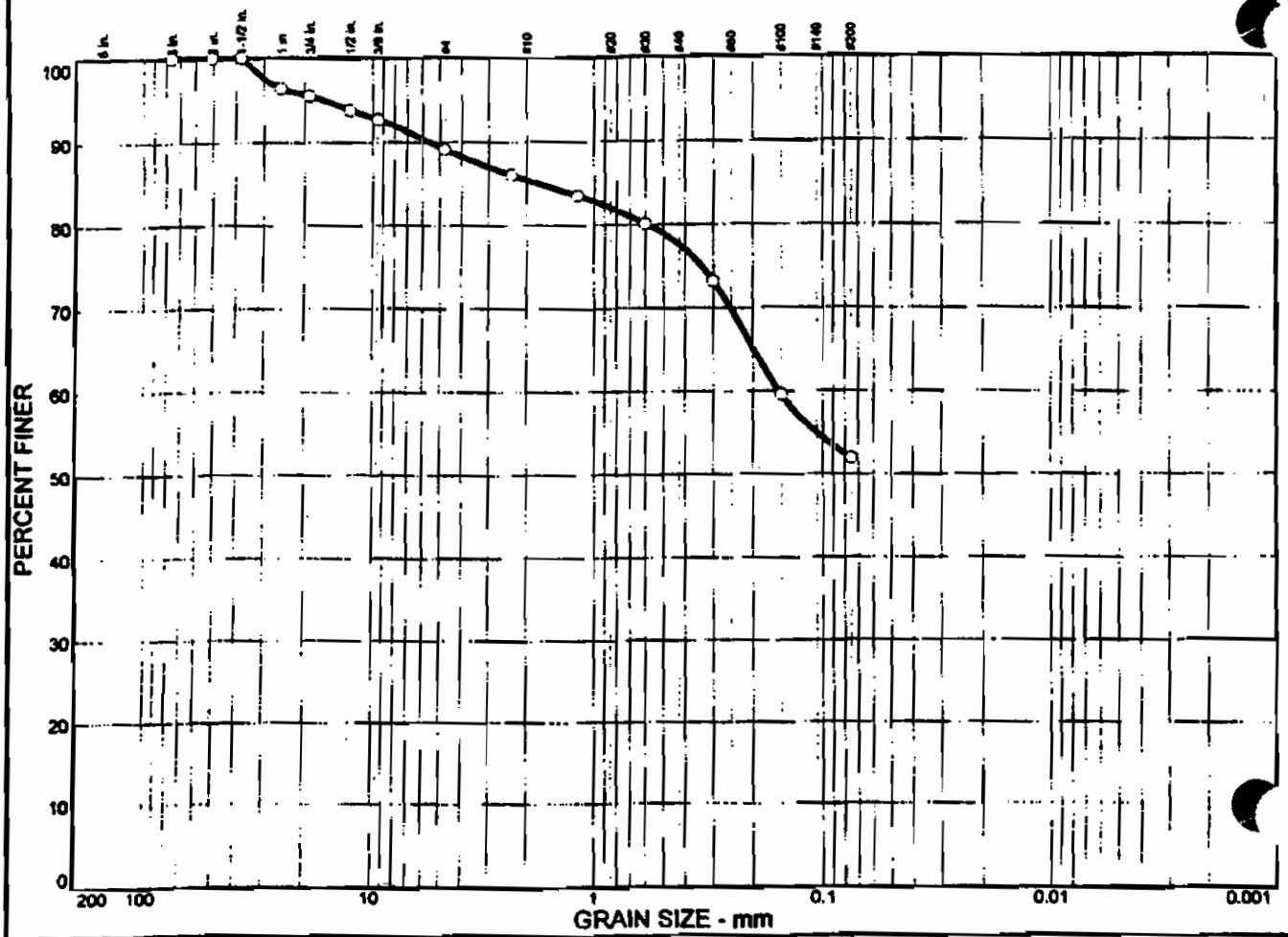
○ Natural moisture - 37.8%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

10-13-98 08:17AM FROM SRK LABORATORY TO SRK TUCSON P07

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.8	37.3	51.9	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
78	34	1.73	0.154						

MATERIAL DESCRIPTION	USCS	AASHTO
sandy fat CLAY, mixed browns	CH	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-6 **Sample No.:** TOP

Remarks:

Natural moisture - 48.0%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

DATA REPORT FOR THE LEVIATHAN MINE STUDY AREA WATER AND SEDIMENT TOXICITY TESTING AND BENTHIC COMMUNITY DATA, SEPTEMBER 1998 ASSESSMENT

(ENSR, 1999)

Bioassessment Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
BC-BRC	9/21/1998	%C	21.2	percent		ENS-001
BC-BRC	9/21/1998	EPT	7.2	index		ENS-001
BC-BRC	9/21/1998	HBI	4.46	index		ENS-001
BC-BRC	9/21/1998	Mean Density	2815	number/sq.meter		ENS-001
BC-BRC	9/21/1998	Total Taxa	47	number		ENS-001
EFC 1	9/21/1998	%C	21.7	percent		ENS-001
EFC 1	9/21/1998	EPT	14	index		ENS-001
EFC 1	9/21/1998	HBI	3.48	index		ENS-001
EFC 1	9/21/1998	Mean Density	4774	number/sq.meter		ENS-001
EFC 1	9/21/1998	Total Taxa	54	number		ENS-001
EFC 2	9/21/1998	%C	13	percent		ENS-001
EFC 2	9/21/1998	EPT	13.4	index		ENS-001
EFC 2	9/21/1998	HBI	3.1	index		ENS-001
EFC 2	9/21/1998	Mean Density	6052	number/sq.meter		ENS-001
EFC 2	9/21/1998	Total Taxa	47	number		ENS-001
EFC-Riverview	9/21/1998	%C	16.2	percent		ENS-001
EFC-Riverview	9/21/1998	EPT	13.4	index		ENS-001
EFC-Riverview	9/21/1998	HBI	3.22	index		ENS-001
EFC-Riverview	9/21/1998	Mean Density	12506	number/sq.meter		ENS-001
EFC-Riverview	9/21/1998	Total Taxa	52	number		ENS-001
EFC-Ruhen	9/21/1998	%C	29.1	percent		ENS-001
EFC-Ruhen	9/21/1998	EPT	12.2	index		ENS-001
EFC-Ruhen	9/21/1998	HBI	3.5	index		ENS-001
EFC-Ruhen	9/21/1998	Mean Density	13594	number/sq.meter		ENS-001
EFC-Ruhen	9/21/1998	Total Taxa	41	number		ENS-001
Sta 1	9/21/1998	%C	16.9	percent		ENS-001
Sta 1	9/21/1998	EPT	15.6	index		ENS-001
Sta 1	9/21/1998	HBI	3.5	index		ENS-001
Sta 1	9/21/1998	Mean Density	7206	number/sq.meter		ENS-001
Sta 1	9/21/1998	Total Taxa	60	number		ENS-001
Sta 15	9/21/1998	%C	91.9	percent		ENS-001
Sta 15	9/21/1998	EPT	0.4	index		ENS-001
Sta 15	9/21/1998	HBI	6.86	index		ENS-001
Sta 15	9/21/1998	Mean Density	231	number/sq.meter		ENS-001
Sta 15	9/21/1998	Total Taxa	15	number		ENS-001
Sta 16	9/21/1998	%C	87.5	percent		ENS-001
Sta 16	9/21/1998	EPT	1.2	index		ENS-001
Sta 16	9/21/1998	HBI	6.84	index		ENS-001
Sta 16	9/21/1998	Mean Density	1025	number/sq.meter		ENS-001
Sta 16	9/21/1998	Total Taxa	16	number		ENS-001
Sta 16	9/29/1998	Water Toxicity	20	percent		ENS-001
Sta 16	9/29/1998	Water Toxicity	45	percent		ENS-001
Sta 16	9/29/1998	Water Toxicity	50	percent		ENS-001
Sta 16	9/29/1998	Water Toxicity	75	percent		ENS-001
Sta 16	9/29/1998	Water Toxicity	80	percent		ENS-001
Sta 16	10/1/1998	Water Toxicity	0	percent		ENS-001
Sta 16	10/1/1998	Water Toxicity	100	percent		ENS-001
Sta 16	10/1/1998	Water Toxicity	50	percent		ENS-001
Sta 22	9/21/1998	%C	27.1	percent		ENS-001
Sta 22	9/21/1998	EPT	8	index		ENS-001
Sta 22	9/21/1998	HBI	4.59	index		ENS-001
Sta 22	9/21/1998	Mean Density	23898	number/sq.meter		ENS-001
Sta 22	9/21/1998	Total Taxa	48	number		ENS-001
Sta 23	9/21/1998	%C	90	percent		ENS-001
Sta 23	9/21/1998	EPT	0.4	index		ENS-001
Sta 23	9/21/1998	HBI	7.31	index		ENS-001
Sta 23	9/21/1998	Mean Density	708	number/sq.meter		ENS-001
Sta 23	9/21/1998	Total Taxa	11	number		ENS-001
Sta 24	9/21/1998	%C	4.1	percent		ENS-001
Sta 24	9/21/1998	EPT	20.2	index		ENS-001
Sta 24	9/21/1998	HBI	3.5	index		ENS-001
Sta 24	9/21/1998	Mean Density	12339	number/sq.meter		ENS-001
Sta 24	9/21/1998	Total Taxa	55	number		ENS-001
Sta 25	9/21/1998	%C	62.5	percent		ENS-001
Sta 25	9/21/1998	EPT	5.8	index		ENS-001

Bioassessment Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 25	9/21/1998	HBI	6.11	index		ENS-001
Sta 25	9/21/1998	Mean Density	2573	number/sq.meter		ENS-001
Sta 25	9/21/1998	Total Taxa	40	number		ENS-001
Sta 26	9/21/1998	%C	6.1	percent		ENS-001
Sta 26	9/21/1998	EPT	8.6	index		ENS-001
Sta 26	9/21/1998	HBI	4.12	index		ENS-001
Sta 26	9/21/1998	Mean Density	11844	number/sq.meter		ENS-001
Sta 26	9/21/1998	Total Taxa	50	number		ENS-001
Sta 29	9/21/1998	%C	41.1	percent		ENS-001
Sta 29	9/21/1998	EPT	6	index		ENS-001
Sta 29	9/21/1998	HBI	5.41	index		ENS-001
Sta 29	9/21/1998	Mean Density	12577	number/sq.meter		ENS-001
Sta 29	9/21/1998	Total Taxa	50	number		ENS-001

Notes:

Informaton obtained from database source code CLA-002 within the project database. The original source was from *Data Report for the Leviathan Mine Study Area Water and Sediment Toxicity Testing and Benthic Community Data,* ENSR (1999)

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
BC-BRC	23-Sep-98	Coarse Grain	0	%		ENS-001
BC-BRC	23-Sep-98	Cr	18.8	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Silt	55	%		ENS-001
BC-BRC	23-Sep-98	Moisture Content	77.27	%		ENS-001
BC-BRC	23-Sep-98	S	4.4	umoles		ENS-001
BC-BRC	23-Sep-98	TOC	0.11	%		ENS-001
BC-BRC	23-Sep-98	Clay	1.25	%		ENS-001
BC-BRC	23-Sep-98	Coarse Grain	23.9	%		ENS-001
BC-BRC	23-Sep-98	Clay	20	%		ENS-001
BC-BRC	23-Sep-98	S	14.1	umoles		ENS-001
BC-BRC	23-Sep-98	Pb	2.2	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Mn	3310	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Mn	857	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	38	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Sand	94.38	%		ENS-001
BC-BRC	23-Sep-98	As	81.2	mg/Kg		ENS-001
BC-BRC	23-Sep-98	S	25.4	umoles		ENS-001
BC-BRC	23-Sep-98	Coarse Grain	58	%		ENS-001
BC-BRC	23-Sep-98	Pb	6.4	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Silt	4.37	%		ENS-001
BC-BRC	23-Sep-98	AVS	1.92			ENS-001
BC-BRC	23-Sep-98	TOC	1.15	%		ENS-001
BC-BRC	23-Sep-98	TOC	1.48	%		ENS-001
BC-BRC	23-Sep-98	Cd	0.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cd	0.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Mn	524	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Sand	25	%		ENS-001
BC-BRC	23-Sep-98	Sand	75	%		ENS-001
BC-BRC	23-Sep-98	Silt	17.5	%		ENS-001
BC-BRC	23-Sep-98	Cd	0.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Al	6630	mg/Kg		ENS-001
BC-BRC	23-Sep-98	AVS	2.54	umoles/g		ENS-001
BC-BRC	23-Sep-98	AVS	1.45	umoles/g		ENS-001
BC-BRC	23-Sep-98	As	85.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Pb	2.2	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cd	0.78	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Pb	1.8	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Clay	7.5	%		ENS-001
BC-BRC	23-Sep-98	Moisture Content	38.1	%		ENS-001
BC-BRC	23-Sep-98	Cd	0.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	34.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	66.4	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	227	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	145	mg/Kg		ENS-001
BC-BRC	23-Sep-98	As	185	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	37	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	18.4	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	39.5	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	23	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Fe	42000	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	65	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Fe	28000	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	13.5	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	23	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	71.9	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	89.8	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	37	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Ni	18.4	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	117	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Al	19500	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cr	30.7	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Pb	1.8	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	13.5	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	13.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cu	126	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
BC-BRC	23-Sep-98	Zn	25	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Al	11000	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	76.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	25	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Cr	14.2	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Fe	19300	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Zn	13.1	mg/Kg		ENS-001
BC-BRC	23-Sep-98	Moisture Content	19.1	%		ENS-001
BCU	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 9	ENS-001
BCU	24-Sep-98	Percent Survival of Hyalella azteca	100	%	Sediment Toxicity Test,Site 9	ENS-001
BCU	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 9	ENS-001
EFC 1	23-Sep-98	AVS	1.24			ENS-001
EFC 1	23-Sep-98	Zn	55.7	mg/Kg		ENS-001
EFC 1	23-Sep-98	Zn	29.7	mg/Kg		ENS-001
EFC 1	23-Sep-98	Al	4630	mg/Kg		ENS-001
EFC 1	23-Sep-98	Mn	228	mg/Kg		ENS-001
EFC 1	23-Sep-98	As	17.8	mg/Kg		ENS-001
EFC 1	23-Sep-98	Mn	769	mg/Kg		ENS-001
EFC 1	23-Sep-98	As	7.1	mg/Kg		ENS-001
EFC 1	23-Sep-98	TOC	1.38	%		ENS-001
EFC 1	23-Sep-98	Ni	3.9	mg/Kg		ENS-001
EFC 1	23-Sep-98	TOC	0.26	%		ENS-001
EFC 1	23-Sep-98	Ni	12.3	mg/Kg		ENS-001
EFC 1	23-Sep-98	Al	14800	mg/Kg		ENS-001
EFC 1	23-Sep-98	Cr	4.2	mg/Kg		ENS-001
EFC 1	23-Sep-98	Moisture Content	36.11	%		ENS-001
EFC 1	23-Sep-98	Silt	1.87	%		ENS-001
EFC 1	23-Sep-98	Coarse Grain	3.29	%		ENS-001
EFC 1	23-Sep-98	Fe	20600	mg/Kg		ENS-001
EFC 1	23-Sep-98	Fe	9660	mg/Kg		ENS-001
EFC 1	23-Sep-98	Coarse Grain	65.52	%		ENS-001
EFC 1	23-Sep-98	Clay	18.12	%		ENS-001
EFC 1	23-Sep-98	AVS	1.1			ENS-001
EFC 1	23-Sep-98	Clay	0.62	%		ENS-001
EFC 1	23-Sep-98	Cd	0.042	mg/Kg		ENS-001
EFC 1	23-Sep-98	Zn	8.8	mg/Kg		ENS-001
EFC 1	23-Sep-98	Zn	116	mg/Kg		ENS-001
EFC 1	23-Sep-98	Ni	14.6	mg/Kg		ENS-001
EFC 1	23-Sep-98	Ni	16	mg/Kg		ENS-001
EFC 1	23-Sep-98	Moisture Content	13.69	%		ENS-001
EFC 1	23-Sep-98	Cr	8.9	mg/Kg		ENS-001
EFC 1	23-Sep-98	Pb	123	mg/Kg		ENS-001
EFC 1	23-Sep-98	Cd	0.031	mg/Kg		ENS-001
EFC 1	23-Sep-98	Cu	22.6	mg/Kg		ENS-001
EFC 1	23-Sep-98	Sand	97.51	%		ENS-001
EFC 1	23-Sep-98	Sand	21.88	%		ENS-001
EFC 1	23-Sep-98	Cu	8.6	mg/Kg		ENS-001
EFC 1	23-Sep-98	S	8.1	umoles		ENS-001
EFC 1	23-Sep-98	S	9.7	umoles		ENS-001
EFC 1	23-Sep-98	Pb	1.7	mg/Kg		ENS-001
EFC 1	23-Sep-98	Cu	477	mg/Kg		ENS-001
EFC 1	23-Sep-98	Silt	60	%		ENS-001
EFC 1	23-Sep-98	Cu	4.5	mg/Kg		ENS-001
EFC 2	23-Sep-98	Cr	3.9	mg/Kg		ENS-001
EFC 2	23-Sep-98	Cu	15.5	mg/Kg		ENS-001
EFC 2	23-Sep-98	Cu	3.5	mg/Kg		ENS-001
EFC 2	23-Sep-98	Fe	23500	mg/Kg		ENS-001
EFC 2	23-Sep-98	Ni	11	mg/Kg		ENS-001
EFC 2	23-Sep-98	Cu	11.2	mg/Kg		ENS-001
EFC 2	23-Sep-98	Fe	12300	mg/Kg		ENS-001
EFC 2	23-Sep-98	Cu	27.9	mg/Kg		ENS-001
EFC 2	23-Sep-98	Ni	13.9	mg/Kg		ENS-001
EFC 2	23-Sep-98	Ni	3.9	mg/Kg		ENS-001
EFC 2	23-Sep-98	Ni	3.8	mg/Kg		ENS-001
EFC 2	23-Sep-98	Silt	67.5	%		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
EFC 2	23-Sep-98	AVS	0.33			ENS-001
EFC 2	23-Sep-98	Sand	96.26	%		ENS-001
EFC 2	23-Sep-98	Sand	12.5	%		ENS-001
EFC 2	23-Sep-98	Cd	0.05	mg/Kg		ENS-001
EFC 2	23-Sep-98	AVS	0.53			ENS-001
EFC 2	23-Sep-98	Cd	0.032	mg/Kg		ENS-001
EFC 2	23-Sep-98	Zn	27.1	mg/Kg		ENS-001
EFC 2	23-Sep-98	Pb	6	mg/Kg		ENS-001
EFC 2	23-Sep-98	Clay	0.62	%		ENS-001
EFC 2	23-Sep-98	Cr	9.1	mg/Kg		ENS-001
EFC 2	23-Sep-98	Silt	3.12	%		ENS-001
EFC 2	23-Sep-98	Coarse Grain	0.3	%		ENS-001
EFC 2	23-Sep-98	Coarse Grain	55.6	%		ENS-001
EFC 2	23-Sep-98	As	13.4	mg/Kg		ENS-001
EFC 2	23-Sep-98	As	18.5	mg/Kg		ENS-001
EFC 2	23-Sep-98	Pb	0.89	mg/Kg		ENS-001
EFC 2	23-Sep-98	Al	4490	mg/Kg		ENS-001
EFC 2	23-Sep-98	Al	16700	mg/Kg		ENS-001
EFC 2	23-Sep-98	Clay	20	%		ENS-001
EFC 2	23-Sep-98	Zn	26.3	mg/Kg		ENS-001
EFC 2	23-Sep-98	S	1.2	umoles		ENS-001
EFC 2	23-Sep-98	Moisture Content	14.75	%		ENS-001
EFC 2	23-Sep-98	Zn	7.7	mg/Kg		ENS-001
EFC 2	23-Sep-98	Moisture Content	46.12	%		ENS-001
EFC 2	23-Sep-98	Mn	920	mg/Kg		ENS-001
EFC 2	23-Sep-98	Mn	235	mg/Kg		ENS-001
EFC 2	23-Sep-98	Zn	60.9	mg/Kg		ENS-001
EFC 2	23-Sep-98	TOC	0.08	%		ENS-001
EFC 2	23-Sep-98	TOC	2.74	%		ENS-001
EFC 2	23-Sep-98	S	0.4	umoles		ENS-001
EFC-1	24-Sep-98	Percent Survival of Hyalella azteca	96	%	Sediment Toxicity Test,Site 12	ENS-001
EFC-1	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 12	ENS-001
EFC-2	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 11	ENS-001
EFC-2	24-Sep-98	Percent Survival of Hyalella azteca	96	%	Sediment Toxicity Test,Site 11	ENS-001
EFC-Review	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 14	ENS-001
EFC-Review	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 14	ENS-001
EFC-Review	24-Sep-98	Percent Survival of Hyalella azteca	100	%	Sediment Toxicity Test,Site 14	ENS-001
EFC-Riverview	21-Sep-98	As	12.7	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cd	0.04	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cd	0.11	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	As	19.8	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	TOC	0.95	%		ENS-001
EFC-Riverview	21-Sep-98	S	-0.8	umoles		ENS-001
EFC-Riverview	21-Sep-98	Clay	11.25	%		ENS-001
EFC-Riverview	21-Sep-98	AVS	8.77			ENS-001
EFC-Riverview	21-Sep-98	TOC	1.09	%		ENS-001
EFC-Riverview	21-Sep-98	Clay	0	%		ENS-001
EFC-Riverview	21-Sep-98	Clay	25	%		ENS-001
EFC-Riverview	21-Sep-98	Mn	250	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Sand	99.38	%		ENS-001
EFC-Riverview	21-Sep-98	Sand	65	%		ENS-001
EFC-Riverview	21-Sep-98	Sand	7.5	%		ENS-001
EFC-Riverview	21-Sep-98	Fe	10900	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cu	9.6	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Silt	67.5	%		ENS-001
EFC-Riverview	21-Sep-98	Mn	505	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cu	8.6	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	As	11.2	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cu	18.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Silt	0.62	%		ENS-001
EFC-Riverview	21-Sep-98	AVS	0.76			ENS-001
EFC-Riverview	21-Sep-98	Fe	17400	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	S	5.2	umoles		ENS-001
EFC-Riverview	21-Sep-98	Mn	883	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cd	0.047	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
EFC-Riverview	21-Sep-98	Silt	23.75	%		ENS-001
EFC-Riverview	21-Sep-98	Ni	9.7	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	S	5.2	umoles		ENS-001
EFC-Riverview	21-Sep-98	Zn	20.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Pb	7.2	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	AVS	0.89			ENS-001
EFC-Riverview	21-Sep-98	AVS	0.73			ENS-001
EFC-Riverview	21-Sep-98	Cu	11.6	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cr	10.2	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Pb	3.1	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Zn	12.9	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Moisture Content	13.56	%		ENS-001
EFC-Riverview	21-Sep-98	Cu	92	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Ni	25	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cr	6.2	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Ni	5.6	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Zn	65.9	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cr	4.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Zn	50.5	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Zn	27.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Zn	28.7	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Cu	28.7	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Moisture Content	31.88	%		ENS-001
EFC-Riverview	21-Sep-98	AVS	0.33			ENS-001
EFC-Riverview	21-Sep-98	S	4.4	umoles		ENS-001
EFC-Riverview	21-Sep-98	Coarse Grain	0	%		ENS-001
EFC-Riverview	21-Sep-98	S	52	umoles		ENS-001
EFC-Riverview	21-Sep-98	Fe	24400	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Ni	15.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Coarse Grain	0.16	%		ENS-001
EFC-Riverview	21-Sep-98	Moisture Content	42.14	%		ENS-001
EFC-Riverview	21-Sep-98	Coarse Grain	49.83	%		ENS-001
EFC-Riverview	21-Sep-98	Al	5080	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Al	10900	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Ni	11.4	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Ni	3.8	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Pb	15.6	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	Al	16900	mg/Kg		ENS-001
EFC-Riverview	21-Sep-98	TOC	0.08	%		ENS-001
Sta 1	24-Sep-98	S	2.4	umoles		ENS-001
Sta 1	24-Sep-98	S	0.4	umoles		ENS-001
Sta 1	24-Sep-98	S	3.2	umoles		ENS-001
Sta 1	24-Sep-98	Ni	2.3	mg/Kg		ENS-001
Sta 1	24-Sep-98	Coarse Grain	60.1	%		ENS-001
Sta 1	24-Sep-98	Coarse Grain	1.4	%		ENS-001
Sta 1	24-Sep-98	Zn	7.6	mg/Kg		ENS-001
Sta 1	24-Sep-98	Zn	6.2	mg/Kg		ENS-001
Sta 1	24-Sep-98	Silt	3.75	%		ENS-001
Sta 1	24-Sep-98	Silt	1.25	%		ENS-001
Sta 1	24-Sep-98	Ni	1.5	mg/Kg		ENS-001
Sta 1	24-Sep-98	Clay	5	%		ENS-001
Sta 1	24-Sep-98	S	51	umoles		ENS-001
Sta 1	24-Sep-98	Mn	252	mg/Kg		ENS-001
Sta 1	24-Sep-98	Mn	264	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cd	0.21	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cd	0.15	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cr	8.7	mg/Kg		ENS-001
Sta 1	24-Sep-98	Pb	2.8	mg/Kg		ENS-001
Sta 1	24-Sep-98	Pb	1.6	mg/Kg		ENS-001
Sta 1	24-Sep-98	Clay	1.25	%		ENS-001
Sta 1	24-Sep-98	TOC	0.46	%		ENS-001
Sta 1	24-Sep-98	Fe	11100	mg/Kg		ENS-001
Sta 1	24-Sep-98	AVS	0.37	umoles/g		ENS-001
Sta 1	24-Sep-98	Cu	9.1	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cu	3.5	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 1	24-Sep-98	Sand	97.5	%		ENS-001
Sta 1	24-Sep-98	As	5.6	mg/Kg		ENS-001
Sta 1	24-Sep-98	As	5.6	mg/Kg		ENS-001
Sta 1	24-Sep-98	Zn	29.7	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cu	7.4	mg/Kg		ENS-001
Sta 1	24-Sep-98	Zn	31.5	mg/Kg		ENS-001
Sta 1	24-Sep-98	Al	6660	mg/Kg		ENS-001
Sta 1	24-Sep-98	Al	5620	mg/Kg		ENS-001
Sta 1	24-Sep-98	AVS	0.45	umoles/g		ENS-001
Sta 1	24-Sep-98	AVS	0.39	umoles/g		ENS-001
Sta 1	24-Sep-98	Cr	6.5	mg/Kg		ENS-001
Sta 1	24-Sep-98	Sand	91.25	%		ENS-001
Sta 1	24-Sep-98	Ni	3.7	mg/Kg		ENS-001
Sta 1	24-Sep-98	AVS	6.95	umoles/g		ENS-001
Sta 1	24-Sep-98	Fe	10400	mg/Kg		ENS-001
Sta 1	24-Sep-98	Cu	2	mg/Kg		ENS-001
Sta 1	24-Sep-98	TOC	0.19	%		ENS-001
Sta 1	24-Sep-98	Ni	7	mg/Kg		ENS-001
Sta 15	24-Sep-98	Al	10800	mg/Kg		ENS-001
Sta 15	24-Sep-98	Cu	37.5	mg/Kg		ENS-001
Sta 15	24-Sep-98	Cr	27.1	mg/Kg		ENS-001
Sta 15	24-Sep-98	Cu	10.9	mg/Kg		ENS-001
Sta 15	24-Sep-98	Mn	499	mg/Kg		ENS-001
Sta 15	24-Sep-98	Al	10700	mg/Kg		ENS-001
Sta 15	24-Sep-98	Ni	4.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Ni	6.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Clay	27.5	%		ENS-001
Sta 15	24-Sep-98	Clay	7.5	%		ENS-001
Sta 15	24-Sep-98	Zn	13.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Ni	16.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Coarse Grain	0.4	%		ENS-001
Sta 15	24-Sep-98	Percent Survival of Hyalella azteca	40	%	Sediment Toxicity Test,Site 2	ENS-001
Sta 15	24-Sep-98	Percent Survival of Hyalella azteca	1	%	Sediment Toxicity Test,Site 2	ENS-001
Sta 15	24-Sep-98	Zn	35.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Zn	43.7	mg/Kg		ENS-001
Sta 15	24-Sep-98	Fe	35000	mg/Kg		ENS-001
Sta 15	24-Sep-98	Fe	135000	mg/Kg		ENS-001
Sta 15	24-Sep-98	Ni	14.8	mg/Kg		ENS-001
Sta 15	24-Sep-98	Zn	7	mg/Kg		ENS-001
Sta 15	24-Sep-98	Silt	31.25	%		ENS-001
Sta 15	24-Sep-98	Silt	3.75	%		ENS-001
Sta 15	24-Sep-98	TOC	0.21	%		ENS-001
Sta 15	24-Sep-98	Cu	8.8	mg/Kg		ENS-001
Sta 15	24-Sep-98	TOC	0.57	%		ENS-001
Sta 15	24-Sep-98	Coarse Grain	57.1	%		ENS-001
Sta 15	24-Sep-98	Pb	5	mg/Kg		ENS-001
Sta 15	24-Sep-98	Sand	41.25	%		ENS-001
Sta 15	24-Sep-98	As	231	mg/Kg		ENS-001
Sta 15	24-Sep-98	S	0.4	umoles		ENS-001
Sta 15	24-Sep-98	S	1.2	umoles		ENS-001
Sta 15	24-Sep-98	Sand	88.75	%		ENS-001
Sta 15	24-Sep-98	Cu	40.6	mg/Kg		ENS-001
Sta 15	24-Sep-98	Mn	203	mg/Kg		ENS-001
Sta 15	24-Sep-98	As	147	mg/Kg		ENS-001
Sta 15	24-Sep-98	AVS	0.72	umoles/g		ENS-001
Sta 15	24-Sep-98	Cd	1.1	mg/Kg		ENS-001
Sta 15	24-Sep-98	Cr	19.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	AVS	0.37	umoles/g		ENS-001
Sta 15	24-Sep-98	Cd	8.3	mg/Kg		ENS-001
Sta 15	24-Sep-98	Pb	1.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	S	21	umoles		ENS-001
Sta 16	24-Sep-98	AVS	6.7	umoles/g		ENS-001
Sta 16	24-Sep-98	Cu	93.4	mg/Kg		ENS-001
Sta 16	24-Sep-98	Pb	2.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cd	0.1	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 16	24-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 16	24-Sep-98	Moisture Content	16.8	%		ENS-001
Sta 16	24-Sep-98	Ni	6.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	Mn	1170	mg/Kg		ENS-001
Sta 16	24-Sep-98	S	12.5	umoles		ENS-001
Sta 16	24-Sep-98	Sand	80.01	%		ENS-001
Sta 16	24-Sep-98	Zn	18	mg/Kg		ENS-001
Sta 16	24-Sep-98	Sand	42.5	%		ENS-001
Sta 16	24-Sep-98	Ni	7.9	mg/Kg		ENS-001
Sta 16	24-Sep-98	Zn	73.3	mg/Kg		ENS-001
Sta 16	24-Sep-98	Zn	79	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cu	93.4	mg/Kg		ENS-001
Sta 16	24-Sep-98	AVS	1.33	umoles/g		ENS-001
Sta 16	24-Sep-98	Fe	27300	mg/Kg		ENS-001
Sta 16	24-Sep-98	Coarse Grain	67.9	%		ENS-001
Sta 16	24-Sep-98	As	49.7	mg/Kg		ENS-001
Sta 16	24-Sep-98	AVS	1.61	umoles/g		ENS-001
Sta 16	24-Sep-98	Cu	55.9	mg/Kg		ENS-001
Sta 16	24-Sep-98	Zn	15.3	mg/Kg		ENS-001
Sta 16	24-Sep-98	Zn	18	mg/Kg		ENS-001
Sta 16	24-Sep-98	AVS	2.1	umoles/g		ENS-001
Sta 16	24-Sep-98	S	15.7	umoles		ENS-001
Sta 16	24-Sep-98	Ni	32.4	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cu	241	mg/Kg		ENS-001
Sta 16	24-Sep-98	Al	19700	mg/Kg		ENS-001
Sta 16	24-Sep-98	Al	10900	mg/Kg		ENS-001
Sta 16	24-Sep-98	Ni	6.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 16	24-Sep-98	Coarse Grain	9.9	%		ENS-001
Sta 16	24-Sep-98	Ni	25.4	mg/Kg		ENS-001
Sta 16	24-Sep-98	S	65.8	umoles		ENS-001
Sta 16	24-Sep-98	Pb	2.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	Cu	180	mg/Kg		ENS-001
Sta 16	24-Sep-98	TOC	0.14	%		ENS-001
Sta 16	24-Sep-98	Pb	2.8	mg/Kg		ENS-001
Sta 16	24-Sep-98	TOC	0.44	%		ENS-001
Sta 16	24-Sep-98	Mn	2450	mg/Kg		ENS-001
Sta 16	24-Sep-98	Silt	8.12	%		ENS-001
Sta 16	24-Sep-98	Clay	11.87	%		ENS-001
Sta 16	24-Sep-98	Clay	38.75	%		ENS-001
Sta 16	24-Sep-98	Fe	23400	mg/Kg		ENS-001
Sta 16	24-Sep-98	Silt	18.75	(%)		ENS-001
Sta 16	24-Sep-98	As	46.5	mg/Kg		ENS-001
Sta 16	24-Sep-98	Percent Survival of Hyalella azteca	91	%	Sediment Toxicity Test,Site 4	ENS-001
Sta 16	24-Sep-98	Percent Survival of Hyalella azteca	91	%	Sediment Toxicity Test,Site 4	ENS-001
Sta 16	24-Sep-98	Cr	16	mg/Kg		ENS-001
Sta 16	24-Sep-98	Moisture Content	37.4	%		ENS-001
Sta 16	24-Sep-98	Cr	24.1	mg/Kg		ENS-001
Sta 17	24-Sep-98	Percent Survival of Hyalella azteca	100	%	Sediment Toxicity Test,Site 1	ENS-001
Sta 17	24-Sep-98	Percent Survival of Hyalella azteca	96	%	Sediment Toxicity Test,Site 1	ENS-001
Sta 22	24-Sep-98	Cu	4.5	mg/Kg		ENS-001
Sta 22	24-Sep-98	Cu	1.8	mg/Kg		ENS-001
Sta 22	24-Sep-98	Cr	5.4	mg/Kg		ENS-001
Sta 22	24-Sep-98	Cr	6.9	mg/Kg		ENS-001
Sta 22	24-Sep-98	Percent Survival of Hyalella azteca	86	%	Sediment Toxicity Test,Site 3	ENS-001
Sta 22	24-Sep-98	Cu	5.3	mg/Kg		ENS-001
Sta 22	24-Sep-98	Fe	8950	mg/Kg		ENS-001
Sta 22	24-Sep-98	Fe	9850	mg/Kg		ENS-001
Sta 22	24-Sep-98	Cu	1	mg/Kg		ENS-001
Sta 22	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 3	ENS-001
Sta 22	24-Sep-98	As	8.6	mg/Kg		ENS-001
Sta 22	24-Sep-98	Pb	3.6	mg/Kg		ENS-001
Sta 22	24-Sep-98	Pb	1.9	mg/Kg		ENS-001
Sta 22	24-Sep-98	Coarse Grain	37.3	%		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 22	24-Sep-98	S	17.4	umoles		ENS-001
Sta 22	24-Sep-98	Mn	266	mg/Kg		ENS-001
Sta 22	24-Sep-98	AVS	2.28	umoles/g		ENS-001
Sta 22	24-Sep-98	AVS	0.61	umoles/g		ENS-001
Sta 22	24-Sep-98	Sand	83.75	%		ENS-001
Sta 22	24-Sep-98	Mn	143	mg/Kg		ENS-001
Sta 22	24-Sep-98	As	5.6	mg/Kg		ENS-001
Sta 22	24-Sep-98	S	0	umoles		ENS-001
Sta 22	24-Sep-98	TOC	2.11	%		ENS-001
Sta 22	24-Sep-98	TOC	0.71	%		ENS-001
Sta 22	24-Sep-98	Al	5720	mg/Kg		ENS-001
Sta 22	24-Sep-98	Al	7250	mg/Kg		ENS-001
Sta 22	24-Sep-98	Ni	3.6	mg/Kg		ENS-001
Sta 22	24-Sep-98	Ni	3.67	mg/Kg		ENS-001
Sta 22	24-Sep-98	Zn	23.3	mg/Kg		ENS-001
Sta 22	24-Sep-98	Zn	25.8	mg/Kg		ENS-001
Sta 22	24-Sep-98	Sand	95	%		ENS-001
Sta 22	24-Sep-98	Cd	0.24	mg/Kg		ENS-001
Sta 22	24-Sep-98	Cd	0.27	mg/Kg		ENS-001
Sta 22	24-Sep-98	Zn	7.1	mg/Kg		ENS-001
Sta 22	24-Sep-98	Coarse Grain	10.5	%		ENS-001
Sta 22	24-Sep-98	Zn	9.7	mg/Kg		ENS-001
Sta 22	24-Sep-98	Ni	0.72	mg/Kg		ENS-001
Sta 22	24-Sep-98	Silt	12.5	%		ENS-001
Sta 22	24-Sep-98	Silt	3.75	%		ENS-001
Sta 22	24-Sep-98	Clay	1.25	%		ENS-001
Sta 22	24-Sep-98	Ni	1	mg/Kg		ENS-001
Sta 22	24-Sep-98	Clay	3.75	%		ENS-001
Sta 23	22-Sep-98	Cu	10.4	mg/Kg		ENS-001
Sta 23	22-Sep-98	Silt	28.75	%		ENS-001
Sta 23	22-Sep-98	Pb	200	mg/Kg		ENS-001
Sta 23	22-Sep-98	Silt	4.37	%		ENS-001
Sta 23	22-Sep-98	Ni	3.5	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cu	16.2	mg/Kg		ENS-001
Sta 23	22-Sep-98	Pb	3	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cu	10.4	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cu	16.2	mg/Kg		ENS-001
Sta 23	22-Sep-98	Ni	10.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Ni	13.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Fe	25400	mg/Kg		ENS-001
Sta 23	22-Sep-98	Ni	3.5	mg/Kg		ENS-001
Sta 23	22-Sep-98	Fe	43300	mg/Kg		ENS-001
Sta 23	22-Sep-98	Moisture Content	45.4	%		ENS-001
Sta 23	22-Sep-98	Sand	88.13	%		ENS-001
Sta 23	22-Sep-98	Sand	41.25	%		ENS-001
Sta 23	22-Sep-98	Mn	684	mg/Kg		ENS-001
Sta 23	22-Sep-98	Pb	3	mg/Kg		ENS-001
Sta 23	22-Sep-98	Pb	200	mg/Kg		ENS-001
Sta 23	22-Sep-98	Ni	10.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Mn	646	mg/Kg		ENS-001
Sta 23	22-Sep-98	Moisture Content	17.1	%		ENS-001
Sta 23	22-Sep-98	Ni	17.7	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cr	15.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Al	7320	mg/Kg		ENS-001
Sta 23	22-Sep-98	Al	16200	mg/Kg		ENS-001
Sta 23	22-Sep-98	Clay	7.5	%		ENS-001
Sta 23	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Zn	7.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Zn	60.8	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cr	17.9	mg/Kg		ENS-001
Sta 23	22-Sep-98	S	8.9	umoles		ENS-001
Sta 23	22-Sep-98	Zn	35.2	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cd	0.1	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 23	22-Sep-98	Coarse Grain	0.8	%		ENS-001
Sta 23	22-Sep-98	Zn	7.1	mg/Kg		ENS-001
Sta 23	22-Sep-98	Zn	10.8	mg/Kg		ENS-001
Sta 23	22-Sep-98	TOC	1.14	%		ENS-001
Sta 23	22-Sep-98	TOC	0.37	%		ENS-001
Sta 23	22-Sep-98	Clay	30	%		ENS-001
Sta 23	22-Sep-98	Zn	10.8	mg/Kg		ENS-001
Sta 23	22-Sep-98	S	17.8	umoles		ENS-001
Sta 23	22-Sep-98	AVS	0.88	umoles/g		ENS-001
Sta 23	22-Sep-98	As	96.5	mg/Kg		ENS-001
Sta 23	22-Sep-98	Coarse Grain	58.4	%		ENS-001
Sta 23	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 7	ENS-001
Sta 23	24-Sep-98	Percent Survival of Hyalella azteca	92	%	Sediment Toxicity Test,Site 7	ENS-001
Sta 23	22-Sep-98	AVS	1.8	umoles/g		ENS-001
Sta 23	22-Sep-98	As	66.8	mg/Kg		ENS-001
Sta 23	22-Sep-98	Cu	55.9	mg/Kg		ENS-001
Sta 23	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 7	ENS-001
Sta 23	22-Sep-98	Cu	33.9	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cu	10.2	mg/Kg		ENS-001
Sta 24	22-Sep-98	Pb	2	mg/Kg		ENS-001
Sta 24	22-Sep-98	As	8	mg/Kg		ENS-001
Sta 24	22-Sep-98	Pb	1.5	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cu	2.3	mg/Kg		ENS-001
Sta 24	22-Sep-98	Silt	57.5	%		ENS-001
Sta 24	22-Sep-98	As	8.2	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cd	0.082	mg/Kg		ENS-001
Sta 24	22-Sep-98	Clay	33.12	%		ENS-001
Sta 24	22-Sep-98	Silt	16.87	%		ENS-001
Sta 24	22-Sep-98	Zn	5.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cu	2.9	mg/Kg		ENS-001
Sta 24	22-Sep-98	Clay	6.25	%		ENS-001
Sta 24	22-Sep-98	Zn	6.4	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cu	2.9	mg/Kg		ENS-001
Sta 24	22-Sep-98	Clay	5.62	%		ENS-001
Sta 24	22-Sep-98	Cu	2.3	mg/Kg		ENS-001
Sta 24	22-Sep-98	Sand	9.38	%		ENS-001
Sta 24	22-Sep-98	AVS	1.08			ENS-001
Sta 24	22-Sep-98	Sand	77.51	%		ENS-001
Sta 24	22-Sep-98	Ni	6.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Ni	8.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Al	7260	mg/Kg		ENS-001
Sta 24	22-Sep-98	Al	7930	mg/Kg		ENS-001
Sta 24	22-Sep-98	Ni	1.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Ni	1.5	mg/Kg		ENS-001
Sta 24	22-Sep-98	Ni	10.6	mg/Kg		ENS-001
Sta 24	22-Sep-98	Ni	5.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Zn	55.9	mg/Kg		ENS-001
Sta 24	22-Sep-98	AVS	0.65	umoles/g		ENS-001
Sta 24	22-Sep-98	Zn	33.8	mg/Kg		ENS-001
Sta 24	22-Sep-98	Zn	38.4	mg/Kg		ENS-001
Sta 24	22-Sep-98	AVS	0.83	umoles/g		ENS-001
Sta 24	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Sand	86.88	%		ENS-001
Sta 24	22-Sep-98	As	6.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Al	16400	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cr	15.6	mg/Kg		ENS-001
Sta 24	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 6	ENS-001
Sta 24	22-Sep-98	S	8.1	umoles		ENS-001
Sta 24	22-Sep-98	Pb	1.5	mg/Kg		ENS-001
Sta 24	22-Sep-98	Moisture Content	66.13	%		ENS-001
Sta 24	22-Sep-98	Moisture Content	15	%		ENS-001
Sta 24	22-Sep-98	Cu	26.7	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 24	22-Sep-98	Moisture Content	43.4	%		ENS-001
Sta 24	22-Sep-98	Mn	475	mg/Kg		ENS-001
Sta 24	22-Sep-98	Pb	2	mg/Kg		ENS-001
Sta 24	22-Sep-98	S	6.5	umoles		ENS-001
Sta 24	22-Sep-98	Fe	20600	mg/Kg		ENS-001
Sta 24	22-Sep-98	Zn	5.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Silt	6.87	%		ENS-001
Sta 24	22-Sep-98	S	3.6	umoles		ENS-001
Sta 24	22-Sep-98	Cr	11.1	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cr	12	mg/Kg		ENS-001
Sta 24	22-Sep-98	Fe	12000	mg/Kg		ENS-001
Sta 24	22-Sep-98	Fe	13600	mg/Kg		ENS-001
Sta 24	22-Sep-98	Zn	12.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Mn	361	mg/Kg		ENS-001
Sta 24	22-Sep-98	Cu	11.9	mg/Kg		ENS-001
Sta 24	22-Sep-98	Coarse Grain	0	%		ENS-001
Sta 24	22-Sep-98	Ni	1.5	mg/Kg		ENS-001
Sta 24	24-Sep-98	Percent Survival of Hyalella azteca	98	%	Sediment Toxicity Test,Site 6	ENS-001
Sta 24	22-Sep-98	TOC	1.83	%		ENS-001
Sta 24	22-Sep-98	TOC	0.4	%		ENS-001
Sta 24	22-Sep-98	TOC	1.28	%		ENS-001
Sta 24	22-Sep-98	Ni	1.7	mg/Kg		ENS-001
Sta 24	22-Sep-98	Pb	7.6	mg/Kg		ENS-001
Sta 24	22-Sep-98	Zn	6.4	mg/Kg		ENS-001
Sta 24	22-Sep-98	Mn	809	mg/Kg		ENS-001
Sta 24	24-Sep-98	Percent Survival of Hyalella azteca	89	%	Sediment Toxicity Test,Site 6	ENS-001
Sta 24	22-Sep-98	Coarse Grain	4.6	%		ENS-001
Sta 24	22-Sep-98	Coarse Grain	65.6	%		ENS-001
Sta 24	22-Sep-98	Cu	14.5	mg/Kg		ENS-001
Sta 25	22-Sep-98	Ni	44	mg/Kg		ENS-001
Sta 25	22-Sep-98	Al	8520	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	75.5	mg/Kg		ENS-001
Sta 25	22-Sep-98	Moisture Content	33.4	%		ENS-001
Sta 25	24-Sep-98	Percent Survival of Hyalella azteca	0	%	Sediment Toxicity Test,Site 5	ENS-001
Sta 25	22-Sep-98	Moisture Content	18.4	%		ENS-001
Sta 25	22-Sep-98	As	163	mg/Kg		ENS-001
Sta 25	22-Sep-98	Ni	88.8	mg/Kg		ENS-001
Sta 25	22-Sep-98	Ni	65.2	mg/Kg		ENS-001
Sta 25	22-Sep-98	Ni	44	mg/Kg		ENS-001
Sta 25	24-Sep-98	Percent Survival of Hyalella azteca	1	%	Sediment Toxicity Test,Site 5	ENS-001
Sta 25	22-Sep-98	Ni	18.4	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	138	mg/Kg		ENS-001
Sta 25	22-Sep-98	As	82.5	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	11.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cu	161	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	17.8	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cu	11.2	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cu	22.6	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	17.8	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	11.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	TOC	0.12	%		ENS-001
Sta 25	22-Sep-98	Mn	2890	mg/Kg		ENS-001
Sta 25	22-Sep-98	TOC	0.23	%		ENS-001
Sta 25	22-Sep-98	S	12.1	umoles		ENS-001
Sta 25	22-Sep-98	Cu	22.6	mg/Kg		ENS-001
Sta 25	22-Sep-98	Al	9840	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	56	mg/Kg		ENS-001
Sta 25	22-Sep-98	TOC	1.79	%		ENS-001
Sta 25	22-Sep-98	Mn	1480	mg/Kg		ENS-001
Sta 25	22-Sep-98	Mn	1130	mg/Kg		ENS-001
Sta 25	22-Sep-98	Ni	121	mg/Kg		ENS-001
Sta 25	22-Sep-98	Zn	56	mg/Kg		ENS-001
Sta 25	22-Sep-98	S	8.1	umoles		ENS-001
Sta 25	22-Sep-98	S	6.5	umoles		ENS-001
Sta 25	22-Sep-98	Al	23300	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 25	22-Sep-98	Moisture Content	77.02	%		ENS-001
Sta 25	22-Sep-98	Ni	203	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cu	11.2	mg/Kg		ENS-001
Sta 25	22-Sep-98	Coarse Grain	2.5	%		ENS-001
Sta 25	22-Sep-98	Pb	1.7	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	Clay	23.12	%		ENS-001
Sta 25	22-Sep-98	Sand	13.76	%		ENS-001
Sta 25	22-Sep-98	Clay	5	%		ENS-001
Sta 25	22-Sep-98	Coarse Grain	59.9	%		ENS-001
Sta 25	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cu	43.5	mg/Kg		ENS-001
Sta 25	22-Sep-98	Pb	2.7	mg/Kg		ENS-001
Sta 25	22-Sep-98	Pb	6.9	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cd	0.1	mg/Kg		ENS-001
Sta 25	22-Sep-98	Fe	55700	mg/Kg		ENS-001
Sta 25	22-Sep-98	As	85.3	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cd	0.46	mg/Kg		ENS-001
Sta 25	22-Sep-98	Pb	1.7	mg/Kg		ENS-001
Sta 25	22-Sep-98	Pb	2.7	mg/Kg		ENS-001
Sta 25	22-Sep-98	Coarse Grain	0	%		ENS-001
Sta 25	22-Sep-98	Silt	6.87	%		ENS-001
Sta 25	22-Sep-98	Silt	3.75	%		ENS-001
Sta 25	22-Sep-98	Clay	9.37	%		ENS-001
Sta 25	22-Sep-98	Cu	57.6	mg/Kg		ENS-001
Sta 25	22-Sep-98	AVS	2.68			ENS-001
Sta 25	22-Sep-98	Silt	63.12	%		ENS-001
Sta 25	22-Sep-98	Cu	91	mg/Kg		ENS-001
Sta 25	22-Sep-98	Fe	25300	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cr	15.7	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cr	18.3	mg/Kg		ENS-001
Sta 25	22-Sep-98	AVS	1.24	umoles/g		ENS-001
Sta 25	22-Sep-98	Ni	18.4	mg/Kg		ENS-001
Sta 25	22-Sep-98	AVS	0.8	umoles/g		ENS-001
Sta 25	22-Sep-98	Sand	91.25	%		ENS-001
Sta 25	22-Sep-98	Sand	83.76	%		ENS-001
Sta 25	22-Sep-98	Fe	23400	mg/Kg		ENS-001
Sta 25	22-Sep-98	Cr	27	mg/Kg		ENS-001
Sta 26	23-Sep-98	S	13.7	umoles		ENS-001
Sta 26	23-Sep-98	Ni	121	mg/Kg		ENS-001
Sta 26	23-Sep-98	Coarse Grain	0	%		ENS-001
Sta 26	23-Sep-98	Silt	0.62	%		ENS-001
Sta 26	23-Sep-98	Silt	13.12	%		ENS-001
Sta 26	23-Sep-98	Zn	57.3	mg/Kg		ENS-001
Sta 26	23-Sep-98	Ni	20.7	mg/Kg		ENS-001
Sta 26	23-Sep-98	S	16.9	umoles		ENS-001
Sta 26	23-Sep-98	Mn	1380	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cu	172	mg/Kg		ENS-001
Sta 26	23-Sep-98	Moisture Content	46.86	%		ENS-001
Sta 26	23-Sep-98	Moisture Content	81.65	%		ENS-001
Sta 26	23-Sep-98	Cr	9	mg/Kg		ENS-001
Sta 26	23-Sep-98	Mn	485	mg/Kg		ENS-001
Sta 26	23-Sep-98	Coarse Grain	0.63	%		ENS-001
Sta 26	23-Sep-98	Fe	13600	mg/Kg		ENS-001
Sta 26	23-Sep-98	Coarse Grain	59.96	%		ENS-001
Sta 26	23-Sep-98	Mn	3330	mg/Kg		ENS-001
Sta 26	23-Sep-98	Moisture Content	13.94	%		ENS-001
Sta 26	23-Sep-98	TOC	3.21	%		ENS-001
Sta 26	23-Sep-98	Cr	29.3	mg/Kg		ENS-001
Sta 26	23-Sep-98	S	13.7	umoles		ENS-001
Sta 26	23-Sep-98	Cr	15.1	mg/Kg		ENS-001
Sta 26	23-Sep-98	Pb	7	mg/Kg		ENS-001
Sta 26	23-Sep-98	TOC	0.11	%		ENS-001
Sta 26	23-Sep-98	TOC	2.12	%		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 26	23-Sep-98	Fe	21300	mg/Kg		ENS-001
Sta 26	23-Sep-98	As	44.8	mg/Kg		ENS-001
Sta 26	23-Sep-98	Sand	99.38	%		ENS-001
Sta 26	23-Sep-98	AVS	1.56			ENS-001
Sta 26	23-Sep-98	Clay	0	%		ENS-001
Sta 26	23-Sep-98	Ni	328	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cu	60.8	mg/Kg		ENS-001
Sta 26	23-Sep-98	Al	10200	mg/Kg		ENS-001
Sta 26	23-Sep-98	Al	6360	mg/Kg		ENS-001
Sta 26	23-Sep-98	AVS	3.11			ENS-001
Sta 26	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 8	ENS-001
Sta 26	23-Sep-98	Al	22400	mg/Kg		ENS-001
Sta 26	23-Sep-98	Sand	83.76	%		ENS-001
Sta 26	23-Sep-98	Cu	51.8	mg/Kg		ENS-001
Sta 26	23-Sep-98	As	150	mg/Kg		ENS-001
Sta 26	23-Sep-98	AVS	7.22			ENS-001
Sta 26	23-Sep-98	Silt	66.25	%		ENS-001
Sta 26	23-Sep-98	Ni	31.1	mg/Kg		ENS-001
Sta 26	23-Sep-98	Ni	118	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cu	111	mg/Kg		ENS-001
Sta 26	24-Sep-98	Percent Survival of Hyalella azteca	95	%	Sediment Toxicity Test,Site 8	ENS-001
Sta 26	23-Sep-98	As	68.7	mg/Kg		ENS-001
Sta 26	24-Sep-98	Percent Survival of Hyalella azteca	99	%	Sediment Toxicity Test,Site 8	ENS-001
Sta 26	23-Sep-98	Cu	28.5	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cd	0.98	mg/Kg		ENS-001
Sta 26	23-Sep-98	Zn	181	mg/Kg		ENS-001
Sta 26	23-Sep-98	Clay	13.75	%		ENS-001
Sta 26	23-Sep-98	Zn	14.8	mg/Kg		ENS-001
Sta 26	23-Sep-98	Zn	114	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cd	0.32	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cd	0.031	mg/Kg		ENS-001
Sta 26	23-Sep-98	Fe	43600	mg/Kg		ENS-001
Sta 26	23-Sep-98	Zn	79.9	mg/Kg		ENS-001
Sta 26	23-Sep-98	Zn	45.3	mg/Kg		ENS-001
Sta 26	23-Sep-98	Ni	215	mg/Kg		ENS-001
Sta 26	23-Sep-98	Cu	11.4	mg/Kg		ENS-001
Sta 26	23-Sep-98	Pb	4.1	mg/Kg		ENS-001
Sta 26	23-Sep-98	Pb	2.1	mg/Kg		ENS-001
Sta 26	23-Sep-98	Sand	20	%		ENS-001
Sta 26	23-Sep-98	Clay	3.12	%		ENS-001
Sta 29	23-Sep-98	Cu	35	mg/Kg		ENS-001
Sta 29	23-Sep-98	Cu	25.8	mg/Kg		ENS-001
Sta 29	23-Sep-98	Cu	13.1	mg/Kg		ENS-001
Sta 29	23-Sep-98	Zn	7.5	mg/Kg		ENS-001
Sta 29	23-Sep-98	Fe	17600	mg/Kg		ENS-001
Sta 29	24-Sep-98	Percent Survival of Hyalella azteca	100	%	Sediment Toxicity Test,Site 10	ENS-001
Sta 29	23-Sep-98	Zn	18.8	mg/Kg		ENS-001
Sta 29	23-Sep-98	Cu	7.6	mg/Kg		ENS-001
Sta 29	23-Sep-98	Moisture Content	30.7	%		ENS-001
Sta 29	23-Sep-98	Moisture Content	21	%		ENS-001
Sta 29	24-Sep-98	Percent Survival of Hyalella azteca	99	%	Sediment Toxicity Test,Site 10	ENS-001
Sta 29	23-Sep-98	Fe	16800	mg/Kg		ENS-001
Sta 29	23-Sep-98	Sand	78.75	%		ENS-001
Sta 29	23-Sep-98	Coarse Grain	49	%		ENS-001
Sta 29	23-Sep-98	Cd	0.17	mg/Kg		ENS-001
Sta 29	23-Sep-98	Pb	1.8	mg/Kg		ENS-001
Sta 29	23-Sep-98	Pb	1.1	mg/Kg		ENS-001
Sta 29	23-Sep-98	Al	8570	mg/Kg		ENS-001
Sta 29	23-Sep-98	Zn	60.5	mg/Kg		ENS-001
Sta 29	23-Sep-98	AVS	0.35			ENS-001
Sta 29	23-Sep-98	Cd	0.054	mg/Kg		ENS-001
Sta 29	23-Sep-98	Sand	95	%		ENS-001
Sta 29	23-Sep-98	AVS	4.79			ENS-001
Sta 29	23-Sep-98	Ni	27.8	mg/Kg		ENS-001
Sta 29	23-Sep-98	Ni	49.9	mg/Kg		ENS-001

Sediment Quality
Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Sta 29	23-Sep-98	As	54.2	mg/Kg		ENS-001
Sta 29	23-Sep-98	As	34.7	mg/Kg		ENS-001
Sta 29	23-Sep-98	Al	6770	mg/Kg		ENS-001
Sta 29	23-Sep-98	TOC	1.79	%		ENS-001
Sta 29	23-Sep-98	S	0	umoles		ENS-001
Sta 29	23-Sep-98	Cr	7.5	mg/Kg		ENS-001
Sta 29	23-Sep-98	Cr	12.8	mg/Kg		ENS-001
Sta 29	23-Sep-98	Ni	22.3	mg/Kg		ENS-001
Sta 29	23-Sep-98	Ni	11.9	mg/Kg		ENS-001
Sta 29	23-Sep-98	Zn	38.7	mg/Kg		ENS-001
Sta 29	23-Sep-98	Mn	479	mg/Kg		ENS-001
Sta 29	23-Sep-98	S	33.9	umoles		ENS-001
Sta 29	23-Sep-98	TOC	0.56	%		ENS-001
Sta 29	23-Sep-98	Coarse Grain	31.24	%		ENS-001
Sta 29	23-Sep-98	Silt	15	%		ENS-001
Sta 29	23-Sep-98	Silt	2.5	%		ENS-001
Sta 29	23-Sep-98	Clay	2.5	%		ENS-001
Sta 29	23-Sep-98	Clay	6.25	%		ENS-001
Sta 29	23-Sep-98	Mn	486	mg/Kg		ENS-001

Notes:

Informaton obtained from database source code ENS-001 within the project database. The original source was from *Data Report for the Leviathan Mine Study Area Water and Sediment Toxicity and Benthic Community Data. September 1998 Assessment.* By ENSR (1999).

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, S = Sulfur, Zn = Zinc, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, DO = dissolved oxygen, DOC = dissolved organic carbon, TSS = total suspended solids. TOC = total organic carbon, AVS = acid volatile sulfide

Dis = dissolved, SpC = specific conductance, uS/cm = microseimens per centimeter, ppm = parts per million, mg/L = milligrams per liter, mg/Kg = milligrams per kilogram, umoles = micromoles, % = percentage

Surface Water Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
BC-BRC	9/23/1998	Al	0.0439	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Al	1.6	mg/L	Total	ENS-001
BC-BRC	9/23/1998	As	0.0041	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	As	0.0094	mg/L	Total	ENS-001
BC-BRC	9/23/1998	Cr	0.0092	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Cr	0.0092	mg/L	Total	ENS-001
BC-BRC	9/23/1998	Cu	0.002	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Cu	0.0142	mg/L	Total	ENS-001
BC-BRC	9/23/1998	DO	8.8	mg/L	Field	ENS-001
BC-BRC	9/23/1998	DOC	1.8	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Fe	0.0181	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Fe	2.18	mg/L	Total	ENS-001
BC-BRC	9/23/1998	Mn	0.794	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Mn	0.802	mg/L	Total	ENS-001
BC-BRC	9/23/1998	Ni	0.0555	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Ni	0.0616	mg/L	Total	ENS-001
BC-BRC	9/23/1998	pH	8.1	su	Field	ENS-001
BC-BRC	9/23/1998	TDS	239	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Temp	11.5	C	Field	ENS-001
BC-BRC	9/23/1998	TOC	1.2	mg/L	Total	ENS-001
BC-BRC	9/23/1998	TSS	13	mg/L	Total	ENS-001
BC-BRC	9/23/1998	Zn	0.0081	mg/L	Dis	ENS-001
BC-BRC	9/23/1998	Zn	0.051	mg/L	Total	ENS-001
BC-BRC	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
BC-BRC	10/1/1998	Water Toxicity Test	30	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
BC-BRC	10/1/1998	Water Toxicity Test	90	%	Percent Survival of Ceriodaphnia dubia, 12.5	ENS-001
BC-BRC	10/1/1998	Water Toxicity Test	90	%	Percent Survival of Ceriodaphnia dubia, 25	ENS-001
BC-BRC	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 50	ENS-001
BC-BRC	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 6.25	ENS-001
EFC 1	9/23/1998	Al	0.0392	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Al	0.0617	mg/L	Total	ENS-001
EFC 1	9/23/1998	As	0.0084	mg/L	Total	ENS-001
EFC 1	9/23/1998	As	0.0088	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Cr	0.0092	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Cr	0.0092	mg/L	Total	ENS-001
EFC 1	9/23/1998	Cu	0.002	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Cu	0.0023	mg/L	Total	ENS-001
EFC 1	9/23/1998	DO	8.8	mg/L	Field	ENS-001
EFC 1	9/23/1998	DOC	0.5	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Fe	0.035	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Fe	0.14	mg/L	Total	ENS-001
EFC 1	9/23/1998	Mn	0.0141	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Mn	0.0241	mg/L	Total	ENS-001
EFC 1	9/23/1998	Ni	0.0193	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Ni	0.0193	mg/L	Total	ENS-001
EFC 1	9/23/1998	pH	7.5	su	Field	ENS-001
EFC 1	9/23/1998	TDS	80	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Temp	12.5	C	Field	ENS-001
EFC 1	9/23/1998	TOC	0.8	mg/L	Total	ENS-001
EFC 1	9/23/1998	TSS	4	mg/L	Total	ENS-001
EFC 1	9/23/1998	Zn	0.0071	mg/L	Dis	ENS-001
EFC 1	9/23/1998	Zn	0.0071	mg/L	Total	ENS-001
EFC 1	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
EFC 1	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
EFC 2	9/23/1998	Al	0.0392	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Al	0.0492	mg/L	Total	ENS-001
EFC 2	9/23/1998	As	0.0061	mg/L	Total	ENS-001
EFC 2	9/23/1998	As	0.009	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Cr	0.0092	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Cr	0.0092	mg/L	Total	ENS-001
EFC 2	9/23/1998	Cu	0.0026	mg/L	Total	ENS-001
EFC 2	9/23/1998	Cu	0.0029	mg/L	Dis	ENS-001
EFC 2	9/23/1998	DO	8.8	mg/L	Field	ENS-001
EFC 2	9/23/1998	DOC	0.9	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Fe	0.049	mg/L	Dis	ENS-001

EFC 2	9/23/1998	Fe	0.133	mg/L	Total	ENS-001
EFC 2	9/23/1998	Mn	0.0161	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Mn	0.0241	mg/L	Total	ENS-001
EFC 2	9/23/1998	Ni	0.0193	mg/L	Total	ENS-001
EFC 2	9/23/1998	Ni	0.0205	mg/L	Dis	ENS-001
EFC 2	9/23/1998	pH	7.5	su	Field	ENS-001
EFC 2	9/23/1998	TDS	76	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Temp	14	C	Field	ENS-001
EFC 2	9/23/1998	TOC	0.5	mg/L	Total	ENS-001
EFC 2	9/23/1998	TSS	4	mg/L	Total	ENS-001
EFC 2	9/23/1998	Zn	0.0071	mg/L	Dis	ENS-001
EFC 2	9/23/1998	Zn	0.0071	mg/L	Total	ENS-001
EFC 2	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
EFC 2	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
EFC-Riverview	9/21/1998	Al	0.0392	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Al	0.0717	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	As	0.0071	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	As	0.0079	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Cr	0.0092	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Cr	0.0092	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	Cu	0.002	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	Cu	0.0022	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	DO	6.4	mg/L	Field	ENS-001
EFC-Riverview	9/21/1998	DOC	0.5	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Fe	0.028	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Fe	0.14	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	Mn	0.008	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Mn	0.0141	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	Ni	0.0193	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Ni	0.0193	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	pH	8	su	Field	ENS-001
EFC-Riverview	9/21/1998	TDS	81	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Temp	18	C	Field	ENS-001
EFC-Riverview	9/21/1998	TOC	0.5	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	TSS	4	mg/L	Total	ENS-001
EFC-Riverview	9/21/1998	Zn	0.0071	mg/L	Dis	ENS-001
EFC-Riverview	9/21/1998	Zn	0.0071	mg/L	Total	ENS-001
EFC-Riverview	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
EFC-Riverview	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
EFC-Ruhen	9/22/1998	Al	0.0392	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Al	0.0937	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	As	0.0084	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	As	0.0104	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	Cr	0.0092	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Cr	0.0092	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	Cu	0.002	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Cu	0.002	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	DO	7.2	mg/L	Field	ENS-001
EFC-Ruhen	9/22/1998	DOC	1.2	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Fe	0.0412	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Fe	0.165	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	Mn	0.0041	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Mn	0.0102	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	Ni	0.0193	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Ni	0.0193	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	pH	8	su	Field	ENS-001
EFC-Ruhen	9/22/1998	TDS	107	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Temp	12	C	Field	ENS-001
EFC-Ruhen	9/22/1998	TOC	1.2	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	TSS	4	mg/L	Total	ENS-001
EFC-Ruhen	9/22/1998	Zn	0.0071	mg/L	Dis	ENS-001
EFC-Ruhen	9/22/1998	Zn	0.0071	mg/L	Total	ENS-001
EFC-Ruhen	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
EFC-Ruhen	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 1	9/24/1998	Al	0.0392	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Al	0.0407	mg/L	Total	ENS-001
Sta 1	9/24/1998	As	0.0036	mg/L	Dis	ENS-001
Sta 1	9/24/1998	As	0.0064	mg/L	Total	ENS-001

Sta 1	9/24/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 1	9/24/1998	Cu	0.002	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Cu	0.002	mg/L	Total	ENS-001
Sta 1	9/24/1998	DO	7.5	mg/L	Field	ENS-001
Sta 1	9/24/1998	DOC	2.2	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Fe	0.0549	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Fe	0.144	mg/L	Total	ENS-001
Sta 1	9/24/1998	Mn	0.0082	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Mn	0.0102	mg/L	Total	ENS-001
Sta 1	9/24/1998	Ni	0.0193	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Ni	0.0193	mg/L	Total	ENS-001
Sta 1	9/24/1998	pH	7.9	su	Field	ENS-001
Sta 1	9/24/1998	TDS	118	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Temp	9	C	Field	ENS-001
Sta 1	9/24/1998	TOC	2.2	mg/L	Total	ENS-001
Sta 1	9/24/1998	TSS	4	mg/L	Total	ENS-001
Sta 1	9/24/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 1	9/24/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 1	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 1	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 15	9/24/1998	Al	0.659	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Al	0.74	mg/L	Total	ENS-001
Sta 15	9/24/1998	Al	1.29	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Al	1.43	mg/L	Total	ENS-001
Sta 15	9/24/1998	Al	2.7	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Al	2.96	mg/L	Total	ENS-001
Sta 15	9/24/1998	Al	5.37	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Al	6	mg/L	Total	ENS-001
Sta 15	9/24/1998	Al	10	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Al	11.4	mg/L	Total	ENS-001
Sta 15	9/24/1998	As	0.0047	mg/L	Dis	ENS-001
Sta 15	9/24/1998	As	0.0066	mg/L	Dis	ENS-001
Sta 15	9/24/1998	As	0.0096	mg/L	Total	ENS-001
Sta 15	9/24/1998	As	0.0118	mg/L	Total	ENS-001
Sta 15	9/24/1998	As	0.0149	mg/L	Dis	ENS-001
Sta 15	9/24/1998	As	0.0178	mg/L	Total	ENS-001
Sta 15	9/24/1998	As	0.0248	mg/L	Dis	ENS-001
Sta 15	9/24/1998	As	0.031	mg/L	Total	ENS-001
Sta 15	9/24/1998	As	0.0605	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cr	0.0103	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.002	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.0031	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Cu	0.0034	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Cu	0.0034	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.0044	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Cu	0.0044	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.0053	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Cu	0.0059	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.0108	mg/L	Total	ENS-001
Sta 15	9/24/1998	Cu	0.0111	mg/L	Dis	ENS-001
Sta 15	9/24/1998	DO	7.7	mg/L	Field	ENS-001
Sta 15	9/24/1998	DOC	1.4	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	2.83	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	3.8	mg/L	Total	ENS-001
Sta 15	9/24/1998	Fe	5.56	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	7.28	mg/L	Total	ENS-001
Sta 15	9/24/1998	Fe	11.4	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	14.9	mg/L	Total	ENS-001
Sta 15	9/24/1998	Fe	22.5	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	29.9	mg/L	Total	ENS-001
Sta 15	9/24/1998	Fe	42.7	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Fe	59	mg/L	Total	ENS-001
Sta 15	9/24/1998	Mn	0.418	mg/L	Total	ENS-001
Sta 15	9/24/1998	Mn	0.429	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Mn	0.816	mg/L	Total	ENS-001

Sta 15	9/24/1998	Mn	0.825	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Mn	1.67	mg/L	Total	ENS-001
Sta 15	9/24/1998	Mn	1.69	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Mn	3.33	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Mn	3.33	mg/L	Total	ENS-001
Sta 15	9/24/1998	Mn	6.3	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Mn	6.51	mg/L	Total	ENS-001
Sta 15	9/24/1998	Ni	0.0419	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Ni	0.0512	mg/L	Total	ENS-001
Sta 15	9/24/1998	Ni	0.077	mg/L	Total	ENS-001
Sta 15	9/24/1998	Ni	0.0862	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Ni	0.138	mg/L	Total	ENS-001
Sta 15	9/24/1998	Ni	0.167	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Ni	0.297	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Ni	0.312	mg/L	Total	ENS-001
Sta 15	9/24/1998	Ni	0.535	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Ni	0.584	mg/L	Total	ENS-001
Sta 15	9/24/1998	pH	3.9	su	Field	ENS-001
Sta 15	9/24/1998	TDS	923	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Temp	9.5	C	Field	ENS-001
Sta 15	9/24/1998	TOC	2.2	mg/L	Total	ENS-001
Sta 15	9/24/1998	TSS	100	mg/L	Total	ENS-001
Sta 15	9/24/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 15	9/24/1998	Zn	0.0092	mg/L	Total	ENS-001
Sta 15	9/24/1998	Zn	0.0106	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Zn	0.0194	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Zn	0.031	mg/L	Total	ENS-001
Sta 15	9/24/1998	Zn	0.0319	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Zn	0.0477	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Zn	0.0648	mg/L	Total	ENS-001
Sta 15	9/24/1998	Zn	0.104	mg/L	Dis	ENS-001
Sta 15	9/24/1998	Zn	0.113	mg/L	Total	ENS-001
Sta 15	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 15	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 12.5 Percent	ENS-001
Sta 15	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 25 Percent	ENS-001
Sta 15	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 50 Percent	ENS-001
Sta 15	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 6.25 Percent	ENS-001
Sta 15	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 15	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 12.5	ENS-001
Sta 15	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 25	ENS-001
Sta 15	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 50	ENS-001
Sta 15	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 6.25	ENS-001
Sta 16	9/24/1998	Al	0.473	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Al	2.13	mg/L	Total	ENS-001
Sta 16	9/24/1998	As	0.0049	mg/L	Dis	ENS-001
Sta 16	9/24/1998	As	0.006	mg/L	Total	ENS-001
Sta 16	9/24/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 16	9/24/1998	Cu	0.0598	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Cu	0.0657	mg/L	Total	ENS-001
Sta 16	9/24/1998	DO	8.2	mg/L	Field	ENS-001
Sta 16	9/24/1998	DOC	0.5	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Fe	0.0412	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Fe	0.117	mg/L	Total	ENS-001
Sta 16	9/24/1998	Mn	1.61	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Mn	1.62	mg/L	Total	ENS-001
Sta 16	9/24/1998	Ni	0.0639	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Ni	0.0685	mg/L	Total	ENS-001
Sta 16	9/24/1998	pH	5.8	su	Field	ENS-001
Sta 16	9/24/1998	TDS	440	mg/L	Dis	ENS-001
Sta 16	9/24/1998	Temp	9.5	C	Field	ENS-001
Sta 16	9/24/1998	TOC	0.9	mg/L	Total	ENS-001
Sta 16	9/24/1998	TSS	5	mg/L	Total	ENS-001
Sta 16	9/24/1998	Zn	0.0647	mg/L	Total	ENS-001
Sta 16	9/24/1998	Zn	0.0743	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Al	0.0392	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Al	0.0392	mg/L	Total	ENS-001
Sta 22	9/24/1998	As	0.0016	mg/L	Dis	ENS-001

Sta 22	9/24/1998	As	0.0032	mg/L	Total	ENS-001
Sta 22	9/24/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 22	9/24/1998	Cu	0.002	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Cu	0.002	mg/L	Total	ENS-001
Sta 22	9/24/1998	DO	6.6	mg/L	Field	ENS-001
Sta 22	9/24/1998	DOC	0.7	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Fe	0.0181	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Fe	0.0686	mg/L	Total	ENS-001
Sta 22	9/24/1998	Mn	0.0036	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Mn	0.0082	mg/L	Total	ENS-001
Sta 22	9/24/1998	Ni	0.0193	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Ni	0.0193	mg/L	Total	ENS-001
Sta 22	9/24/1998	pH	7.7	su	Field	ENS-001
Sta 22	9/24/1998	TDS	113	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Temp	12	C	Field	ENS-001
Sta 22	9/24/1998	TOC	0.7	mg/L	Total	ENS-001
Sta 22	9/24/1998	TSS	5	mg/L	Total	ENS-001
Sta 22	9/24/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 22	9/24/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 22	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 22	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 23	9/22/1998	Al	0.381	mg/L	Total	ENS-001
Sta 23	9/22/1998	Al	0.387	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Al	0.711	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Al	0.72	mg/L	Total	ENS-001
Sta 23	9/22/1998	Al	1.51	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Al	1.52	mg/L	Total	ENS-001
Sta 23	9/22/1998	Al	3	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Al	3.02	mg/L	Total	ENS-001
Sta 23	9/22/1998	Al	6.05	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Al	6.09	mg/L	Total	ENS-001
Sta 23	9/22/1998	As	0.0016	mg/L	Total	ENS-001
Sta 23	9/22/1998	As	0.002	mg/L	Total	ENS-001
Sta 23	9/22/1998	As	0.0025	mg/L	Total	ENS-001
Sta 23	9/22/1998	As	0.0031	mg/L	Dis	ENS-001
Sta 23	9/22/1998	As	0.0035	mg/L	Dis	ENS-001
Sta 23	9/22/1998	As	0.0036	mg/L	Dis	ENS-001
Sta 23	9/22/1998	As	0.0036	mg/L	Total	ENS-001
Sta 23	9/22/1998	As	0.0037	mg/L	Dis	ENS-001
Sta 23	9/22/1998	As	0.0044	mg/L	Dis	ENS-001
Sta 23	9/22/1998	As	0.0083	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.0059	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Cu	0.0065	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.0067	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.0083	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Cu	0.012	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.0132	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Cu	0.0224	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.023	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Cu	0.0401	mg/L	Total	ENS-001
Sta 23	9/22/1998	Cu	0.0411	mg/L	Dis	ENS-001
Sta 23	9/22/1998	DO	7.3	mg/L	Field	ENS-001
Sta 23	9/22/1998	DOC	0.5	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	0.336	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	0.434	mg/L	Total	ENS-001
Sta 23	9/22/1998	Fe	0.637	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	0.812	mg/L	Total	ENS-001
Sta 23	9/22/1998	Fe	1.35	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	1.81	mg/L	Total	ENS-001
Sta 23	9/22/1998	Fe	2.71	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	3.79	mg/L	Total	ENS-001
Sta 23	9/22/1998	Fe	5.72	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Fe	8.67	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	0.249	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	0.251	mg/L	Dis	ENS-001

Sta 23	9/22/1998	Mn	0.454	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Mn	0.468	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	0.957	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	0.973	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Mn	1.9	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Mn	1.9	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	3.72	mg/L	Total	ENS-001
Sta 23	9/22/1998	Mn	3.85	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Ni	0.0193	mg/L	Total	ENS-001
Sta 23	9/22/1998	Ni	0.0213	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Ni	0.0405	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Ni	0.0426	mg/L	Total	ENS-001
Sta 23	9/22/1998	Ni	0.0777	mg/L	Total	ENS-001
Sta 23	9/22/1998	Ni	0.0799	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Ni	0.15	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Ni	0.152	mg/L	Total	ENS-001
Sta 23	9/22/1998	Ni	0.265	mg/L	Total	ENS-001
Sta 23	9/22/1998	Ni	0.286	mg/L	Dis	ENS-001
Sta 23	9/22/1998	pH	3.7	su	Field	ENS-001
Sta 23	9/22/1998	TDS	655	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Temp	13	C	Field	ENS-001
Sta 23	9/22/1998	TOC	0.6	mg/L	Total	ENS-001
Sta 23	9/22/1998	TSS	14	mg/L	Total	ENS-001
Sta 23	9/22/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 23	9/22/1998	Zn	0.0109	mg/L	Total	ENS-001
Sta 23	9/22/1998	Zn	0.0153	mg/L	Total	ENS-001
Sta 23	9/22/1998	Zn	0.0392	mg/L	Total	ENS-001
Sta 23	9/22/1998	Zn	0.0395	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Zn	0.0774	mg/L	Dis	ENS-001
Sta 23	9/22/1998	Zn	0.082	mg/L	Total	ENS-001
Sta 23	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 23	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 12.5 Percent	ENS-001
Sta 23	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 25 Percent	ENS-001
Sta 23	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 50 Percent	ENS-001
Sta 23	9/29/1998	Water Toxicity Test	0	%	Percent Survival of Rainbow Trout, 6.25 Percent	ENS-001
Sta 23	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 23	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 12.5	ENS-001
Sta 23	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 25	ENS-001
Sta 23	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 50	ENS-001
Sta 23	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 6.25	ENS-001
Sta 24	9/22/1998	Al	0.0392	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Al	0.0434	mg/L	Total	ENS-001
Sta 24	9/22/1998	As	0.0016	mg/L	Dis	ENS-001
Sta 24	9/22/1998	As	0.0016	mg/L	Total	ENS-001
Sta 24	9/22/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 24	9/22/1998	Cu	0.002	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Cu	0.002	mg/L	Total	ENS-001
Sta 24	9/22/1998	DO	7.5	mg/L	Field	ENS-001
Sta 24	9/22/1998	DOC	0.6	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Fe	0.0181	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Fe	0.098	mg/L	Total	ENS-001
Sta 24	9/22/1998	Mn	0.01	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Mn	0.0141	mg/L	Total	ENS-001
Sta 24	9/22/1998	Ni	0.0193	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Ni	0.0193	mg/L	Total	ENS-001
Sta 24	9/22/1998	pH	8.2	su	Field	ENS-001
Sta 24	9/22/1998	TDS	98	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Temp	9	C	Field	ENS-001
Sta 24	9/22/1998	TOC	0.5	mg/L	Total	ENS-001
Sta 24	9/22/1998	TSS	4	mg/L	Total	ENS-001
Sta 24	9/22/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 24	9/22/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 24	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 24	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 25	9/22/1998	Al	0.0392	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Al	1.22	mg/L	Total	ENS-001

Sta 25	9/22/1998	As	0.0027	mg/L	Dis	ENS-001
Sta 25	9/22/1998	As	0.0034	mg/L	Total	ENS-001
Sta 25	9/22/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 25	9/22/1998	Cu	0.0021	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Cu	0.0094	mg/L	Total	ENS-001
Sta 25	9/22/1998	DO	7.5	mg/L	Field	ENS-001
Sta 25	9/22/1998	DOC	0.6	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Fe	0.0181	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Fe	1.72	mg/L	Total	ENS-001
Sta 25	9/22/1998	Mn	0.949	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Mn	0.979	mg/L	Total	ENS-001
Sta 25	9/22/1998	Ni	0.0738	mg/L	Total	ENS-001
Sta 25	9/22/1998	Ni	0.0769	mg/L	Dis	ENS-001
Sta 25	9/22/1998	pH	7.6	su	Field	ENS-001
Sta 25	9/22/1998	TDS	359	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Temp	12	C	Field	ENS-001
Sta 25	9/22/1998	TOC	0.5	mg/L	Total	ENS-001
Sta 25	9/22/1998	TSS	8	mg/L	Total	ENS-001
Sta 25	9/22/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 25	9/22/1998	Zn	0.0223	mg/L	Total	ENS-001
Sta 25	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 25	10/1/1998	Water Toxicity Test	0	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 25	10/1/1998	Water Toxicity Test	90	%	Percent Survival of Ceriodaphnia dubia, 50	ENS-001
Sta 25	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 25	ENS-001
Sta 26	9/23/1998	Al	0.0664	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Al	0.536	mg/L	Total	ENS-001
Sta 26	9/23/1998	As	0.0042	mg/L	Total	ENS-001
Sta 26	9/23/1998	As	0.006	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 26	9/23/1998	Cu	0.0029	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Cu	0.0035	mg/L	Total	ENS-001
Sta 26	9/23/1998	DO	7.8	mg/L	Field	ENS-001
Sta 26	9/23/1998	DOC	0.5	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Fe	0.021	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Fe	0.462	mg/L	Total	ENS-001
Sta 26	9/23/1998	Mn	0.213	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Mn	0.219	mg/L	Total	ENS-001
Sta 26	9/23/1998	Ni	0.0297	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Ni	0.0305	mg/L	Total	ENS-001
Sta 26	9/23/1998	pH	8.3	su	Field	ENS-001
Sta 26	9/23/1998	TDS	216	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Temp	16.5	C	Field	ENS-001
Sta 26	9/23/1998	TOC	0.5	mg/L	Total	ENS-001
Sta 26	9/23/1998	TSS	4	mg/L	Total	ENS-001
Sta 26	9/23/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 26	9/23/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 26	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 26	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001
Sta 29	9/23/1998	Al	0.222	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Al	0.794	mg/L	Total	ENS-001
Sta 29	9/23/1998	As	0.0064	mg/L	Dis	ENS-001
Sta 29	9/23/1998	As	0.0078	mg/L	Total	ENS-001
Sta 29	9/23/1998	Cr	0.0092	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Cr	0.0092	mg/L	Total	ENS-001
Sta 29	9/23/1998	Cu	0.0026	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Cu	0.0029	mg/L	Total	ENS-001
Sta 29	9/23/1998	DO	8.8	mg/L	Field	ENS-001
Sta 29	9/23/1998	DOC	0.5	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Fe	0.091	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Fe	0.469	mg/L	Total	ENS-001
Sta 29	9/23/1998	Mn	0.127	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Mn	0.13	mg/L	Total	ENS-001
Sta 29	9/23/1998	Ni	0.0193	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Ni	0.0193	mg/L	Total	ENS-001
Sta 29	9/23/1998	pH	7.9	su	Field	ENS-001
Sta 29	9/23/1998	TDS	354	mg/L	Dis	ENS-001

Surface Water Results from the Project Database
ENSR (1999)
Leviathan Mine Site
Alpine County, California

Sta 29	9/23/1998	Temp	15	C	Field	ENS-001
Sta 29	9/23/1998	TOC	0.5	mg/L	Total	ENS-001
Sta 29	9/23/1998	TSS	4	mg/L	Total	ENS-001
Sta 29	9/23/1998	Zn	0.0071	mg/L	Dis	ENS-001
Sta 29	9/23/1998	Zn	0.0071	mg/L	Total	ENS-001
Sta 29	9/29/1998	Water Toxicity Test	100	%	Percent Survival of Rainbow Trout, 100 Percent	ENS-001
Sta 29	10/1/1998	Water Toxicity Test	100	%	Percent Survival of Ceriodaphnia dubia, 100	ENS-001

Notes:

Informaton obtained from database source code ENS-001 within the project database. The original source was from *Data Report for the Leviathan Mine Study Area Water and Sediment Toxicity and Benthic Community Data. September 1998 Assessment.* By ENSR (1999).

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, DO = dissolved oxygen, DOC = dissolved organic carbon, TSS = total suspended solids

Dis = dissolved, SpC = specific conductance, uS/cm = microseimens per centimeter, ppm = parts per million, mg/L = milligrams per liter

ASSESSMENTS OF INJURIES TO AQUATIC NATURAL RESOURCES NEAR THE LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA. PHASE 1 DATA REPORT: CONCENTRATIONS OF METALS AND TRACE ELEMENTS IN AQUATIC INSECTS AND FISH

(Thompson and Welch, 1999)

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Assessments of Injuries to Aquatic Natural Resources near the Leviathan Mine, Alpine County, California

Phase I Data Report: Concentrations of Metals and Trace Elements in Aquatic Insects and Fish

Prepared for:

The Leviathan Mine Council
and
The Atlantic Richfield Company

Final Report: December 27, 1999

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by

Larry Thompson and Dan Welsh
U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office

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SUMMARY

The purpose of this study was to determine the concentrations of metals and trace elements in whole aquatic insects, and the muscle and liver tissues of fish, collected in surface waters downstream from the Leviathan Mine and reference sites.

In September 1998, aquatic insect samples (caddisfly larvae and mayfly nymphs) were collected in eleven stream locations, seven that receive surface-water releases from the Leviathan Mine, and four that receive no surface waters from the Leviathan Mine. No samples were obtained from the reaches of Leviathan or Aspen Creeks directly downstream of the Leviathan Mine, due to the absence or near absence of caddisflies and mayflies in these locations. Analyses were performed at a contract laboratory of the U.S. Fish and Wildlife Service to determine the whole-body concentrations of aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, mercury, nickel, lead, selenium, silver, vanadium, and zinc. The data are intended to indicate whether aquatic insects are accumulating metals and trace elements discharged from the Leviathan Mine.

In October 1998, fish (mountain whitefish) were collected in three East Fork Carson River locations to obtain liver and muscle tissue samples. Fish were collected a short distance upstream of the Bryant Creek confluence, a short distance downstream of the Bryant Creek confluence, and below the Ruhenstroth Dam near Dresslerville. None were collected in the stream reaches nearest to the Leviathan Mine (e.g., Aspen Creek, Leviathan Creek, Bryant Creek) because fish are either absent or present in very low numbers in these reaches. Dissections and chemical analyses were performed at a contract laboratory of the U.S. Fish and Wildlife Service. Muscle (fillet) and liver tissue concentrations of aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, mercury, nickel, lead, selenium, silver, vanadium, and zinc were determined. The tissue concentrations are intended to indicate whether fish have been exposed to, or are accumulating, metals and trace elements discharged from the Leviathan Mine.

Data are tabulated and plotted to ease comparisons of the metal and trace element concentrations in aquatic insects and fish. The data may be useful in ecological or human health risk assessments.

INTRODUCTION

The Bryant Creek watershed in California and Nevada receives metal and trace element-enriched wastes from the inactive Leviathan Mine east of Markleeville in Alpine County, California. The contaminated waters enter Aspen and Leviathan Creeks approximately five miles upstream of the California/Nevada border and are conveyed in Bryant Creek to the East Fork of the Carson River, upstream of Dresslerville, Nevada (Figure 1). Underground mining of copper and sulfur occurred intermittently at the Leviathan Mine from 1863 to 1941, and open pit mining of sulfur occurred from 1953 to 1962. Shortly after the open pit mining began, the beneficial uses for aquatic life were lost in the portions of Aspen and Leviathan Creeks downstream of the Leviathan Mine, as well as in Bryant Creek. In the 1950's, fish kills occurred in the East Fork Carson River when large amounts of acidic, metal and trace element-enriched wastes were accidentally released from the Leviathan Mine. Despite remedial efforts at the Leviathan Mine, releases of hazardous substances continue to enter the watershed (Schoen et al. 1995).

In 1998, the Washoe Tribe of Nevada and California, the Bureau of Indian Affairs, the U.S. Fish and Wildlife Service, the U.S. Forest Service, the California Department of Fish and Game, the Nevada Division of Environmental Protection, and the Atlantic Richfield Company initiated a cooperative Natural Resource Damage Assessment (NRDA) to evaluate the effects of hazardous releases from the Leviathan Mine. This report of the metal and trace element concentrations in aquatic insects and fish contains the results of one of several studies conducted in 1998 for Phase I of the NRDA.

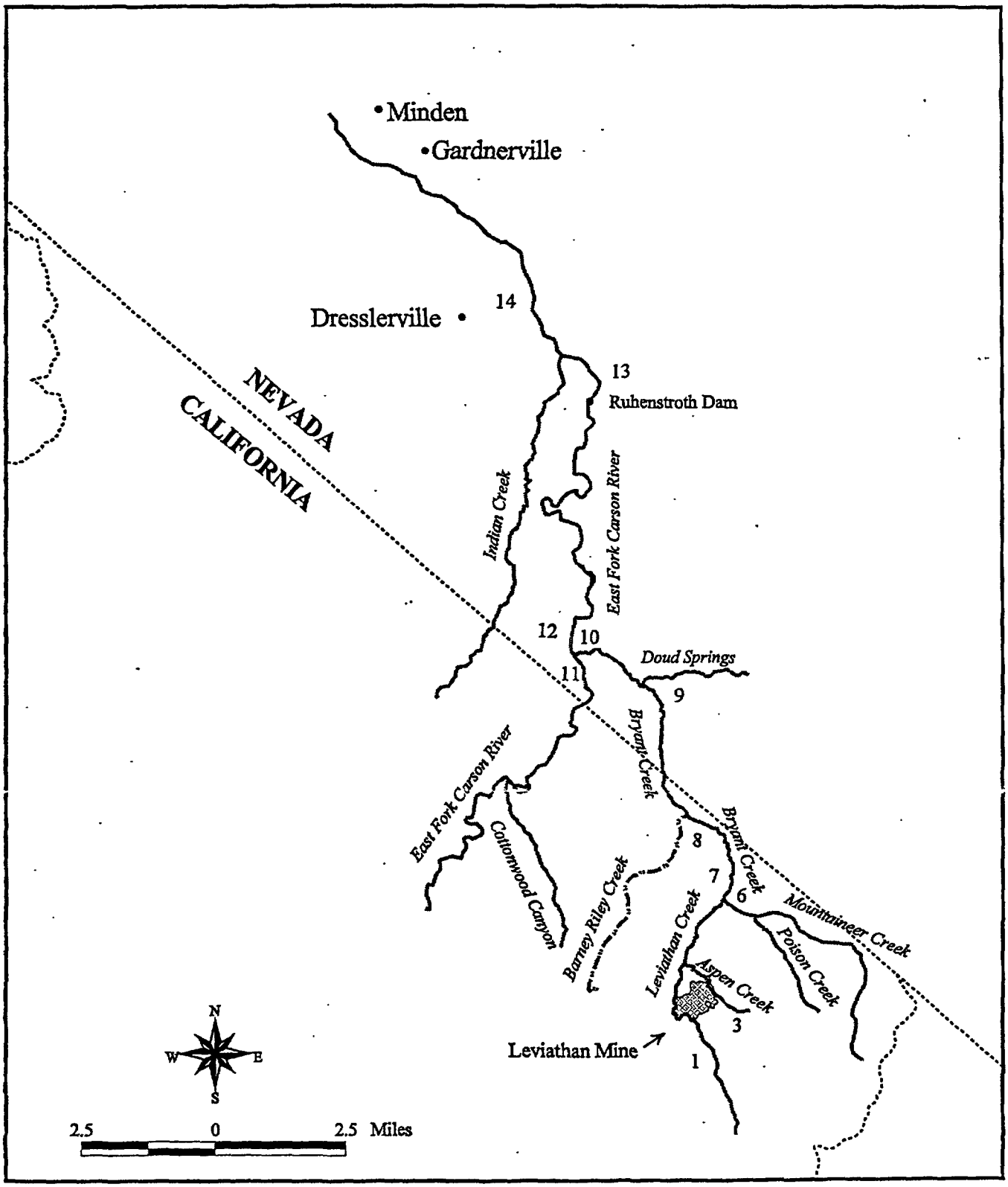
Aquatic insects accumulate metals and trace elements from water, detritus, food, and sediment pathways, and contributions to their whole-body concentrations include tissue incorporations, gut contents, and external adsorptions. Whole-body concentrations serve as indicators of exposure, not direct determinations of the dose of a metal or trace element to which an aquatic invertebrate has been exposed (Luoma and Carter 1991). The whole-body concentrations determined in this study are intended to indicate whether biota are accumulating excessive amounts of metals and trace elements discharged from the Leviathan Mine. The degree of accumulation can be indicated by the relative differences between insect concentrations in streams receiving Leviathan Mine wastes, and in streams not receiving Leviathan Mine wastes.

If appreciable accumulations in aquatic insects occur, potentially hazardous concentrations of contaminants may be available to insectivorous fish through the dietary pathway. Invertebrate diets contaminated by metals and trace elements have been associated with reduced growth and increased mortality in trout, as well as with adverse histopathological and physiological effects (Woodward et al. 1994; Farag et al. 1994; Woodward et al. 1995; Elderkin 1997). Aquatic insects are important foods of the salmonid fishes that currently occupy or historically occupied the Lahontan streams of the eastern Sierra Nevada (Moyle 1976). The historical range of the Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), a species listed as threatened under the Endangered Species Act, includes the surface waters near the Leviathan Mine (U.S. Fish and Wildlife Service 1994). The whole-body concentrations of metals and trace elements in aquatic

insects can be evaluated to indicate whether fish occupying these habitats are likely to be harmed by dietary exposures.

The metal and trace element concentrations in fish tissues may be evaluated to indicate whether fish have been exposed to or are accumulating these contaminants from water, sediment, or foodborne pathways. Skeletal muscle tissue (fillet) concentrations of certain metals (e.g., mercury) are useful in human health and ecological risk assessments, as these tissues comprise much of the fish biomass that is consumed. Due to the detoxification role of the liver, this organ is often a major site of accumulation of metals and trace elements in fish (Sorensen 1991). Analysis of liver tissue concentrations may indicate whether potentially toxic exposures have occurred in fish inhabiting streams affected by the Leviathan Mine.

Figure 1. Map depicting stream locations where samples were collected.



METHODS

A) Field Methods

On September 21-24, 1998, aquatic insect samples were collected in eleven stream locations in the vicinity of the Leviathan Mine to obtain tissue for laboratory analyses (Table 1). All samples were collected by Dr. David Herbst of the University of California's Sierra Nevada Aquatic Research Laboratory. Samples were collected in stream locations that receive contaminated surface waters from the Leviathan Mine, as well as in reaches that receive no surface-water wastes from the Leviathan Mine. Although it would have been desirable to obtain samples in Leviathan Creek and Aspen Creek reaches downstream of the Leviathan Mine, samples of adequate mass could not be collected due to the absence or near absence of caddisflies and mayflies in these locations (Herbst 1995; Herbst 1997).

Table 1. Stream and river locations sampled to collect aquatic insects for metal and trace element analyses.

Site[a]	Site Description	Latitude/Longitude	Date Sampled
1	Leviathan Creek, upstream of releases from the Leviathan Mine	N38° 41' 59.65" W119° 39' 17.65"	09/24/98
3	Aspen Creek, upstream of releases from the Leviathan Mine.	N38° 42' 32.78" W119° 38' 54.40"	09/24/98
6	Mountaineer Creek, a short distance upstream of its confluence with Leviathan Creek.	N38° 44' 07.26" W119° 38' 44.03"	09/22/98
7	Bryant Creek, a short distance downstream of Leviathan and Mountaineer Creeks.	N38° 44' 15.95" W119° 38' 37.59"	09/22/98
8	Bryant Creek, a short distance upstream of Barney Riley Canyon (and the California/Nevada border).	N38° 45' 09.54" W119° 38' 43.71"	09/21/98
9	Bryant Creek, a short distance upstream of Doud Springs Creek.	N38° 47' 40.47" W119° 40' 23.36"	09/21/98
10	Bryant Creek, a short distance upstream of its confluence with the East Fork Carson River.	N38° 48.240' W119° 41.825'	09/21/98
11	East Fork Carson River, a short distance upstream of Bryant Creek.	N38° 48.136' W119° 41.904'	09/21/98
12	East Fork Carson River, a short distance downstream of Bryant Creek.	N38° 48.293' W119° 41.962'	09/21/98
13	East Fork Carson River, a short distance upstream of Ruhenstroth Dam.	N38° 52' 07.48" W119° 41' 33.94"	09/23/98
14	East Fork Carson River, near Dresslerville, NV	N38° 54' 51.64" W119° 43' 02.23"	09/23/98

[a] Site locations are illustrated by number in Figure 1.

At each site, a kick net was held against the stream bottom while the substrates upstream were disturbed to dislodge aquatic insects. Individuals were carried into the net by the current. Plastic forceps were used to randomly pick individual caddisflies (Order Trichoptera, Family Hydropsychidae) and mayflies (Order Ephemeroptera, Family Baetidae) from the net. These taxa were collected because historical data indicate that they are widely distributed in most stream reaches near the Leviathan Mine (Hammermeister and Walmsley 1985; Herbst 1995; Herbst 1997). Members of these families are easily identified in the field without magnification. Individuals were transferred with forceps to nets suspended in plastic buckets of stream water, so that they could be held alive while repeated collections were performed. Separate net-and-bucket arrangements were used so that caddisflies and mayflies could be held apart. An attempt was made to collect enough individuals of each taxon to obtain composite samples of approximately 1 gram (wet weight). When collection at a site was complete, the samples were placed in plastic bags that were labeled to identify the taxon and location of collection (Appendix A). Samples were quickly transferred to an ice chest and frozen on dry ice. The latitude and longitude of each collection site were determined with a Rockwell International PLGR+96 global positioning system receiver (Table 1). The coordinates were obtained by the U.S. Fish and Wildlife Service after accompanying David Herbst to the field sites on June 14 and 15, 1999.

The samples remained under the custody of David Herbst while in the field, during transport, and while they were stored in a freezer at the Sierra Nevada Aquatic Research Laboratory. On November 3, 1998, the samples were packed in ice chests containing dry ice and shipped frozen to the Trace Element Research Laboratory (TERL) at Texas A&M University, College Station, Texas. Chain-of-custody forms were used to document the transfer of samples (Appendix B). The samples were frozen when they arrived at TERL on November 4, 1998. One sample that was inadvertently left out of the November 3 shipment was shipped separately on February 4, 1999. No chain-of-custody forms were used to document the transfer, but TERL notified the U.S. Fish and Wildlife Service on February 5, 1999 that the sample had been received frozen. All samples were stored in a laboratory freezer until preparation for analysis began.

On October 27-28, 1998, fish were collected in three East Fork Carson River locations to obtain liver and muscle tissues for determination of metal and trace element concentrations. Samples were collected upstream of Bryant Creek, downstream of Bryant Creek, and downstream of the Ruhenstroth Dam near Dresslerville. The latitude and longitude of each collection site were determined with a Rockwell PLGR+96 global positioning system receiver (Table 2). Although it would have been desirable to collect fish in the affected streams closer to the Leviathan Mine (e.g., Leviathan Creek, Bryant Creek), this was not done because recent fishery surveys indicate that fish are absent or present in very low numbers in these reaches.

Fish were collected by the U.S. Fish and Wildlife Service and Nevada Division of Wildlife with tow-barge electrofishing equipment and dip nets. Mountain whitefish (*Prosopium williamsoni*) were selected for capture because they are present in all three sample locations, their diet is largely aquatic invertebrates (Moyle 1976), and they are foods consumed by wildlife and humans. Captured individuals were measured on a board to the nearest 0.1 inch and weighed on an electronic balance to the nearest 1 gram. Whole fish were placed in plastic bags that were labeled to identify the location of collection (Appendix C). Samples were quickly transferred to

an ice chest and frozen on dry ice. The samples were under the custody of the U.S. Fish and Wildlife Service while in the field, during transport, and while stored in a laboratory freezer at the Sacramento Fish and Wildlife Office.

Table 2. East Fork Carson River locations sampled to collect fish for metal and trace element analyses.

Site[a]	Site Description	Latitude/Longitude	Date Sampled
11	East Fork Carson River, a short distance upstream of Bryant Creek.	N38° 47' 52.33" W119° 41' 42.50"	10/27/98
12	East Fork Carson River, a short distance downstream of Bryant Creek.	N38° 48' 48.71" W119° 41' 33.95"	10/28/98
13	East Fork Carson River, a short distance downstream of Ruhenstroth Dam.	N38° 52' 31.23" W119° 41' 25.42"	10/28/98

[a] Site locations are illustrated by number in Figure 1.

On November 10, 1998, the samples were packed in ice chests containing dry ice and shipped frozen to TERL. Chain-of-custody forms were used to document the transfer of samples (Appendix D). The samples were frozen when they arrived at TERL on November 11, 1998 and were stored in a laboratory freezer until preparation for analysis began.

METHODS

B) Laboratory Methods

Preparation, digestion, and chemical analyses of the samples were performed at TERL, a contract laboratory of the U.S. Fish and Wildlife Service. Samples were analyzed to determine their concentrations of aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, mercury, nickel, lead, selenium, silver, vanadium, and zinc.

To prepare aquatic insect tissues, samples were thawed, removed from the plastic bags, and lightly rinsed in deionized water to remove any loose debris attached to their external body surfaces. Each fish was thawed and dissected with a titanium knife to remove its liver and a muscle fillet from one side. The skin was removed from the muscle fillets. All dissections were performed in a positive-pressure clean room. The muscle and liver tissue samples from each fish were prepared and analyzed separately. Each insect and fish tissue sample was freeze dried and mechanically powdered with Teflon beads in a Spex mill to produce a fine, well-mixed homogenate. Sample percent moisture was determined by weight loss due to freeze-drying.

The digestion of samples for mercury analysis requires unique procedures, so sub-samples were extracted from each sample homogenate for this purpose. Digestion of samples for all metal or trace element analyses except mercury was accomplished by placing homogenates in Teflon reaction vessels where nitric acid was added. The closed reaction vessels were heated in an oven until digestion was complete. Samples were removed, diluted with quartz-distilled water, and stored in polyethylene bottles for analysis. Digestion for mercury analysis was accomplished by transferring the sub-samples to polypropylene tubes and adding nitric acid, sulfuric acid, potassium permanganate, and potassium persulfate in a water bath at 90-95 degrees Centigrade. Before analysis, hydroxylamine hydrochloride was added to reduce excess permanganate and distilled-deionized water was added to dilute the samples.

Mercury analysis was performed by cold-vapor atomic absorption spectroscopy. Aluminum and zinc analyses were performed by inductively coupled plasma emission spectroscopy. Arsenic and selenium analyses were performed by graphite furnace atomic absorption spectroscopy. Silver, cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead, and vanadium analyses were performed by inductively coupled plasma-mass spectroscopy. The limits of detection depend upon analytical method, sample size, interferences, and other factors.

RESULTS

A) Analyses and Review of Quality Assurance/Quality Control Samples

Data are reported for the analyses of all samples, procedural blanks, duplicates, spikes, and standard reference materials (Appendix E). Results of analyses of blanks, duplicates, spikes, and standard reference materials should be considered in the interpretation of results. In this study, the limits of detection (LOD) were higher than the contract requirement in four samples. The LOD is the "Method Limit of Detection" described by the U.S. Environmental Protection Agency (1994). Its value depends on the statistical variation among several replicate measurements of a sample that contains a low analyte concentration, near the estimated method detection limit.

The minimum acceptable LOD for arsenic analysis of biological tissues is 0.50 ppm, dry weight. This minimum was exceeded in the analyses of caddisflies from Site 1 (LOD = 2.57 ppm, dry weight), caddisflies from Site 8 (LOD = 5.79 ppm, dry weight), and mayflies from Site 14 (LOD = 7.80 ppm, dry weight). The minimum acceptable LOD for selenium analysis of biological tissues is also 0.50 ppm, dry weight. This minimum was exceeded in the analyses of mayflies from Site 14 (LOD = 3.12 ppm, dry weight). Therefore, the concentrations reported for these four analyses may be less accurate than other analyses. The minimum acceptable LOD assumes that an adequate sample mass was submitted for analysis. The higher LOD's reported in these four instances may have occurred because the insect masses were small (< 1 g) in samples from Site 1 (0.435 g), Site 8 (0.068 g), and Site 14 (0.053 g) (Appendix E).

Procedural blanks are analyzed to assure that no contamination occurred during laboratory sample processing. The blank is an empty vessel to which all reagents, acids, or solvents used in an analysis are added. The blank is processed the same as the samples. In this study, concentrations of metals and trace elements in all procedural blanks were acceptably low.

Duplicate samples are analyzed to evaluate the precision of the analytical methods applied. After a sample is homogenized, two separate sub-samples are taken and analyzed. The relative percent difference (RPD) is calculated and compared with the 95% confidence interval estimate of method precision for that analyte, determined from analyses performed at several contract laboratories. In this study, four duplicate analyses yielded RPD's that were higher than expected; analyses of iron in a fish muscle sample from the East Fork Carson River upstream of Bryant Creek (RPD = 20.9%), analyses of manganese in a fish muscle sample from the East Fork Carson River downstream of Bryant Creek (RPD = 69.0%), analyses of manganese in fish muscle tissue from the East Fork Carson River upstream of Bryant Creek (RPD = 34.9%), and analyses of zinc in a fish muscle sample from the East Fork Carson River downstream of Bryant Creek (RPD = 23.1%) (Appendix E).

Spiked samples are analyzed to provide a measure of the accuracy of the analytical methods. After a sample is homogenized, one sub-sample is analyzed while a known quantity of analyte is added to a second sub-sample before analysis. The difference between the analyte concentrations measured in the two sub-samples, divided by the known concentration spiked into the second sub-sample, is multiplied by one-hundred to yield the percent spike recovery. In this study, three spike recovery percentages fell outside the 95% confidence intervals bracketing the mean recovery for that analyte, where the confidence intervals were computed from multiple analyses performed at several contract laboratories. The recovery of silver spiked into a caddisfly sample from Site 9 was 59.6%, the recovery of chromium spiked into a fish muscle sample from the East Fork Carson River upstream of Bryant Creek was 132%, and the recovery of lead spiked into a caddisfly sample from Site 9 was 133% (Appendix E).

Standard reference materials (dogfish liver and muscle tissue) which contain known (certified) concentrations of metal and trace elements are also analyzed and the results compared with the certified value. In this study, the recoveries were low in four analyses of standard reference materials. The recovery of cadmium from dogfish liver tissue was 77.9% of the certified value, the recovery of nickel from dogfish muscle tissue was 61.9% of the certified value, the recovery of nickel in a second analysis of dogfish muscle tissue was 77.8% of the certified value, and the recovery of selenium from dogfish muscle tissue was 72.9% of the certified value (Appendix E).

RESULTS

B) Concentrations of Metals and Trace Elements in Aquatic Insects

No summary statistics (e.g., median concentrations) could be calculated with the aquatic insect data from a location because single, composite samples were collected at each site. However, the data were tabulated (Table 3) so that the concentrations in insects sampled from all eleven locations could be compared.

Table 3. Concentrations of metals and trace elements (ppm, dry weight) in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

Site[a]	Taxon	Mass	Aluminum	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron
1	caddisfly	0.435	1330	<2.57[b]	0.288	4.90	4.68	24.7	3000
1	mayfly	0.126	3080	5.28	0.549	5.79	5.14	20.3	6480
3	caddisfly	0.349	191	<1.35	0.119	2.84	0.861	14.8	473
3	mayfly	0.504	1630	2.32	0.276	4.33	5.03	16.1	3100
6	caddisfly	1.387	1000	1.10	0.0833	3.68	3.37	16.5	1550
6	mayfly	0.779	986	2.51	0.350	3.56	6.70	15.4	1950
7	caddisfly	0.147	2890	8.21	0.641	3.84	18.6	91.8	14300
7	mayfly	0.304	3130	11.7	5.32	3.86	69.3	118	12800
8	caddisfly	0.068	789	<5.79	2.49	3.10	66.7	45.6	935
8	mayfly	1.239	4130	28.0	7.85	5.34	353	113	6830
9	caddisfly	1.541	1170	6.50	1.48	3.23	157	36.0	1970
9	mayfly	0.927	3850	41.5	10.6	8.90	190	117	8020
10	caddisfly	1.588	2060	9.80	0.978	3.40	40.5	18.9	2550
10	mayfly	0.325	3720	13.4	5.60	5.36	49.0	39.5	4940
11	caddisfly	0.540	3000	5.77	0.380	4.50	7.90	17.7	5110
11	mayfly	0.072	5990	5.45	0.386	4.24	7.74	9.55	9260
12	caddisfly	0.330	2270	6.28	0.381	4.39	8.49	18.0	3980
12	mayfly	0.253	3570	7.39	2.19	5.54	15.1	23.2	6510
13	caddisfly	1.156	2890	5.05	0.592	4.25	10.6	17.6	4440
13	mayfly	0.379	1990	4.53	5.75	4.59	39.2	24.0	3540
14	caddisfly	1.306	4120	6.11	0.442	4.91	8.02	17.4	6210
14	mayfly	0.053	1040	<7.80	3.69	4.44	21.6	27.6	1700

[a] Site locations are illustrated by number in Figure 1.

[b] Values preceded by the symbol "<" mean that reported concentrations were less than the limits of detection.

Table 3. Concentrations of metals and trace elements (ppm, dry weight) in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998. (continued).

Site[a]	Taxon	Mass	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
1	caddisfly	0.435	2.07	955	0.244	4.37	5.09	0.0806	7.58	166
1	mayfly	0.126	9.55	357	1.35	3.86	5.74	0.133	15.3	94.0
3	caddisfly	0.349	0.423	107	0.195	0.575	2.68	0.0615	1.35	172
3	mayfly	0.504	2.03	395	0.0933	1.52	1.49	0.0942	10.5	211
6	caddisfly	1.387	0.617	544	0.0840	1.54	0.397	0.0353	5.28	108
6	mayfly	0.779	0.577	306	0.0352	2.38	0.506	0.0463	7.90	74.9
7	caddisfly	0.147	0.299	316	0.115	25.6	1.67	0.0553	7.58	186
7	mayfly	0.304	0.481	468	0.0645	42.2	4.93	0.0379	10.2	771
8	caddisfly	0.068	0.192	426	0.0837	45.1	6.55	0.0781	1.43	235
8	mayfly	1.239	1.48	2280	0.0600	124	2.32	0.0230	9.90	830
9	caddisfly	1.541	0.338	5940	0.0919	132	1.06	0.0151	7.70	165
9	mayfly	0.927	1.52	3110	0.182	114	7.56	0.0356	17.0	651
10	caddisfly	1.588	0.395	1960	0.0872	52.7	1.84	0.0133	3.52	138
10	mayfly	0.325	2.00	1200	0.0735	43.4	0.858	0.0172	9.14	374
11	caddisfly	0.540	2.19	1640	0.249	5.55	<0.332[b]	0.0763	9.74	125
11	mayfly	0.072	2.30	442	0.0470	5.55	<1.09	0.0630	27.1	42.2
12	caddisfly	0.330	2.00	1740	0.249	6.06	<0.503	0.0808	9.08	135
12	mayfly	0.253	1.87	554	0.149	6.10	<0.618	0.0950	11.4	138
13	caddisfly	1.156	1.95	1010	0.161	6.80	<0.216	0.0796	10.3	123
13	mayfly	0.379	1.54	425	0.135	5.01	<0.544	0.0661	9.08	172
14	caddisfly	1.306	2.85	1030	0.175	7.17	<0.509	0.0759	13.0	108
14	mayfly	0.053	1.70	198	0.223	2.12	<3.12	0.0850	3.99	131

[a] Site locations are illustrated by number in Figure 1.

[b] Values preceded by the symbol "<" mean that reported concentrations were less than the limits of detection.

To ease comparisons, the concentrations of each metal or trace element in caddisfly and mayfly samples are plotted so that data from all eleven sample locations are on the same graph (Figures 2-16). Since in some cases the reported concentrations were less than the limits of detection, it was necessary to establish a convention to determine an appropriate value to plot. This is because when a value is reported as less than the limit of detection, only the range containing the concentration is known (less than the limit of detection down to and including zero). By convention, when the reported sample concentration was less than the limit of detection, a value one-half of the limit of detection was plotted.

Figure 2. Whole-body aluminum concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

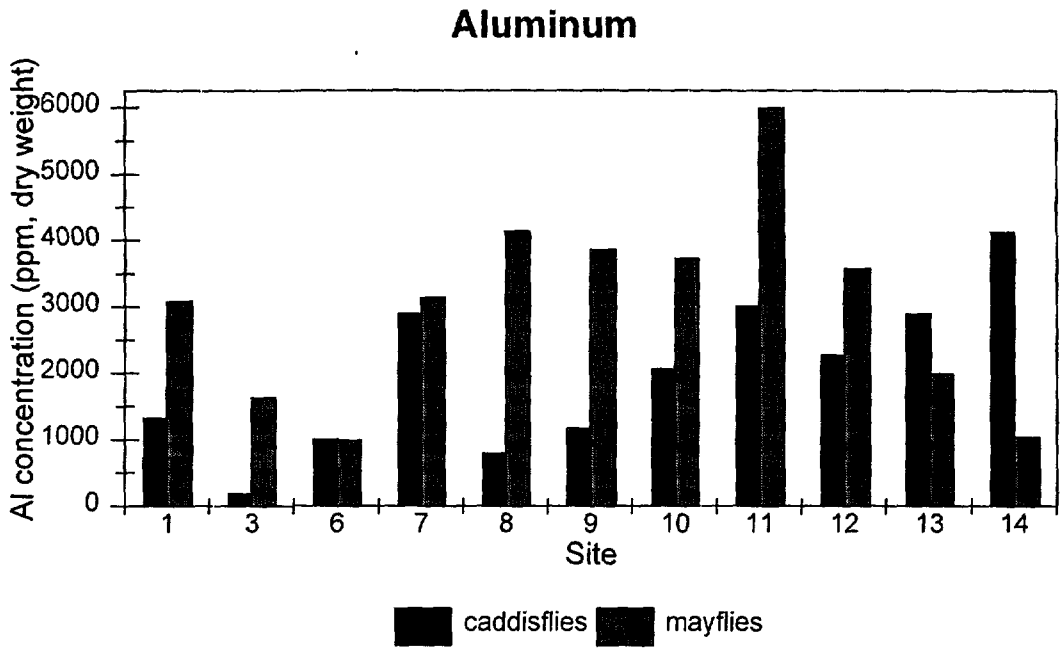


Figure 3. Whole-body arsenic concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

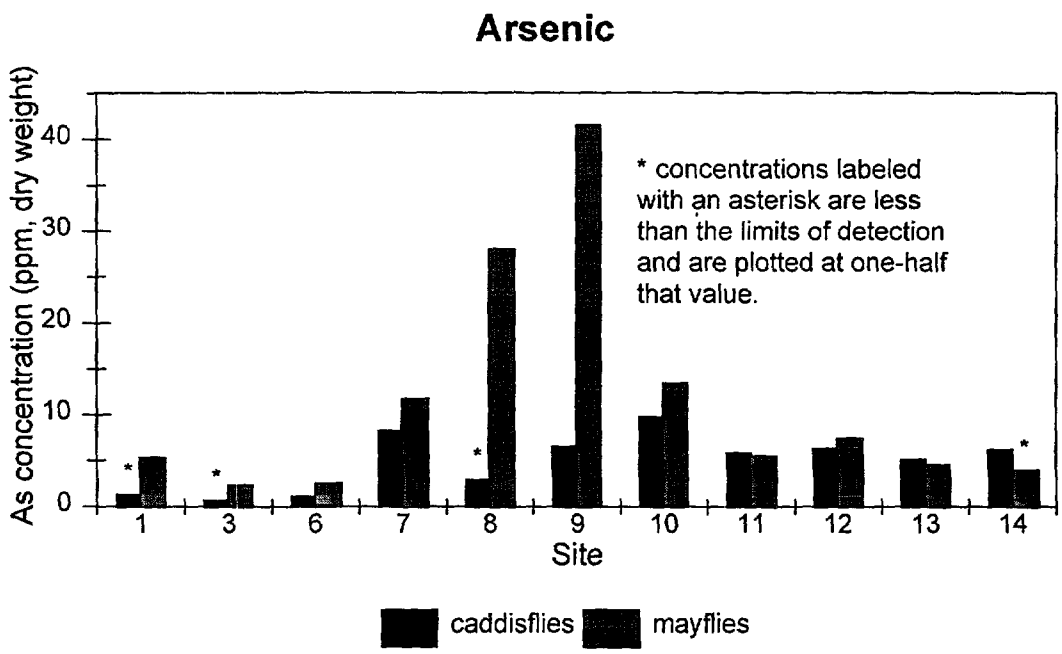


Figure 4. Whole-body cadmium concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

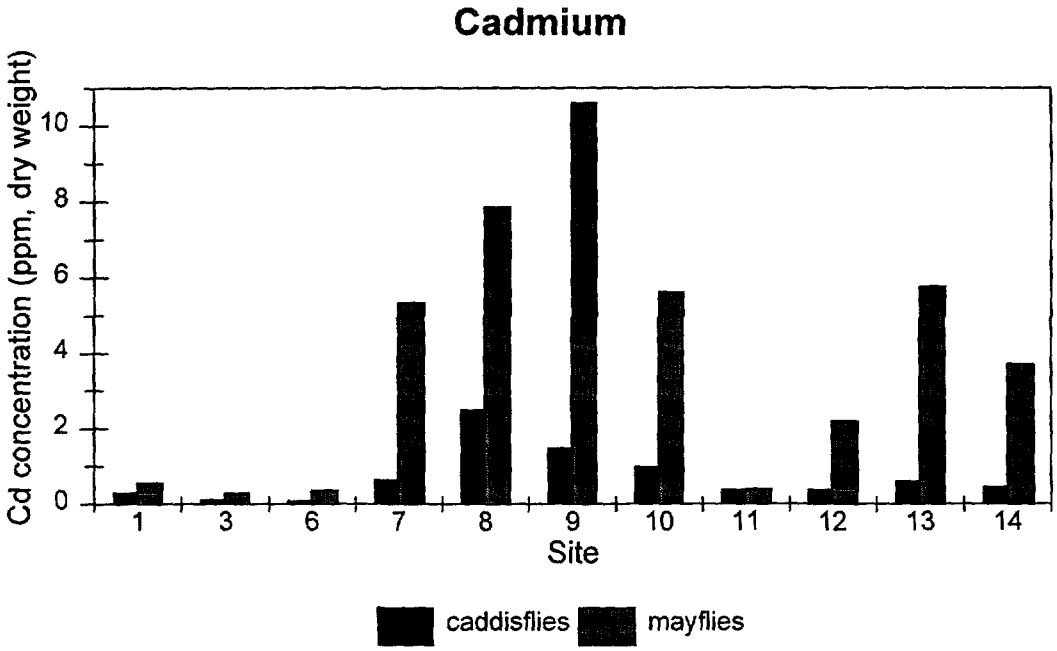


Figure 5. Whole-body chromium concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

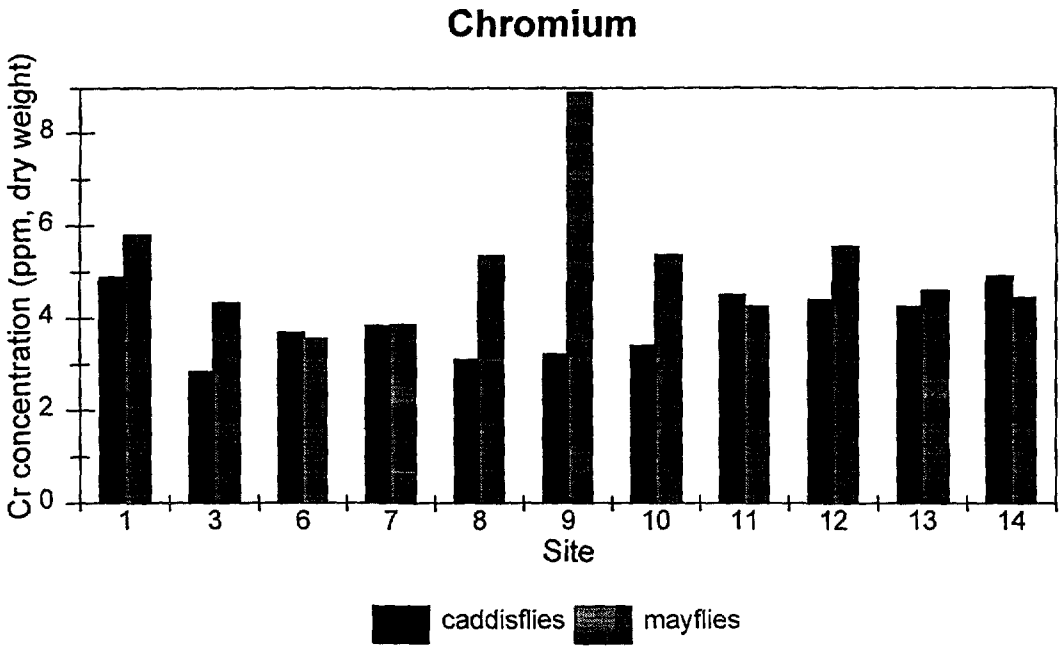


Figure 6. Whole-body cobalt concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

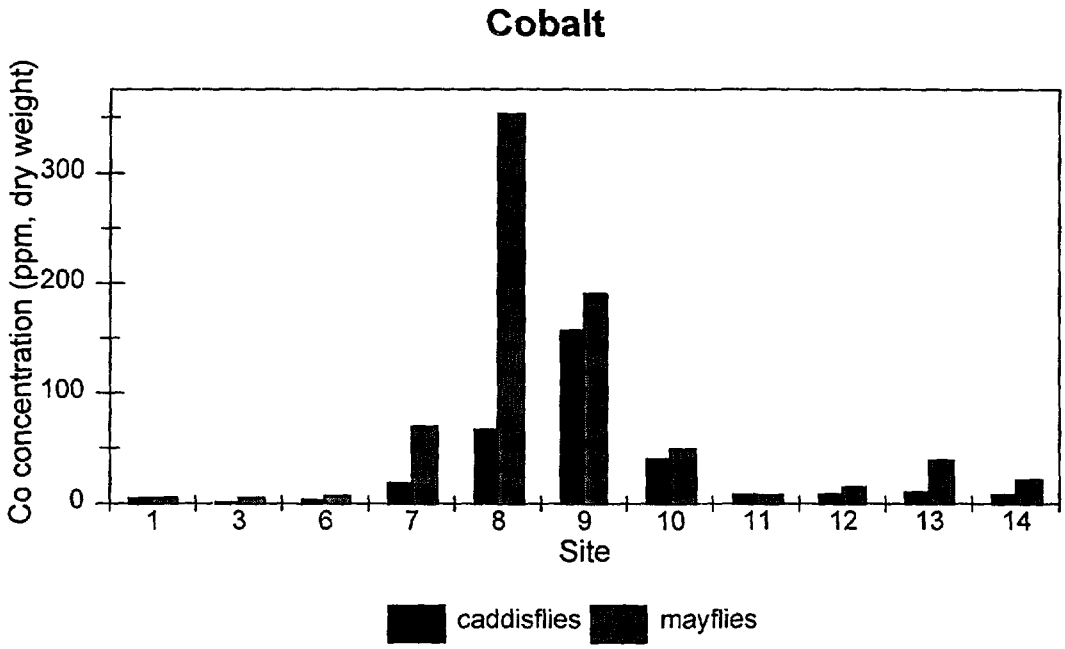


Figure 7. Whole-body copper concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

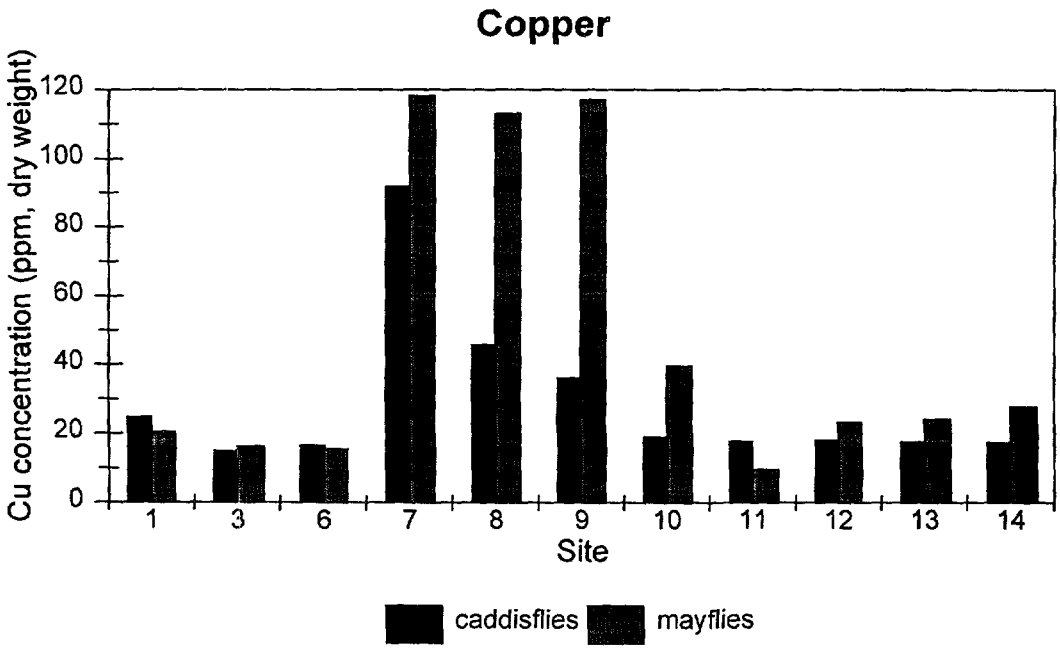


Figure 8. Whole-body iron concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

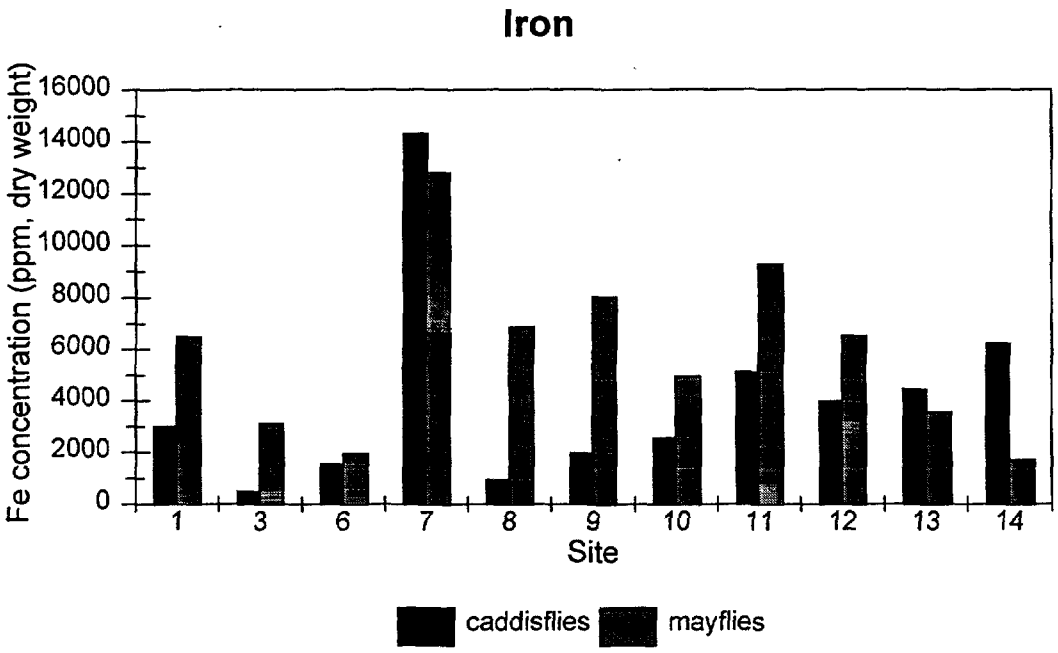


Figure 9. Whole-body lead concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

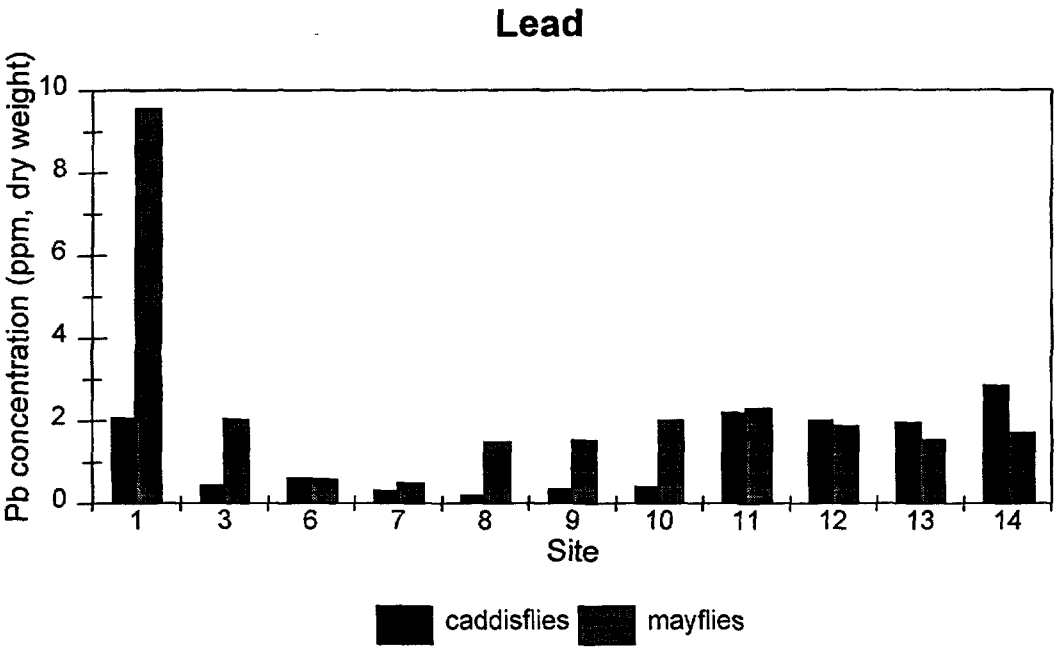


Figure 10. Whole-body manganese concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

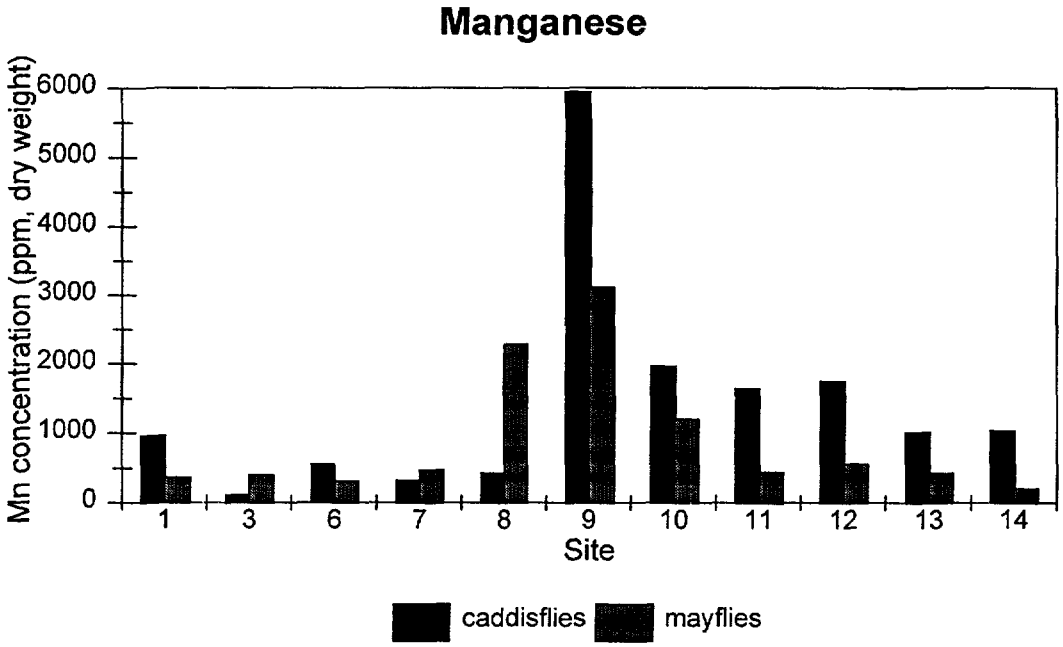


Figure 11. Whole-body mercury concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

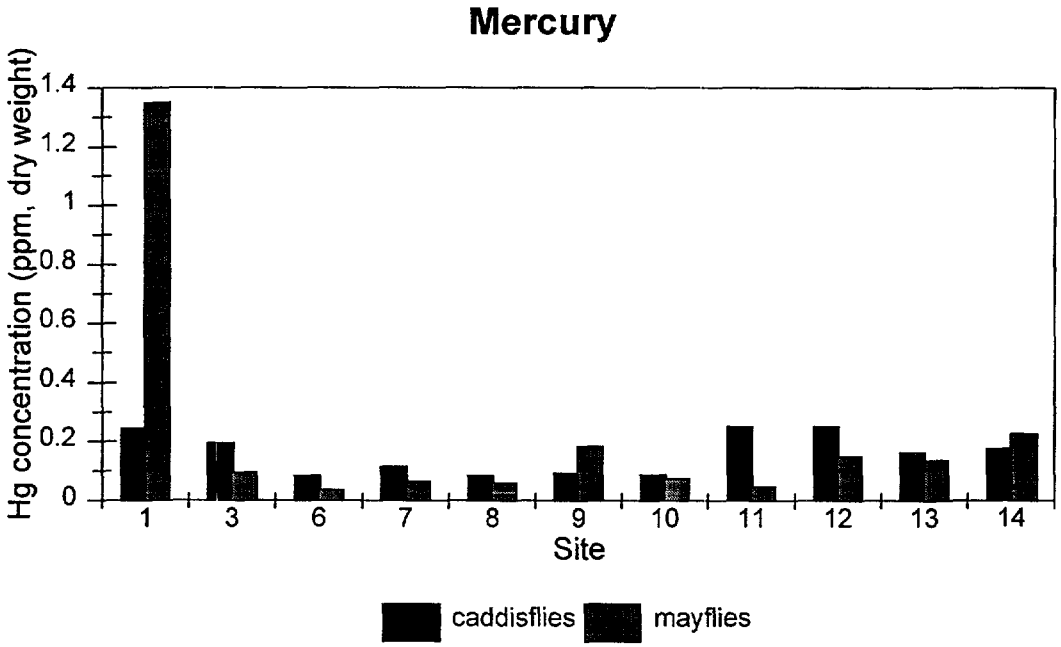


Figure 12. Whole-body nickel concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

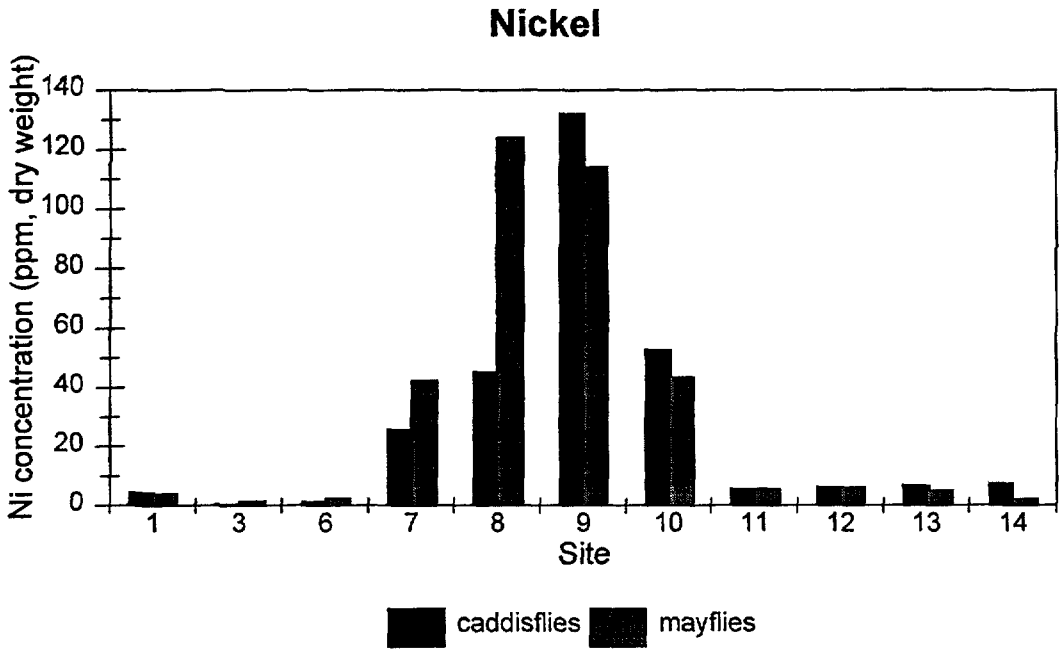


Figure 13. Whole-body selenium concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

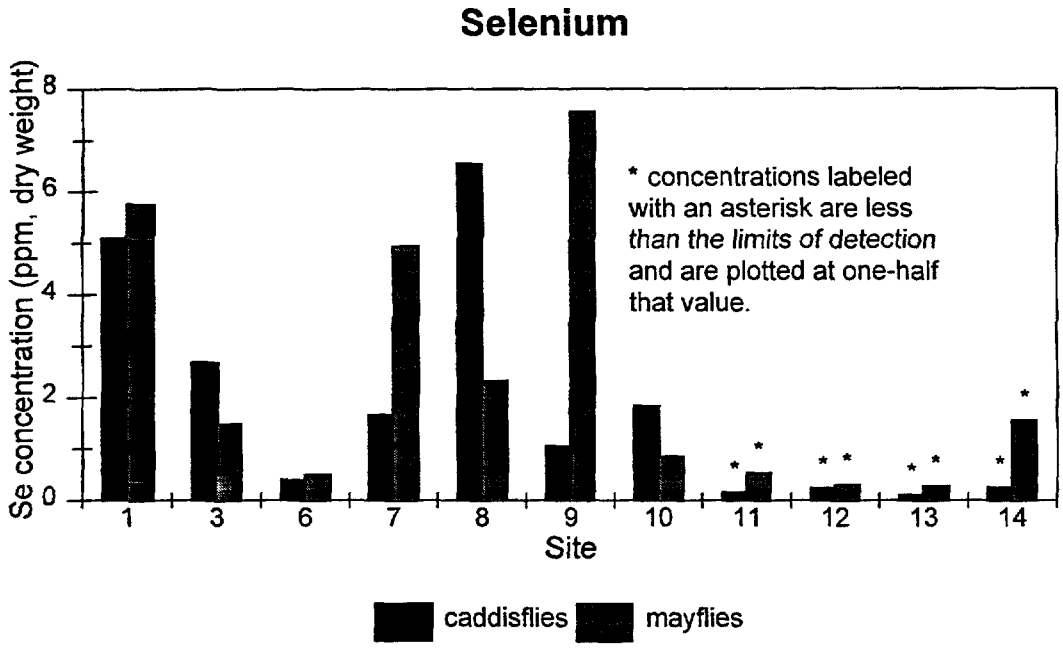


Figure 14. Whole-body silver concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

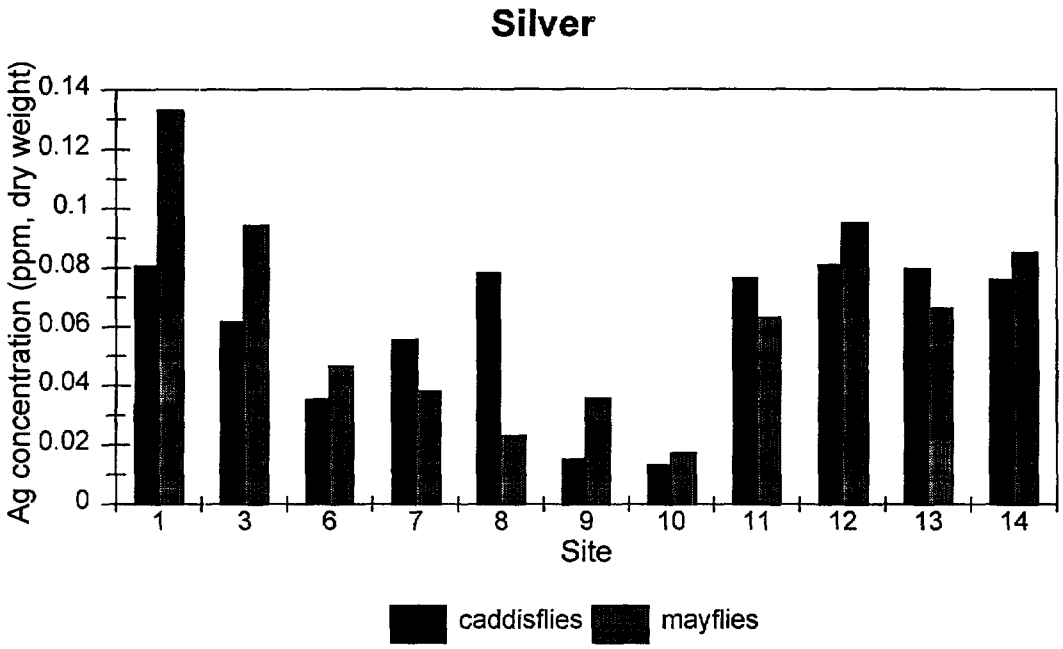


Figure 15. Whole-body vanadium concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.

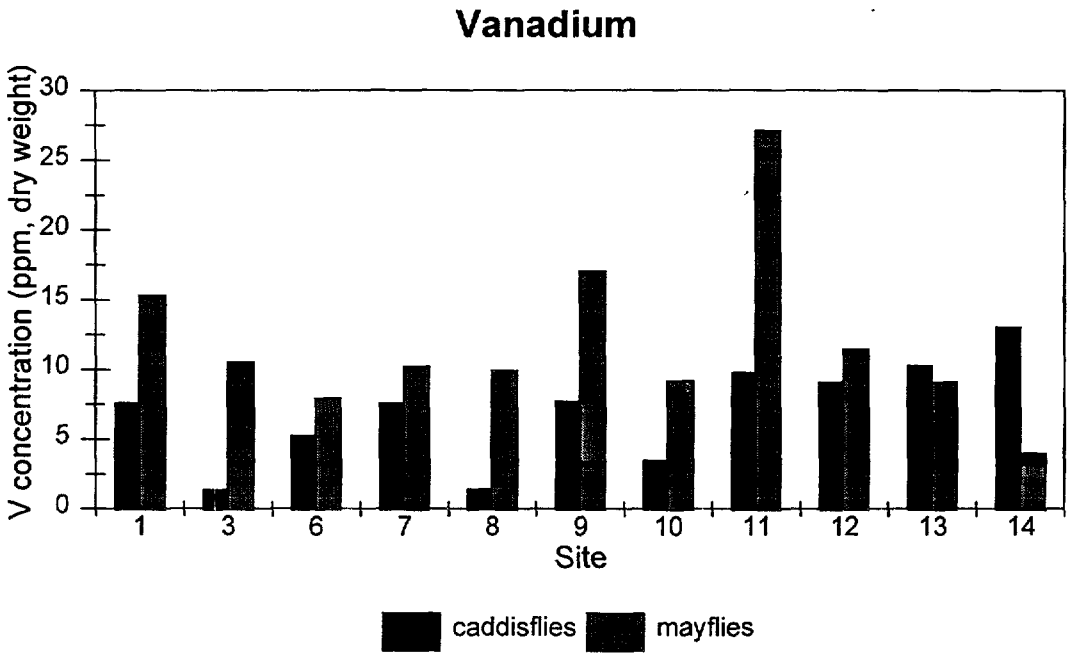
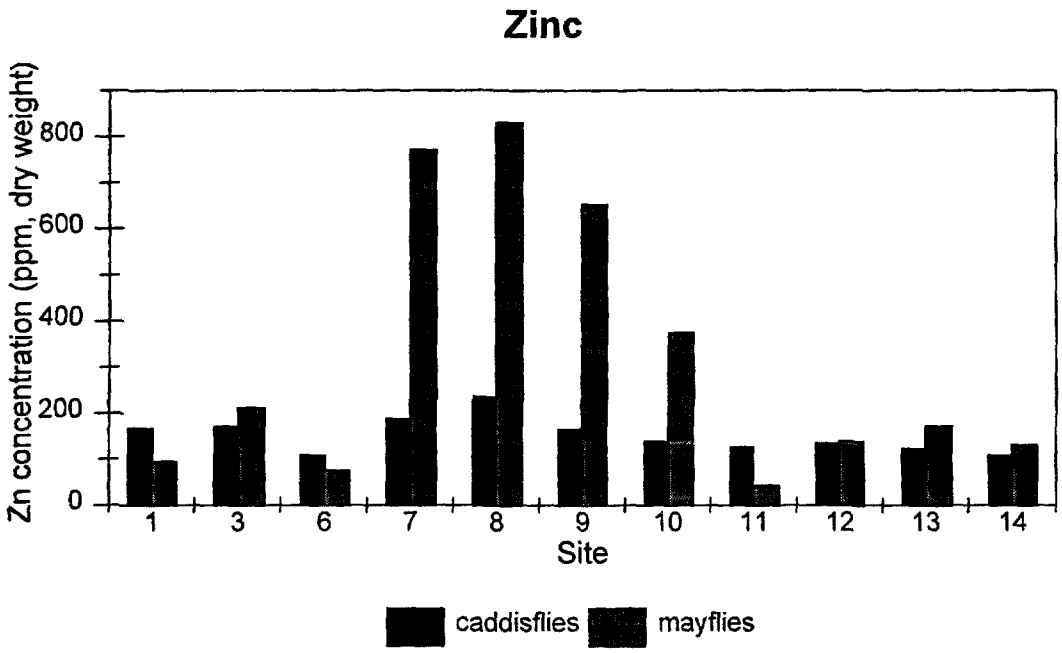


Figure 16. Whole-body zinc concentrations in caddisflies (Family Hydropsychidae) and mayflies (Family Baetidae) collected near the Leviathan Mine, September 21-24, 1998.



RESULTS

C) Concentrations of Metals and Trace Elements in Fish Tissues

Summary statistics were calculated to describe the metal and trace element concentrations in muscle and liver tissues from fish collected upstream of Bryant Creek, downstream of Bryant Creek, and near Ruhenstroth Dam (Tables 4 and 5). Since in some cases reported concentrations were less than the limits of detection, it was necessary to establish conventions to determine appropriate values for statistical calculations. This is because when a value is reported as less than the limit of detection, only the range containing the concentration is known (less than the limit of detection down to and including zero). Since a single value is necessary to calculate some statistics (e.g. a median), a reasonable value between the limit of detection and zero must be chosen. By convention, when the reported sample concentration was less than the limit of detection, a value one-half of the limit of detection was assumed to be the best estimate of the true value and was used in the calculation of summary statistics. When greater than one-half of the samples at a location had reported concentrations less than the limits of detection, no median, lower quartile, or upper quartile statistics were calculated.

To ease site-by-site comparisons, the concentrations of each metal or trace element in muscle and liver tissues were plotted so that data from all three sampled locations are on the same graph (Figures 17-31). By convention, when the reported sample concentration was less than the limit of detection, a value one-half of the limit of detection was used to calculate the statistics that were graphed.

Table 4. Concentrations of metals and trace elements in muscle of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.

Aluminum

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD[a]	< 0.184	0.297	< LOD	< LOD
Downstream of Bryant Cr.	1	0.364	0.364	0.364	--[b]	--
Near Ruhenstroth Dam	5	< LOD	< 0.211	0.380	< LOD	< LOD

Arsenic

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD	< 0.0918	< 0.144	< LOD	< LOD
Downstream of Bryant Cr.	1	< LOD	< 0.0942	< 0.0942	--	--
Near Ruhenstroth Dam	5	< LOD	< 0.0799	< 0.121	< LOD	< LOD

Cadmium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD	< 0.000994	0.00170	< LOD	< LOD
Downstream of Bryant Cr.	1	0.00150	0.00150	0.00150	--	--
Near Ruhenstroth Dam	5	0.00442	0.00185	0.00823	0.00212	0.00492

Chromium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.148	0.114	0.184	0.144	0.161
Downstream of Bryant Cr.	1	0.133	0.133	0.133	--	--
Near Ruhenstroth Dam	5	0.178	0.163	0.186	0.168	0.186

Cobalt

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.0504	0.0182	0.0567	0.0497	0.0510
Downstream of Bryant Cr.	1	0.0717	0.0717	0.0717	--	--
Near Ruhenstroth Dam	5	0.106	0.0354	0.133	0.0903	0.129

[a] The abbreviation "< LOD" means that a median or quartile was not calculated because more than 50% of the samples at the site contained concentrations below the limits of detection.

[b] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.

Table 4. Concentrations of metals and trace elements in muscle of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998 (continued).

Copper

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.460	0.284	0.518	0.316	0.506
Downstream of Bryant Cr.	1	0.579	0.579	0.579	-- [a]	--
Near Ruhenstroth Dam	5	0.484	0.350	0.872	0.385	0.557

Iron

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	5.56	2.87	8.66	4.74	5.95
Downstream of Bryant Cr.	1	6.99	6.99	6.99	--	--
Near Ruhenstroth Dam	5	6.26	4.93	9.77	5.71	9.34

Lead

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.00305	0.00212	0.00682	0.00228	0.00355
Downstream of Bryant Cr.	1	0.00355	0.00355	0.00355	--	--
Near Ruhenstroth Dam	5	0.00419	0.00212	0.00662	0.00348	0.00482

Manganese

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.160	0.112	0.260	0.159	0.217
Downstream of Bryant Cr.	1	0.152	0.152	0.152	--	--
Near Ruhenstroth Dam	5	0.258	0.109	1.05	0.184	0.325

Mercury

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.235	0.0564	0.444	0.135	0.3420
Downstream of Bryant Cr.	1	0.121	0.121	0.121	--	--
Near Ruhenstroth Dam	5	0.166	0.0510	0.360	0.154	0.257

[a] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.

Table 4. Concentrations of metals and trace elements in muscle of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998 (concluded).

Nickel

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD[a]	< 0.00918	0.0116	< LOD	< LOD
Downstream of Bryant Cr.	1	0.0112	0.0112	0.0112	--[b]	--
Near Ruhenstroth Dam	5	0.0189	0.0111	0.0562	0.0111	0.0234

Selenium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.183	0.127	0.315	0.155	0.194
Downstream of Bryant Cr.	1	0.213	0.213	0.213	--	--
Near Ruhenstroth Dam	5	0.231	0.142	0.323	0.149	0.310

Silver

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD	< 0.000918	0.00102	< LOD	< LOD
Downstream of Bryant Cr.	1	0.00116	0.00116	0.00116	--	--
Near Ruhenstroth Dam	5	< LOD	< 0.000799	0.00214	< LOD	< LOD

Vanadium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.0383	0.0267	0.0439	0.0356	0.0414
Downstream of Bryant Cr.	1	0.0246	0.0246	0.0246	--	--
Near Ruhenstroth Dam	5	0.0430	0.0332	0.059	0.0427	0.0518

Zinc

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	2.95	2.58	3.35	2.65	3.26
Downstream of Bryant Cr.	1	3.80	3.80	3.80	--	--
Near Ruhenstroth Dam	5	3.32	2.71	4.27	3.25	3.71

[a] The abbreviation "< LOD" means that a median or quartile was not calculated because more than 50% of the samples at the site contained concentrations below the limits of detection.

[b] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.

Table 5. Concentrations of metals and trace elements in liver of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.

Aluminum

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.426	< 0.188	2.92	0.0954	0.899
Downstream of Bryant Cr.	1	0.221	0.221	0.221	-- [a]	--
Near Ruhenstroth Dam	5	0.510	< 0.224	2.51	0.413	1.64

Arsenic

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	< LOD[b]	< 0.0751	< 0.105	< LOD	< LOD
Downstream of Bryant Cr.	1	< LOD	< 0.0737	< 0.0737	--	--
Near Ruhenstroth Dam	5	< LOD	< 0.0613	< 0.112	< LOD	< LOD

Cadmium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.0472	0.0190	0.0870	0.0292	0.0844
Downstream of Bryant Cr.	1	0.0178	0.0178	0.0178	--	--
Near Ruhenstroth Dam	5	0.115	0.0167	0.732	0.0769	0.170

Chromium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.262	0.210	0.279	0.240	0.275
Downstream of Bryant Cr.	1	0.175	0.175	0.175	--	--
Near Ruhenstroth Dam	5	0.227	0.160	0.256	0.226	0.237

Cobalt

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.404	0.205	0.530	0.207	0.484
Downstream of Bryant Cr.	1	0.353	0.353	0.353	--	--
Near Ruhenstroth Dam	5	0.510	0.263	0.769	0.474	0.664

[a] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.
[b] The abbreviation "< LOD" means that a median or quartile was not calculated because more than 50% of the samples at the site contained concentrations below the limits of detection.

Table 5. Concentrations of metals and trace elements in liver of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998 (continued).

Copper

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	1.13	0.838	4.70	1.00	1.81
Downstream of Bryant Cr.	1	1.38	1.38	1.38	--[a]	--
Near Ruhenstroth Dam	5	3.41	1.12	10.0	1.47	3.47

Iron

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	122	80.1	172	104	151
Downstream of Bryant Cr.	1	65.6	65.6	65.6	--	--
Near Ruhenstroth Dam	5	92.4	45.5	140	70.3	99.2

Lead

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.00643	0.00256	0.0178	0.00470	0.00706
Downstream of Bryant Cr.	1	0.00246	0.00246	0.00246	--	--
Near Ruhenstroth Dam	5	0.00488	0.00327	0.00530	0.00477	0.00505

Manganese

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	1.63	0.644	4.58	1.08	2.42
Downstream of Bryant Cr.	1	0.958	0.958	0.958	--	--
Near Ruhenstroth Dam	5	1.92	1.22	5.20	1.31	3.67

Mercury

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.640	0.102	1.37	0.376	1.10
Downstream of Bryant Cr.	1	0.188	0.188	0.188	--	--
Near Ruhenstroth Dam	5	0.373	0.123	0.780	0.258	0.601

[a] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.

Table 5. Concentrations of metals and trace elements in liver of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998 (concluded).

Nickel

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.0163	0.00989	0.0349	0.0100	0.0304
Downstream of Bryant Cr.	1	0.0559	0.0559	0.0559	-- [a]	--
Near Ruhenstroth Dam	5	0.0414	0.0230	0.0893	0.0413	0.0889

Selenium

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	2.02	1.38	3.87	1.38	3.40
Downstream of Bryant Cr.	1	2.01	2.01	2.01	--	--
Near Ruhenstroth Dam	5	1.62	0.724	3.20	1.39	1.66

Silver

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.0126	0.00262	0.0616	0.00385	0.0217
Downstream of Bryant Cr.	1	0.0232	0.0232	0.0232	--	--
Near Ruhenstroth Dam	5	0.0312	0.00322	0.175	0.00402	0.0619

Vanadium

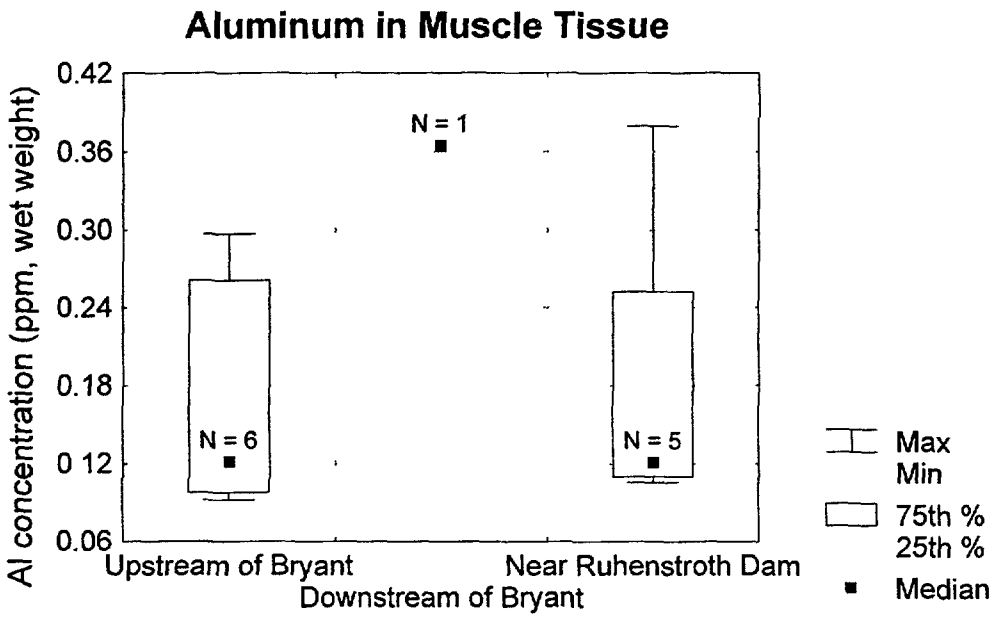
Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	0.145	0.0613	0.402	0.0849	0.312
Downstream of Bryant Cr.	1	0.0308	0.0308	0.0308	--	--
Near Ruhenstroth Dam	5	0.131	0.0649	0.334	0.0694	0.230

Zinc

Site Location	Sample Size	Median (ppm, wet wt.)	Minimum (ppm, wet wt.)	Maximum (ppm, wet wt.)	Lower Quartile (ppm, wet wt.)	Upper Quartile (ppm, wet wt.)
Upstream of Bryant Cr.	6	14.7	10.4	18.1	11.7	16.3
Downstream of Bryant Cr.	1	11.8	11.8	11.8	--	--
Near Ruhenstroth Dam	5	15.9	11.4	19.7	15.6	16.6

[a] The symbol "--" means that the lower and upper quartiles could not be calculated because only a single sample was collected.

Figure 17. Aluminum concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



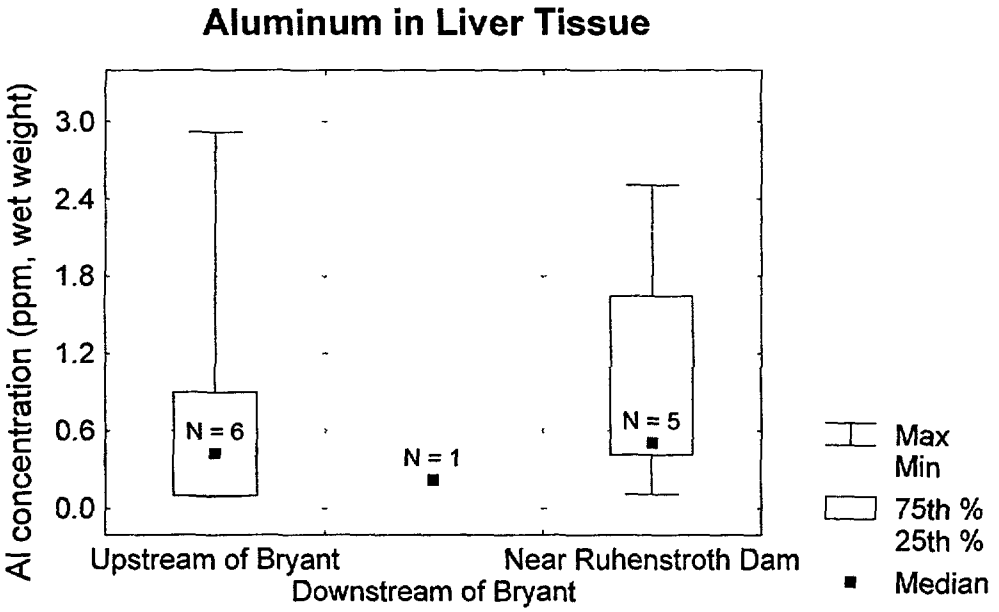
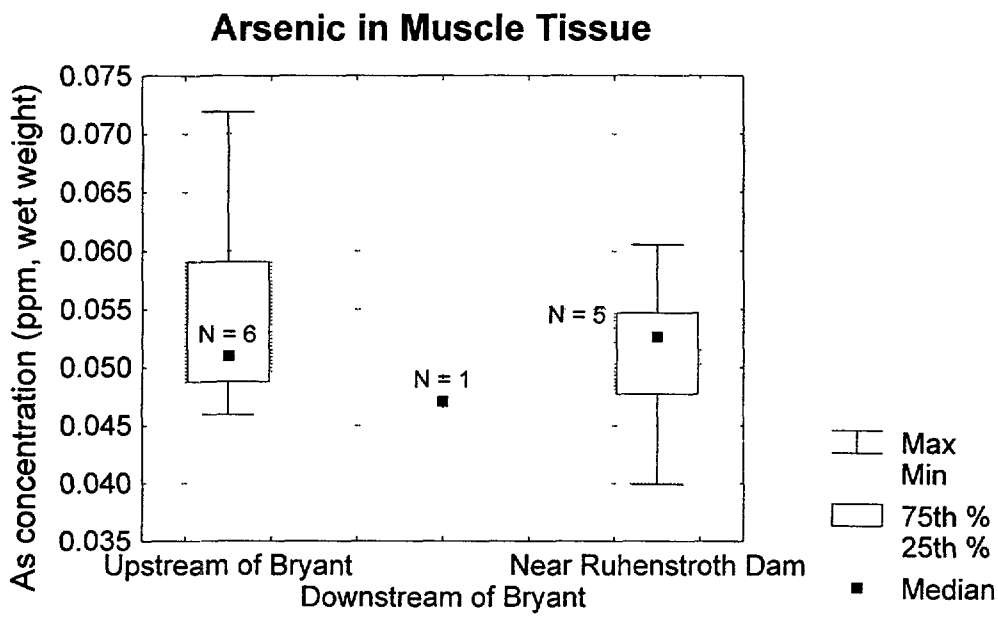


Figure 18. Arsenic concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



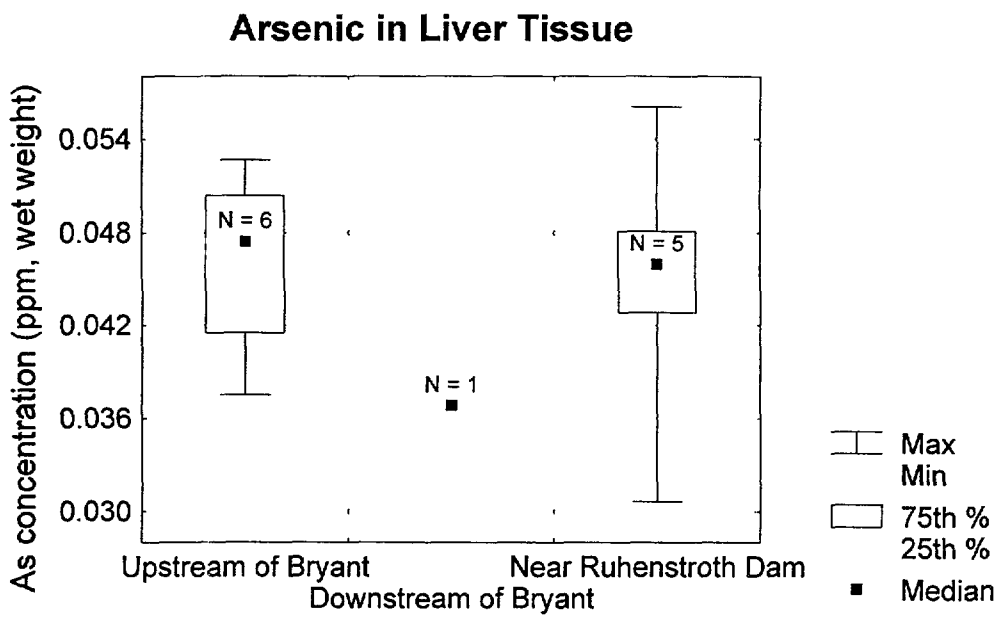
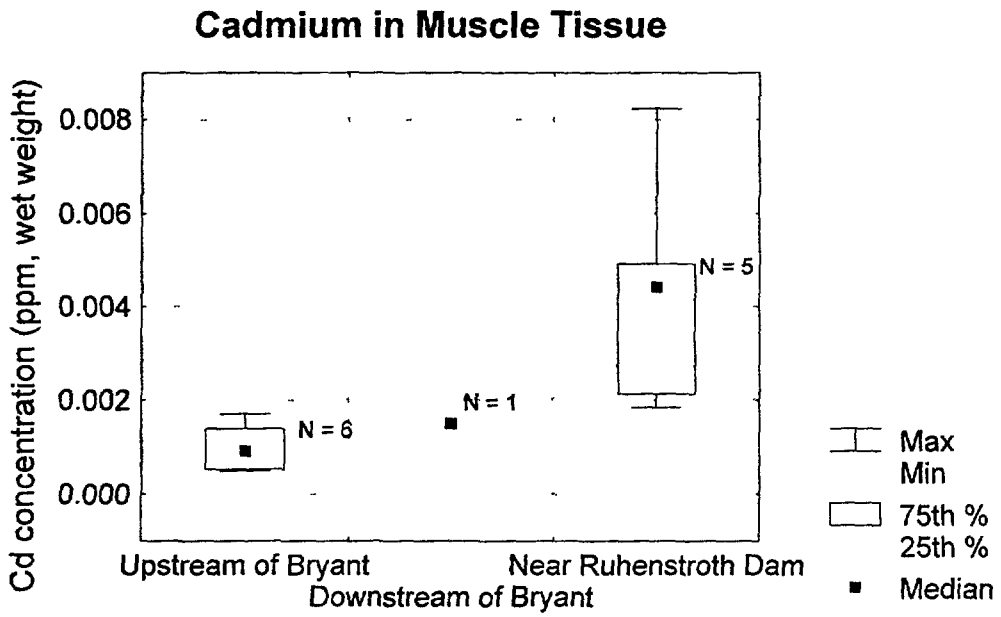


Figure 19. Cadmium concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



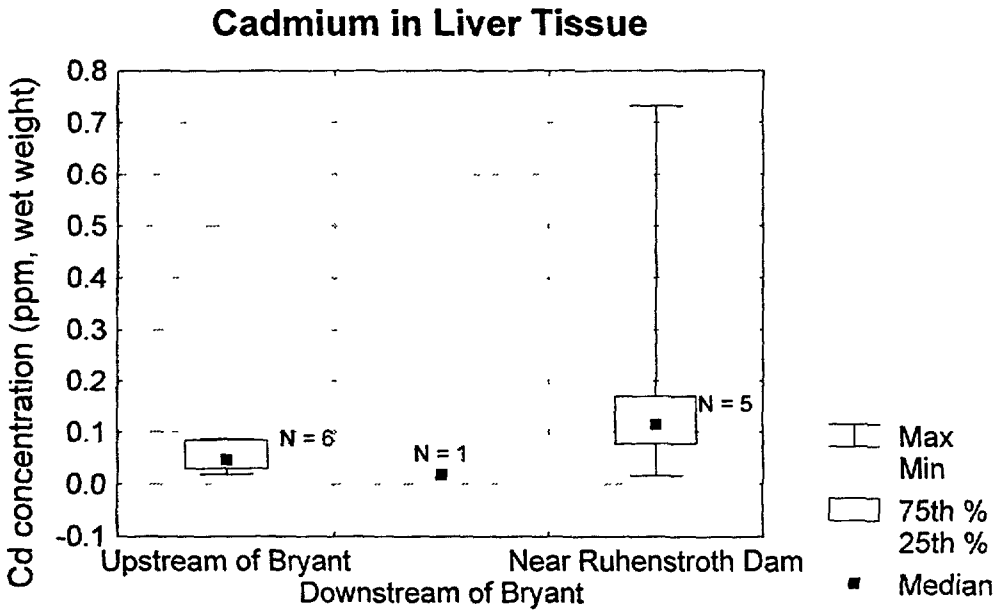
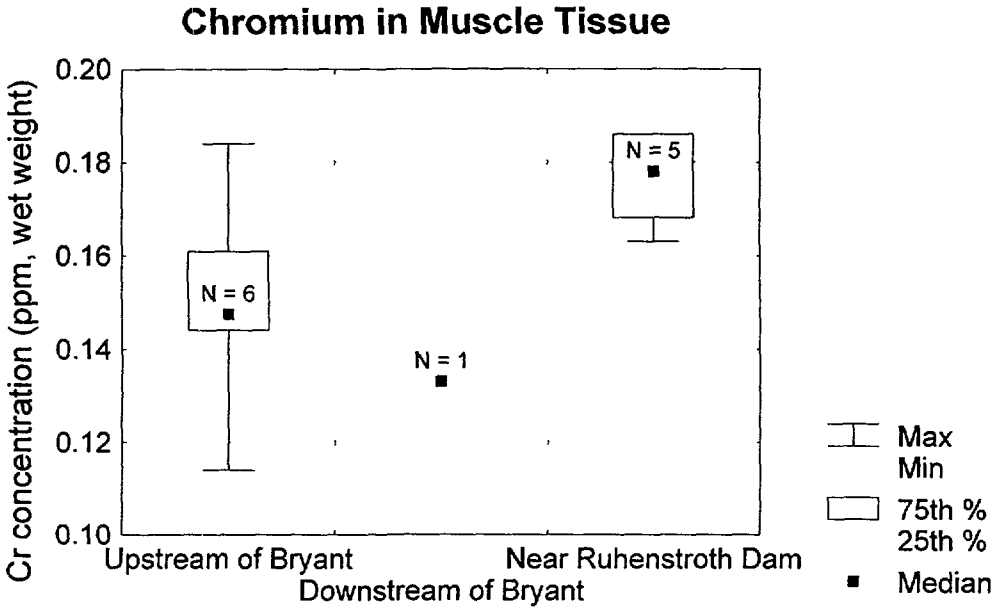


Figure 20. Chromium concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



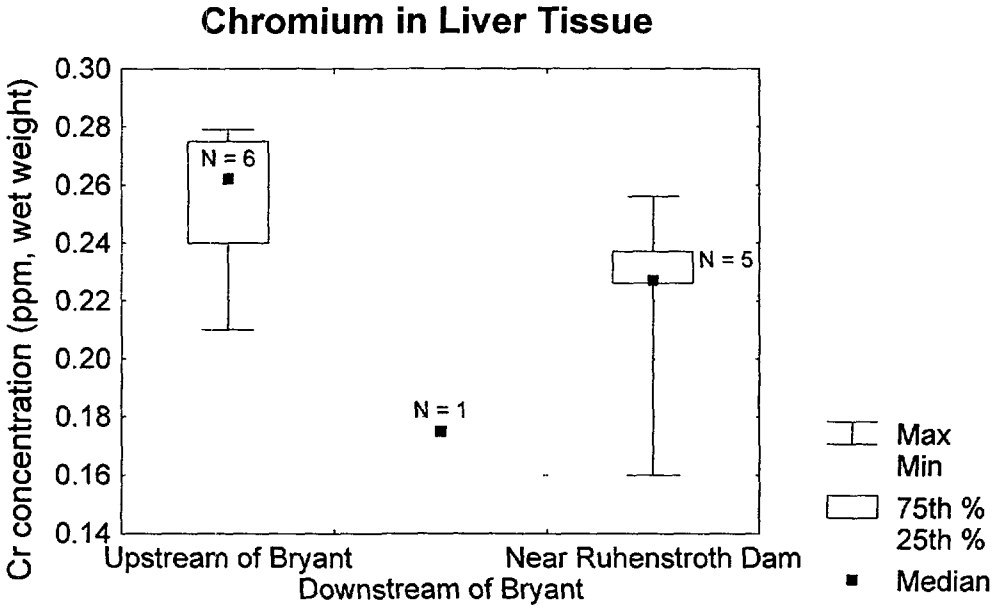
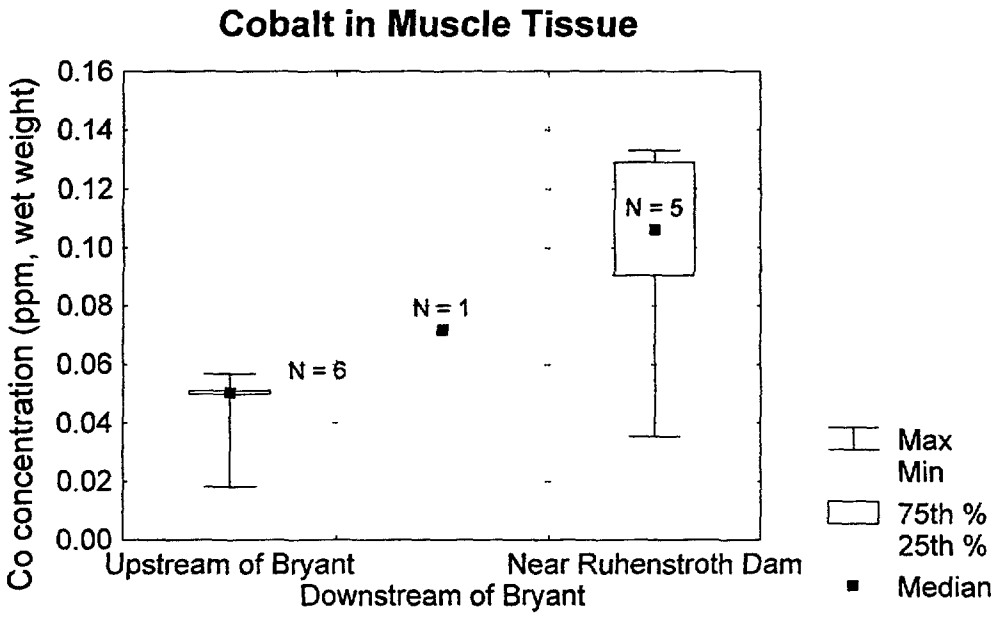


Figure 21. Cobalt concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



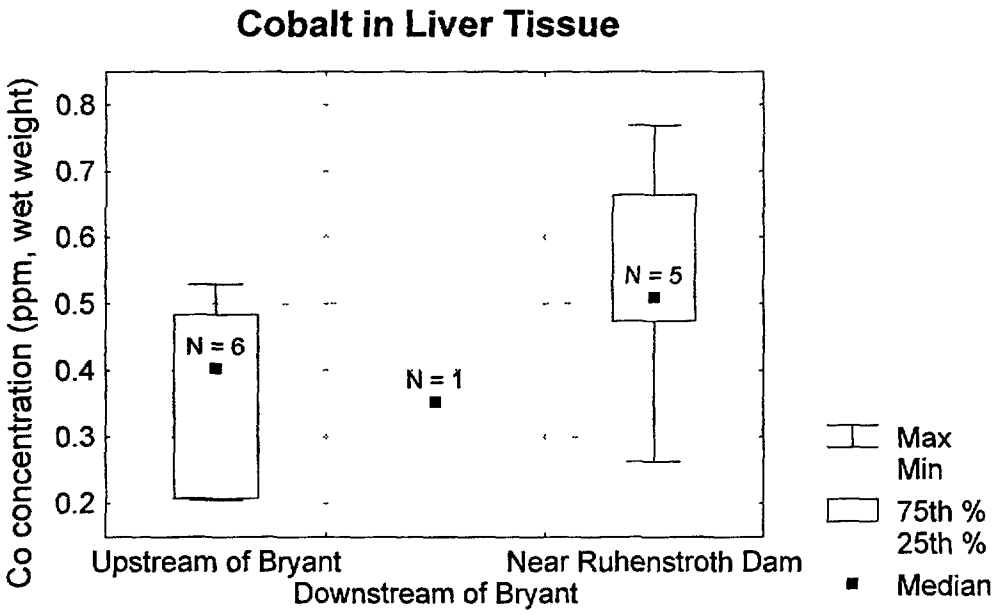
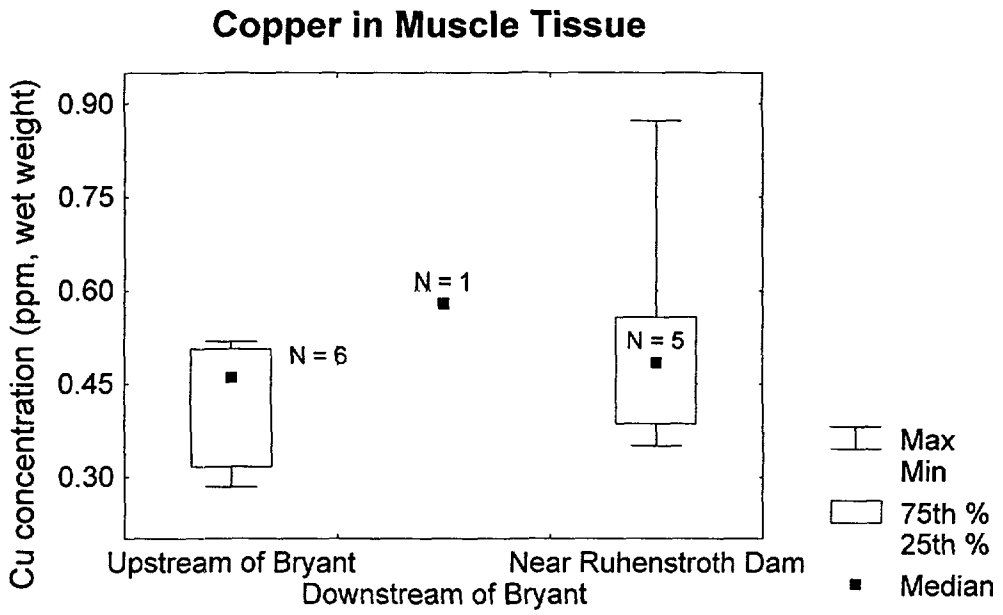


Figure 22. Copper concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



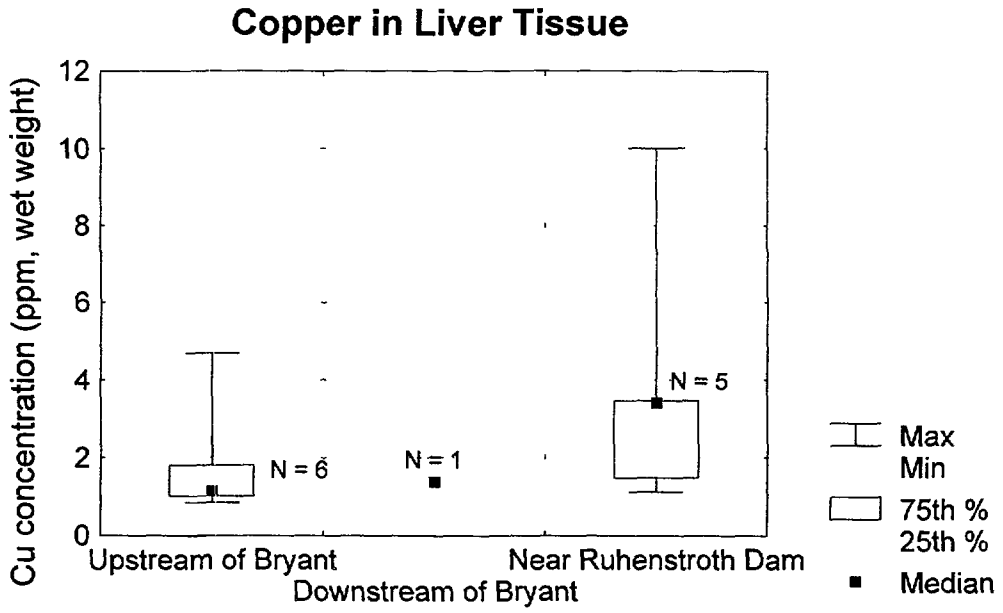
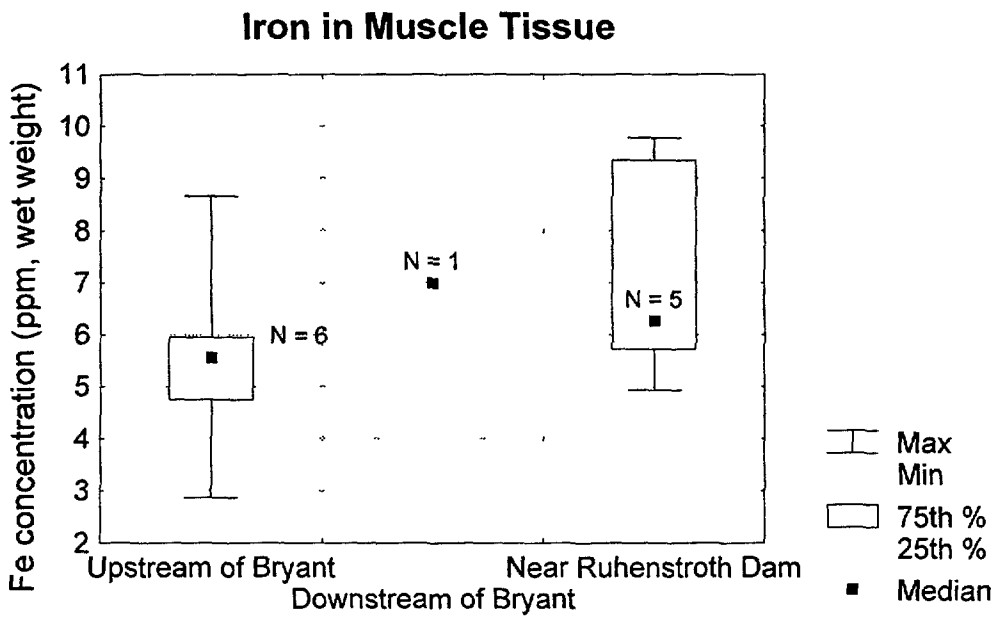


Figure 23. Iron concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



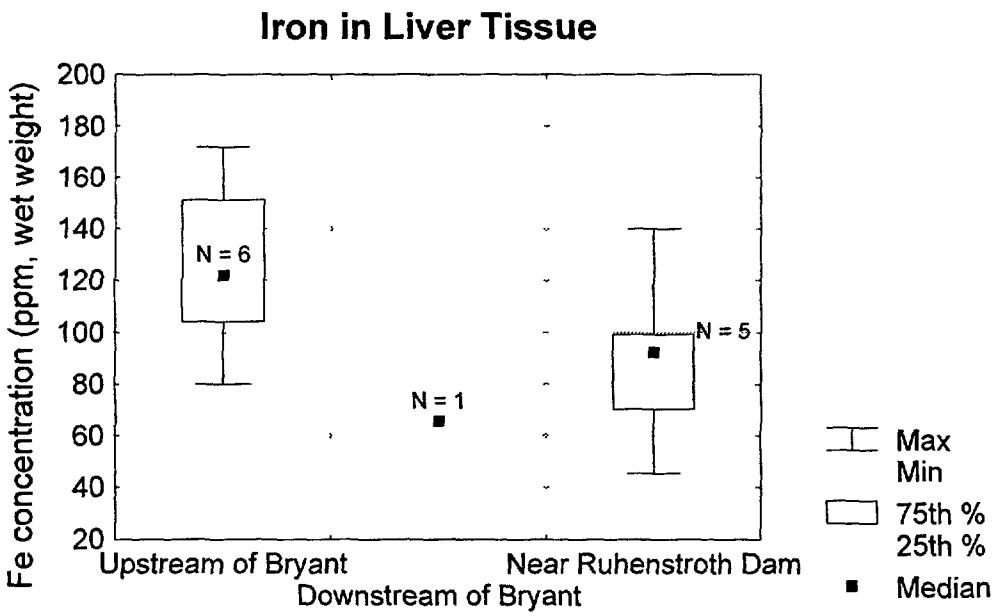
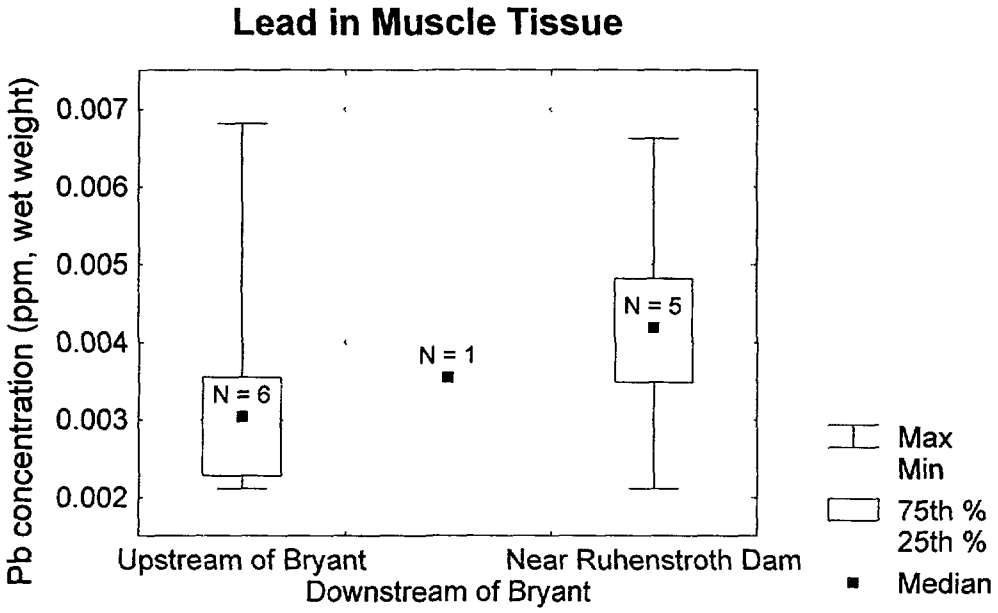


Figure 24. Lead concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



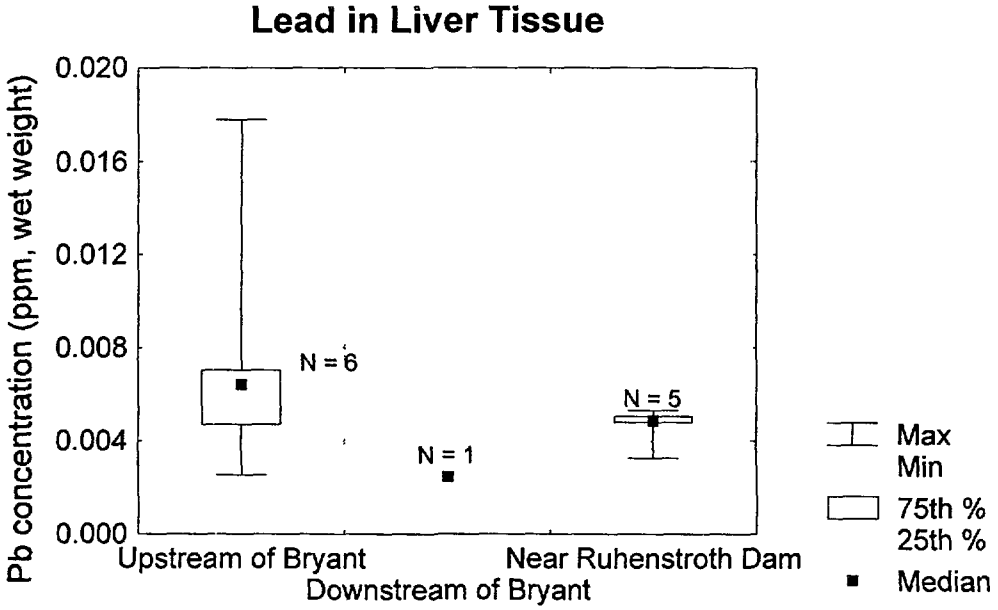
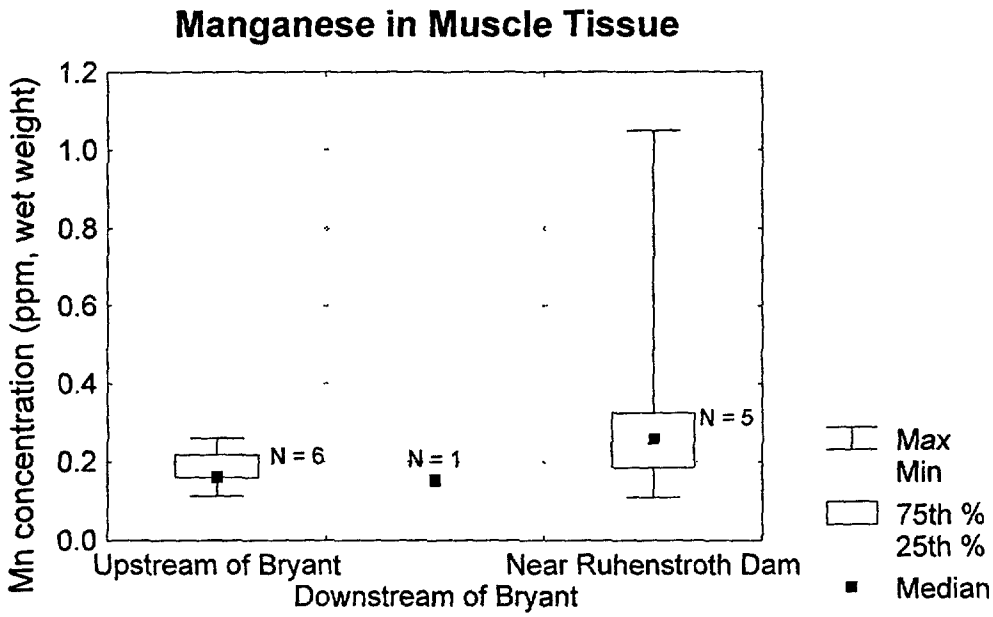


Figure 25. Manganese concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



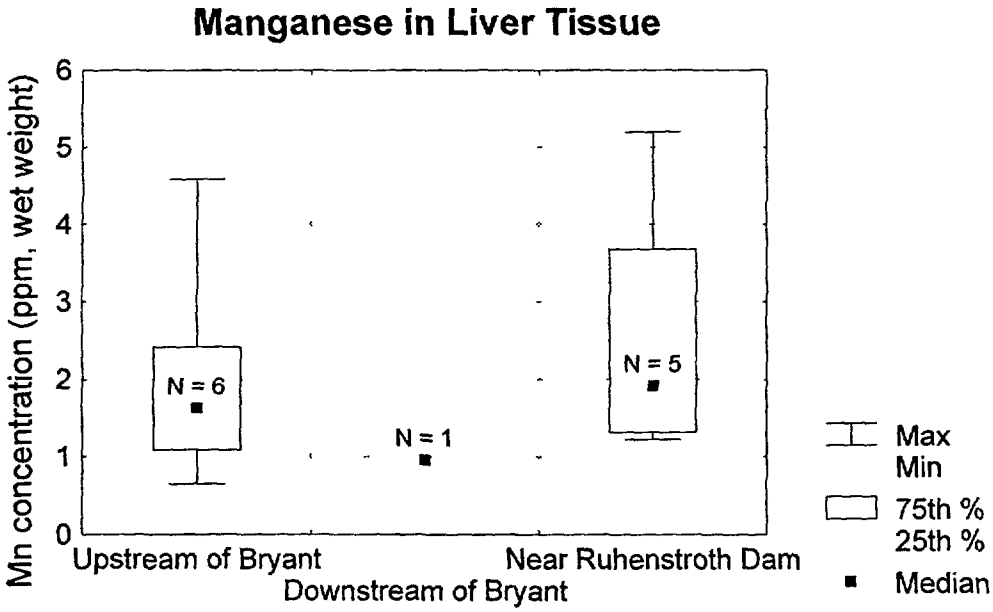
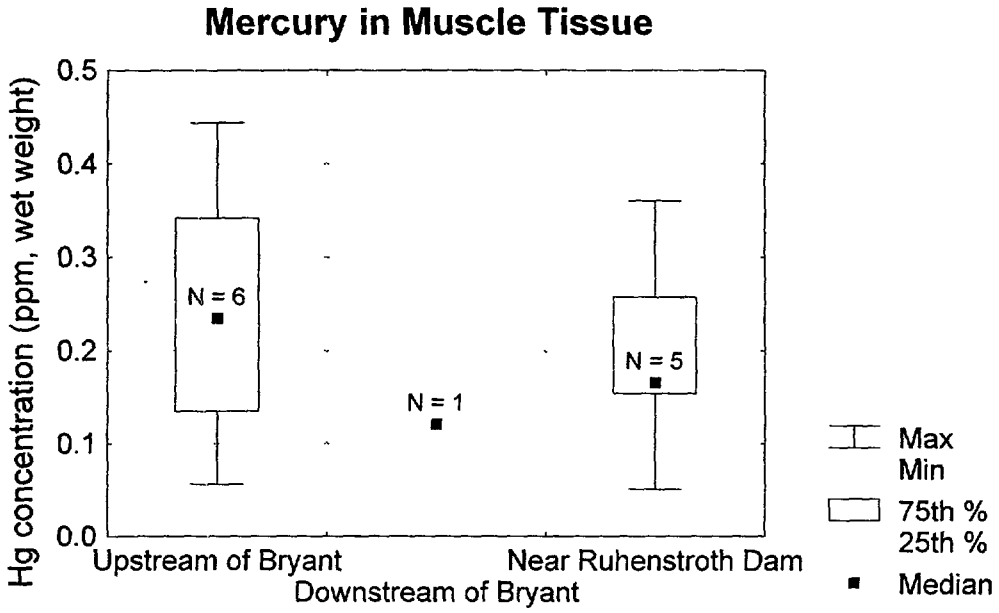


Figure 26. Mercury concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



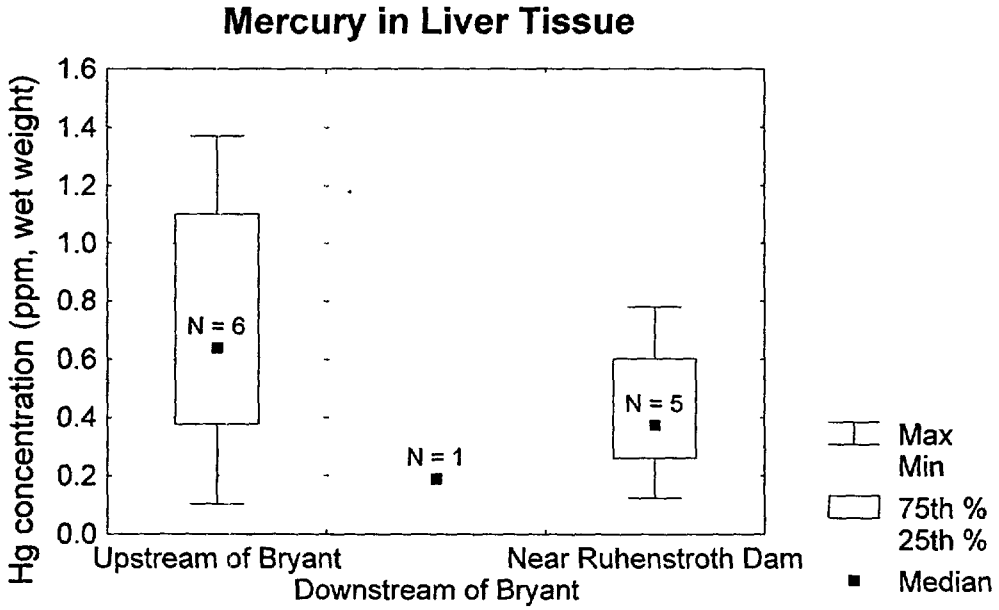
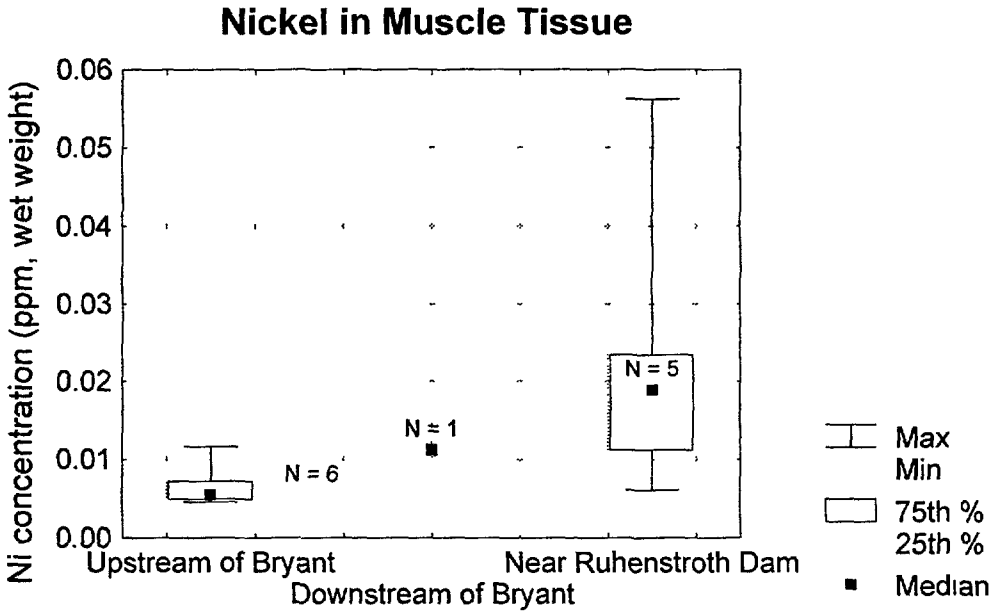


Figure 27. Nickel concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



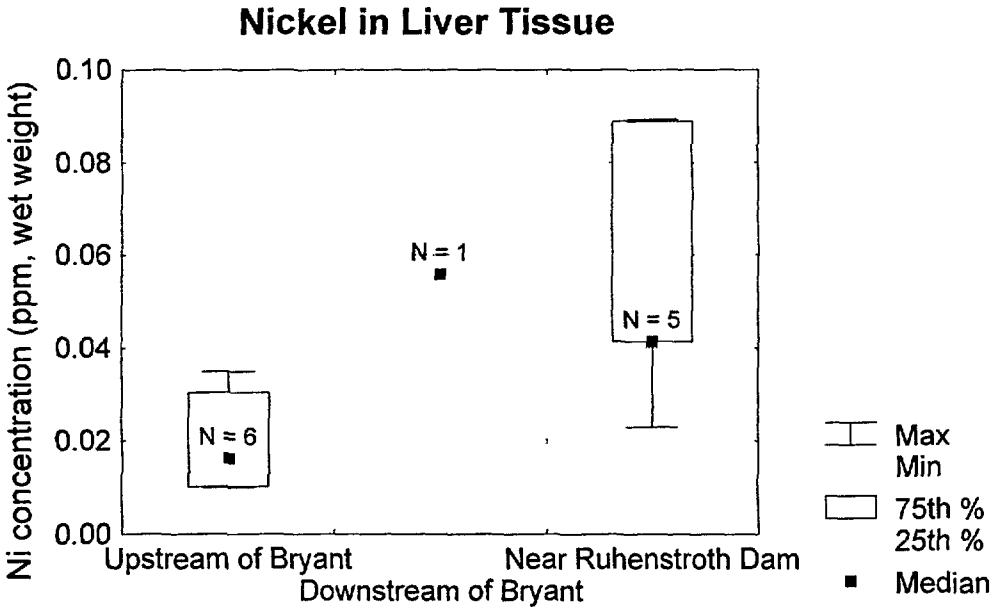
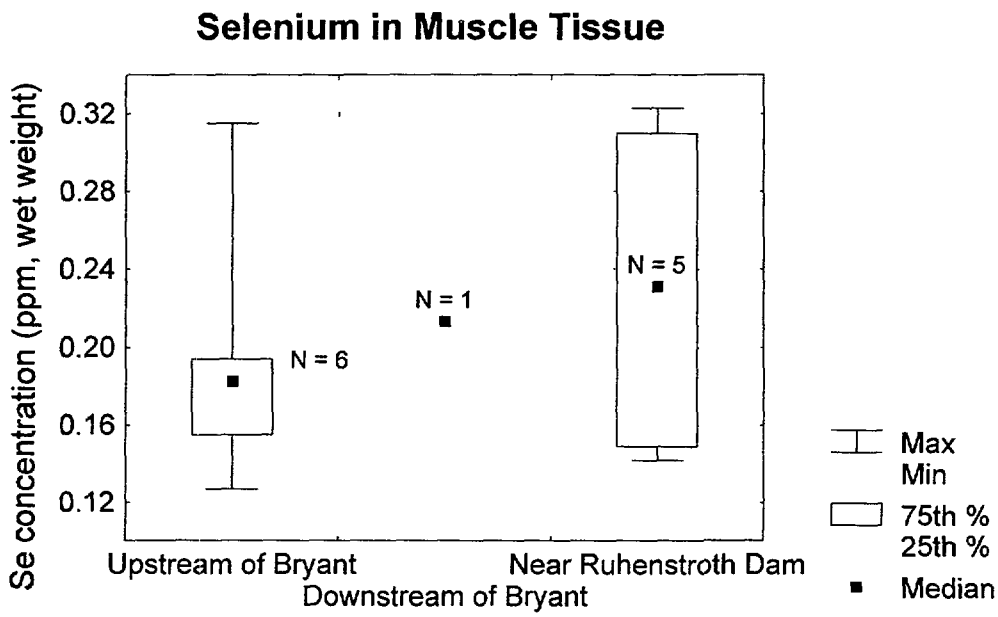


Figure 28. Selenium concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



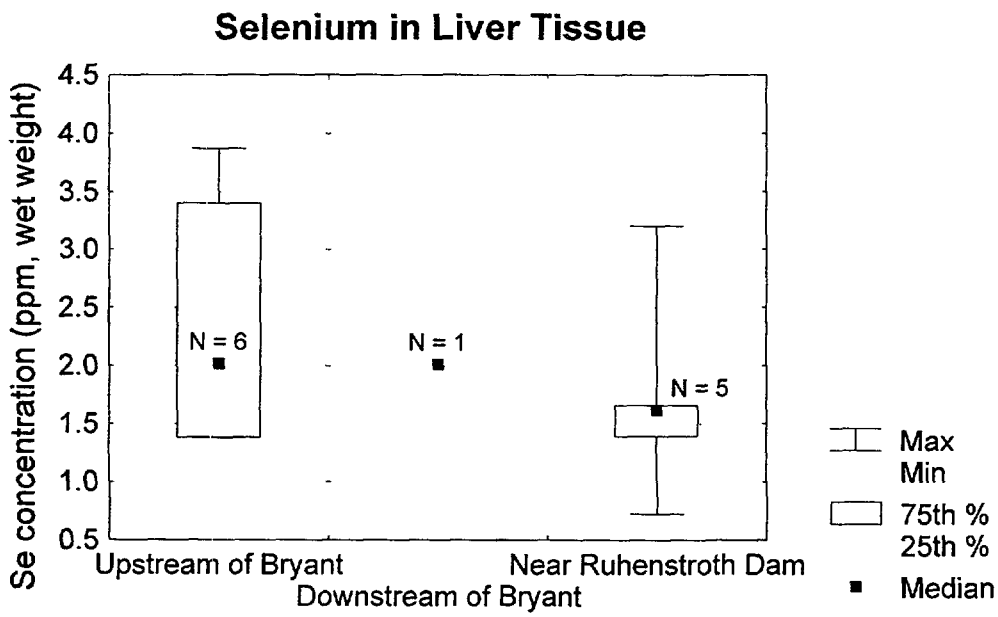
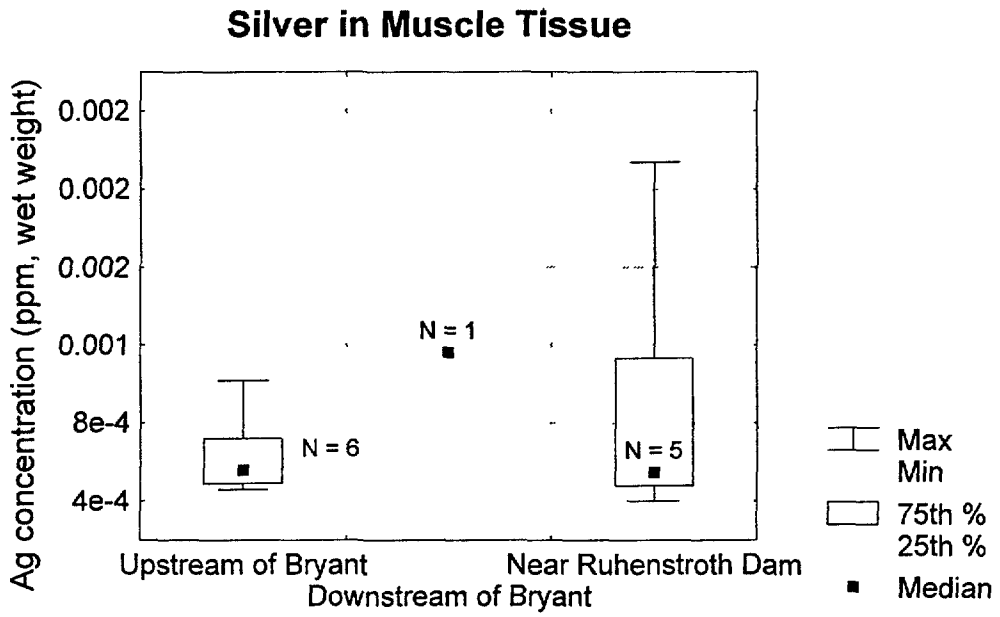


Figure 29. Silver concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



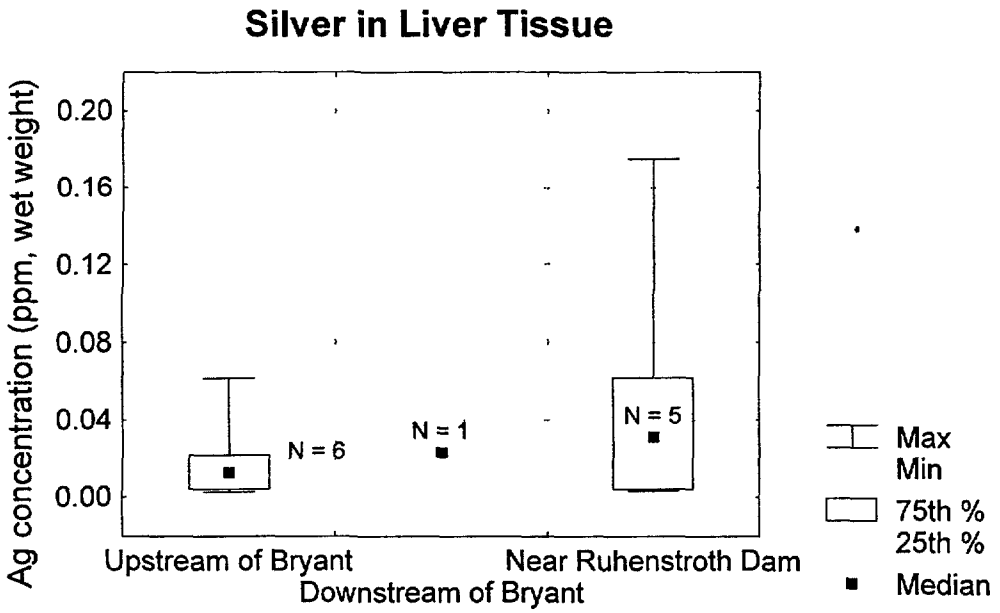
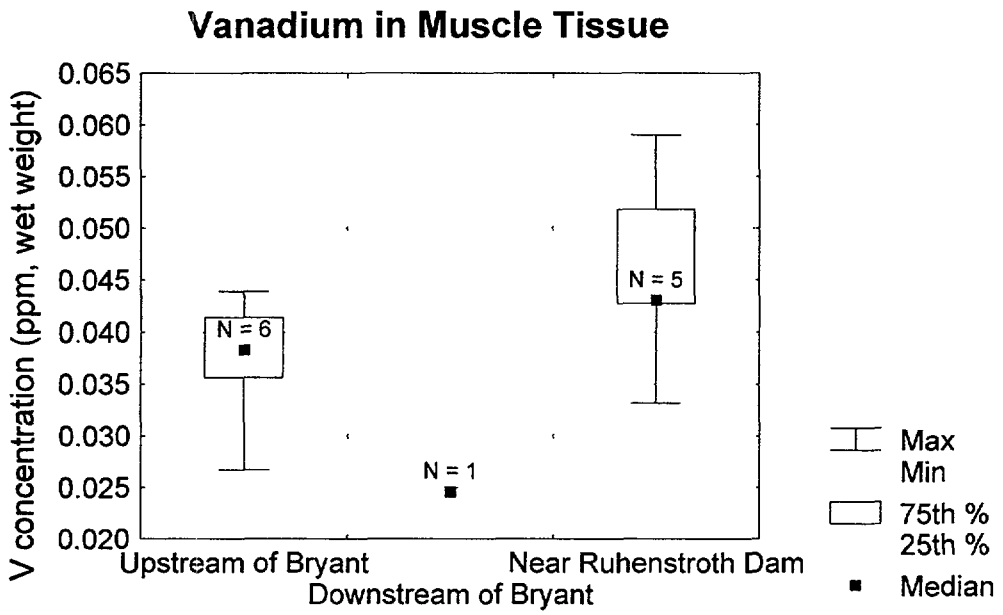


Figure 30. Vanadium concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.



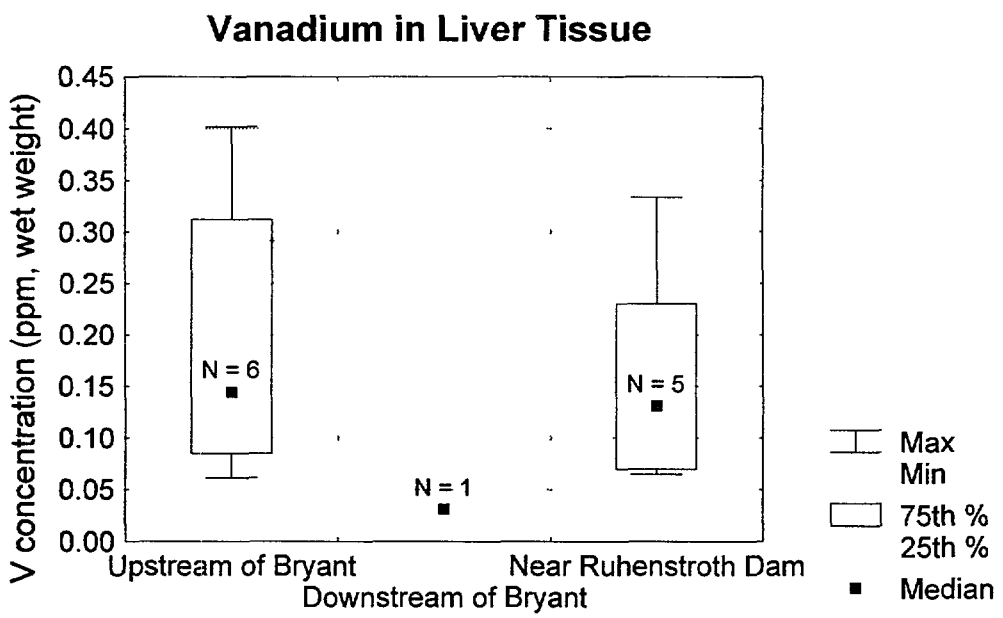
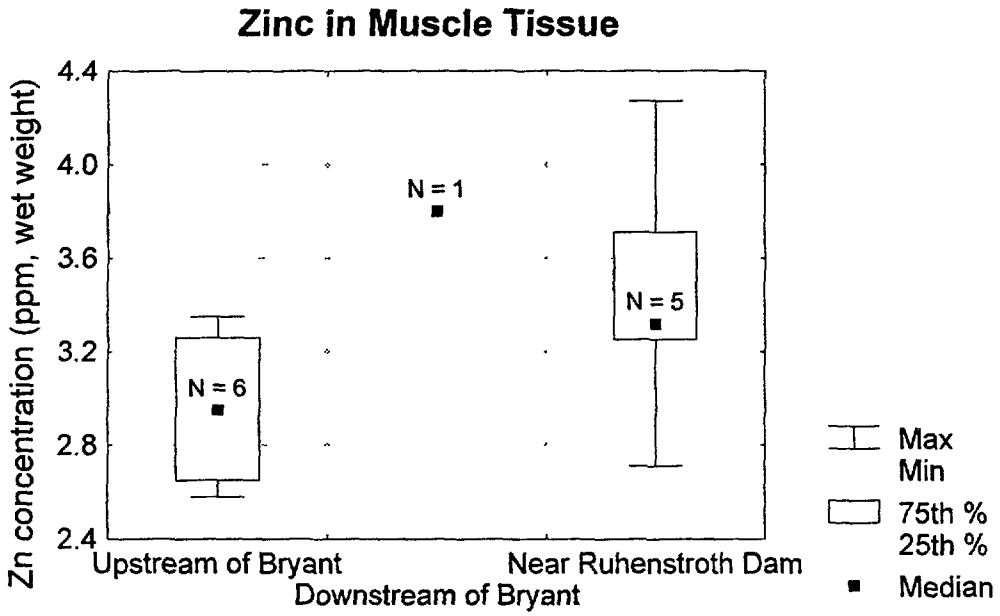
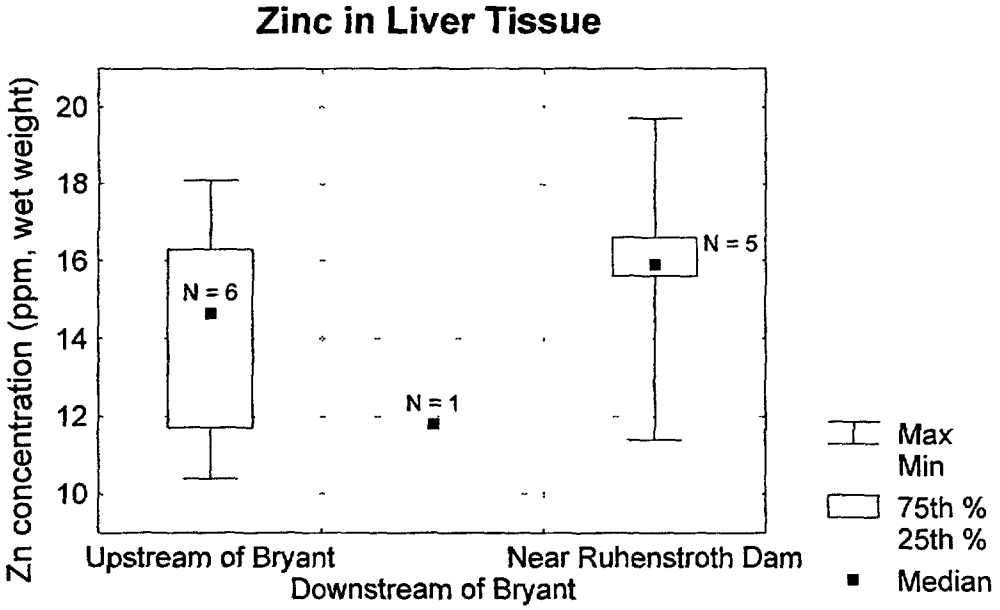


Figure 31. Zinc concentrations in muscle and liver tissues of mountain whitefish (*Prosopium williamsoni*) collected in the East Fork Carson River, October 27-28, 1998.





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APPENDICES

Appendix A. Field-measured wet weights of aquatic insects sampled near the Leviathan Mine for metal and trace element analyses.

Sample Number	Aquatic Insect Family	Wet Weight (grams)	Site Number[a]	Date Sampled
01BTIS01	Hydropsychidae	0.6	1	09/24/98
01BTIS02	Baetidae	0.3	1	09/24/98
03BTIS01	Hydropsychidae	0.3	3	09/24/98
03BTIS02	Baetidae	0.7	3	09/24/98
06BTIS01	Hydropsychidae	1.6	6	09/22/98
06BTIS02	Baetidae	0.8	6	09/22/98
07BTIS01	Hydropsychidae	0.2	7	09/22/98
07BTIS02	Baetidae	0.5	7	09/22/98
08BTIS01	Hydropsychidae	0.1	8	09/21/98
08BTIS02	Baetidae	1.4	8	09/21/98
09BTIS01	Hydropsychidae	1.7	9	09/21/98
09BTIS02	Baetidae	1.3	9	09/21/98
10BTIS01	Hydropsychidae	1.9	10	09/21/98
10BTIS02	Baetidae	0.4	10	09/21/98
11BTIS01	Hydropsychidae	0.6	11	09/21/98
11BTIS02	Baetidae	0.1	11	09/21/98
12BTIS01	Hydropsychidae	0.4	12	09/21/98
12BTIS02	Baetidae	0.3	12	09/21/98
13BTIS01	Hydropsychidae	1.5	13	09/23/98
13BTIS02	Baetidae	0.5	13	09/23/98
14BTIS01	Hydropsychidae	1.8	14	09/23/98
14BTIS02	Baetidae	0.1	14	09/23/98

[a] Site locations are illustrated by number in Figure 1 and described in Table 1.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 014

Lab Matrix	Analyte(s)
Animal Tissue	% Moisture

METHOD CODE: 014

LABORATORY: Trace Element Research Laboratory

Moisture content of sediment, soil, and tissue samples.

XIV. Moisture content is determined by weight loss upon freeze-drying, and is expressed as weight percent of the original wet sample. Depending upon sample size, either the whole sample or a representative aliquot is frozen and then dried under vacuum until a constant weight is attained. Samples are prepared and dried using plastic materials, whenever possible, in order to minimize potential contamination artifacts that might impact subsequent trace element analysis.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 003 007

Lab Matrix	Analyte(s)
Animal Tissue	Hg

METHOD CODE: 003

LABORATORY: Trace Element Research Laboratory

Digestion of water, soil, sediment, and biological tissue for mercury analysis.

III. Before samples are analyzed by the CVAAS method in use in this laboratory, the mercury is converted to the Hg2+ form. Mercury is digested by a modified version of EPA method 245.5 and 245.6. Sediment and tissue samples can be analyzed either freeze dried or on a wet basis. Sediment samples are homogenized by mixing before subsampling, while tissue samples are homogenized in the original sample containers either after freeze drying or with a Tekmar Tissumizer and subsampled. Samples are digested with nitric acid, sulfuric acid, potassium permanganate, and potassium persulfate in polypropylene tubes in a water bath at 90-95 C. Before analysis, hydroxylamine hydrochloride is added to reduce excess permanganate and the samples are brought to volume with distilled-deionized water.

METHOD CODE: 007

LABORATORY: Trace Element Research Laboratory

Analysis of mercury by cold-vapor atomic absorption spectroscopy (CVAAS).

VII. In this procedure, divalent mercury (Hg++) in aqueous samples (digests of water, tissue or sediment samples) is reduced to the elemental state (Hgo) by a strong reducing agent (stannous chloride). Gaseous Hgo enters the sweep gas and is introduced into an atomic absorption cell, where light produced by a mercury vapor lamp is absorbed by the free Hg atoms. Mercury in the sample is determined by comparing light absorption of the sample with that of external calibration standards.

ANALYTICAL METHODS (Cont.)

positively-charged ions on the basis of their mass:charge ratios (m:z) by a quadrupole mass spectrometer. The method offers extremely low detection limits but is subject to interferences from atomic and molecular ions having values within 1 AMU of the target ions. Sample preconcentration and matrix elimination can sometimes eliminate these problems, along with those resulting from high total dissolved solids.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 001 016

Lab Matrix	Analyte(s)
Animal Tissue	Ag
	Cd
	Co
	Cr
	Cu
	Fe
	Mn
	Ni
	Pb
	V

METHOD CODE: 001

LABORATORY: Trace Element Research Laboratory

Digestion of biological tissue.

I. Liquid or solid biological tissue samples are wet digested with nitric acid and converted into acidic digest solutions for analysis by various atomic spectroscopy methods. When possible, tissue is freeze dried in order to minimize loss of analytes and to facilitate subsequent sample preparation steps, and then homogenized to a fine powder by ball-milling in plastic containers. Approximately 0.20 to 0.25 g of powdered tissue is weighed into a Teflon reaction vessel and 3 ml of HNO_3 are added. The closed reaction vessel is heated in a 130 C oven until digestion is complete. Samples are then diluted to a final volume of 20 ml with quartz distilled water and stored in 1 oz. polyethylene bottles for later analysis by instrumental techniques.

METHOD CODE: 016

LABORATORY: Trace Element Research Laboratory

Analysis of trace metals in water samples by inductively coupled plasma-mass spectroscopy (ICP-MS).

XVI. Concentrations of trace elements in water samples are determined with an atomic spectroscopy method that relies on ionization of sample constituents in a high temperature argon plasma and separation of

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 001 006

Lab Matrix	Analyte(s)
Animal Tissue	As Se

METHOD CODE: 001

LABORATORY: Trace Element Research Laboratory

Digestion of biological tissue.

I. Liquid or solid biological tissue samples are wet digested with nitric acid and converted into acidic digest solutions for analysis by various atomic spectroscopy methods. When possible, tissue is freeze dried in order to minimize loss of analytes and to facilitate subsequent sample preparation steps, and then homogenized to a fine powder by ball-milling in plastic containers. Approximately 0.20 to 0.25 g of powdered tissue is weighed into a Teflon reaction vessel and 3 ml of HNO_3 are added. The closed reaction vessel is heated in a 130 C oven until digestion is complete. Samples are then diluted to a final volume of 20 ml with quartz distilled water and stored in 1 oz. polyethylene bottles for later analysis by instrumental techniques.

METHOD CODE: 006

LABORATORY: Trace Element Research Laboratory

Analysis of trace metals by graphite furnace atomic absorption spectroscopy (GFAAS).

VI. Liquid samples requiring lower detection limits than are available by ICP are analyzed by GFAAS, in which electrical resistance heating evaporates solvent (water), removes interfering species, and finally atomizes the analyte into the light path of an atomic absorption spectrophotometer. The method is subject to numerous chemical and physical interferences, and requires the use of matrix modifiers to produce accurate and reliable data in real-world sediment, tissue, and water digest solutions.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 001 005

Lab Matrix	Analyte(s)
Animal Tissue	Al
	Zn

METHOD CODE: 001

LABORATORY: Trace Element Research Laboratory

Digestion of biological tissue.

I. Liquid or solid biological tissue samples are wet digested with nitric acid and converted into acidic digest solutions for analysis by various atomic spectroscopy methods. When possible, tissue is freeze dried in order to minimize loss of analytes and to facilitate subsequent sample preparation steps, and then homogenized to a fine powder by ball-milling in plastic containers. Approximately 0.20 to 0.25 g of powdered tissue is weighed into a Teflon reaction vessel and 3 ml of HNO_3 are added. The closed reaction vessel is heated in a 130 C oven until digestion is complete. Samples are then diluted to a final volume of 20 ml with quartz distilled water and stored in 1 oz. polyethylene bottles for later analysis by instrumental techniques.

METHOD CODE: 005

LABORATORY: Trace Element Research Laboratory

Analysis of trace metals by inductively coupled plasma optical emission spectroscopy (ICP).

V. Liquid samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced by a inductively coupled argon plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the lines are monitored by photomultiplier tubes or solid state detectors. Samples are quantitated by comparison with external standards. One or more internal standards may be incorporated to compensate for physical effects resulting from viscosity and varying levels of total dissolved solids in the samples. Background correction is required and is measured adjacent to analyte lines on samples during analysis.

QA/QC COMMENTS (Cont.)

QA/QC and analytical results were approved by: John Moore (PACF).

QA/QC ANOMALIES - SPIKES

All spiked sample results were within normal limits (with the following exceptions):

Analyte	Sample Number	Lab Matrix	Init. Res. ppm/%	LOD ppm/%	Spike Res. ppm/%	Spike Level ppm/%	% Rec.	Spike/ Back.	QA/QC Comm. Note
Ag	09BTIS01	Animal	.0151	.0890	5.15	8.62	59.6	571.	9
Cr	UpMWFm06	Animal	.772	.562	28.2	20.8	132.	27.0	10
Pb	09BTIS01	Animal	.338	.0890	23.3	17.2	133.	51.0	11

QA/QC ANOMALIES - S.R.M.

All S.R.M. results were within normal limits (with the following exceptions):

Analyte	S.R.M. ID	Certified Value	95%	LOD ppm/%	Result ppm/%	% Recovery	QA/QC Comment Note
Cd	NRCC DOLT-2	20.8	.500	.00476	16.2	77.9	12
Ni	NRCC DORM-2	19.4	3.10	.0524	12.0	61.9	13
	NRCC DORM-2	19.4	3.10	.240	15.1	77.8	14
Se	NRCC DORM-2	1.40	.0900	.192	1.02	72.9	15

S.R.M. Names:

S.R.M. ID	S.R.M. Name
NRCC DOLT-2	Dogfish Liver
NRCC DORM-2	Dogfish Muscle

QA/QC COMMENTS

QA/QC NOTES:

1-4 LODs for 4 analyses were higher than the contract requirement. This was due to sample size.

5-8 Four duplicates had higher than normal RPDs. This should have no affect on the interpretation of the data.

9-11 Three spike recoveries were slightly outside the normal range. This should have no affect on the interpretation of the data.

12-15 Four SRM recoveries were slightly low. This should have no affect on the interpretation of the data.

QA/QC FREQUENCY ANOMALIES

BLANKS: The required number of blanks analyses were performed.

DUPLICATES: The required number of duplicate sample analyses were performed.

SPIKES: The required number of spiked sample analyses were performed.

REFERENCE MATERIALS: The required number of Standard Reference Material analyses were performed.

QA/QC LIMIT OF DETECTION

Limits of Detection were within the contract requirements with the following exceptions:

Analyte	Sample Number	Lab Matrix	CRDL (ppm)	Basis	Acceptable To (ppm)	LOD (ppm)	QA/QC Comment Note
As	01BTIS01	Animal Tissue	.5	Dry	1.5	2.57	1
As	08BTIS01	Animal Tissue	.5	Dry	1.5	5.79	2
As	14BTIS02	Animal Tissue	.5	Dry	1.5	7.80	3
Se	14BTIS02	Animal Tissue	.5	Dry	1.5	3.12	4

QA/QC ANOMALIES - DUPLICATES

All duplicate results were within normal limits (with the following exceptions):

Analyte	Sample Number	Lab Matrix	LOD Mean	Initial Result (ppm/%)	Duplicate Result (ppm/%)	Relative Percent Diff.	QA/QC Comment Note
Fe	UpMWFm06	Animal Tissue	1.00	22.7	18.4	20.9	5
Mn	DnMWFm14	Animal Tissue	.104	.774	1.59	69.0	6
Mn	UpMWFm06	Animal Tissue	.100	1.04	.731	34.9	7
Zn	DnMWFm14	Animal Tissue	.782	19.3	15.3	23.1	8

SPIKE RECOVERIES (Cont.)

Analyte	Sample Number	Sample Matrix	Wet Dry %	Spike Level (ppm/%)	Amount Recovered (ppm/%)	* Spike / Background	Percent Recovery
Ni	UpMWFm06	Muscle	Dry	10.4	11.3	188.	109.
Pb	09BTIS01	Invertebrate	Dry	17.2	23.0	51.0	133.
	DnMWFm14	Muscle	Dry	9.52	8.92	529.	93.7
	UpMWFm06	Muscle	Dry	10.4	9.25	956.	88.8
Se	09BTIS01	Invertebrate	Dry	34.5	36.7	32.5	107.
	DnMWFm14	Muscle	Dry	18.0	20.5	16.7	114.
	UpMWFm06	Muscle	Dry	20.8	24.6	23.4	118.
V	09BTIS01	Invertebrate	Dry	34.5	30.0	4.48	87.0
	DnMWFm14	Muscle	Dry	19.0	18.3	152.	95.9
	UpMWFm06	Muscle	Dry	20.8	23.1	111.	111.
Zn	09BTIS01	Invertebrate	Dry	172.	169.	1.04	98.0
	DnMWFm14	Muscle	Dry	95.2	83.7	4.93	87.9
	UpMWFm06	Muscle	Dry	104.	101.	8.20	97.2

* For a spike to be a valid measure of method accuracy, this ratio must be higher than 1.0.

SPIKE RECOVERIES

Analyte	Sample Number	Sample Matrix	Wet Dry %	Spike Level (ppm/%)	Amount Recovered (ppm/%)	* Spike / Background	Percent Recovery
Ag	09BTIS01	Invertebrate	Dry	8.62	5.13	571.	59.6
	DnMWFm14	Muscle	Dry	4.76	4.30	807.	90.4
	UpMWFm06	Muscle	Dry	5.21	5.58	92.7	107.
Al	09BTIS01	Invertebrate	Dry	345.	1090	.290	316.
	DnMWFm14	Muscle	Dry	190.	176.	103.	92.5
	UpMWFm06	Muscle	Dry	208.	207.	167.	99.2
As	09BTIS01	Invertebrate	Dry	34.5	34.7	5.31	101.
	DnMWFm14	Muscle	Dry	18.0	15.5	23.2	86.0
	UpMWFm06	Muscle	Dry	20.8	19.5	23.2	93.6
Cd	09BTIS01	Invertebrate	Dry	8.62	9.32	5.82	108.
	DnMWFm14	Muscle	Dry	4.76	4.61	627.	96.9
	UpMWFm06	Muscle	Dry	5.21	4.87	92.7	93.5
Co	09BTIS01	Invertebrate	Dry	17.2	0.000	.110	0.000
	DnMWFm14	Muscle	Dry	9.52	9.42	26.2	98.9
	UpMWFm06	Muscle	Dry	10.4	11.4	43.8	109.
Cr	09BTIS01	Invertebrate	Dry	34.5	34.0	10.7	98.5
	DnMWFm14	Muscle	Dry	19.0	21.3	28.2	112.
	UpMWFm06	Muscle	Dry	20.8	27.4	27.0	132.
Cu	09BTIS01	Invertebrate	Dry	34.5	33.8	.960	98.0
	DnMWFm14	Muscle	Dry	19.0	16.6	6.48	86.9
	UpMWFm06	Muscle	Dry	20.8	20.4	10.4	97.9
Fe	09BTIS01	Invertebrate	Dry	345.	790.	.180	229.
	DnMWFm14	Muscle	Dry	190.	170.	5.37	89.0
	UpMWFm06	Muscle	Dry	208.	219.	9.18	105.
Hg	09BTIS01	Invertebrate	Dry	2.59	2.51	28.1	97.0
	DnMWFm14	Muscle	Dry	.142	.136	.230	95.4
	UpMWFm06	Muscle	Dry	.373	.338	.580	90.6
Mn	09BTIS01	Invertebrate	Dry	86.2	-160.	.0100	186.
	DnMWFm14	Muscle	Dry	47.6	48.9	61.5	103.
	UpMWFm06	Muscle	Dry	52.1	59.0	50.1	113.
Ni	09BTIS01	Invertebrate	Dry	17.2	22.0	.130	128.
	DnMWFm14	Muscle	Dry	9.52	9.38	167.	98.5

* For a spike to be a valid measure of method accuracy, this ratio must be higher than 1.0.

REFERENCE MATERIALS (Cont.)

Analyte	Lab Sample Number	S.R.M. ID	Wet Dry %	Certified Reference Value	95% Confidence Interval	Result (ppm/%)	Percent Recovery
Ni	DORM2915	NRCC DORM-2	Dry	19.4	3.1	12.0	61.9
Pb	DOLT2905	NRCC DOLT-2	Dry	.22	.02	.219	99.6
	DORM2910	NRCC DORM-2	Dry	.065	.007	.0536	82.5
	DORM2915	NRCC DORM-2	Dry	.065	.007	.0701	108.
Se	DOLT2905	NRCC DOLT-2	Dry	6.06	.49	5.55	91.6
	DORM2910	NRCC DORM-2	Dry	1.4	.09	1.02	72.9
	DORM2915	NRCC DORM-2	Dry	1.4	.09	1.07	76.4
V	DOLT2905	NRCC DOLT-2	Dry			.424	
	DORM2910	NRCC DORM-2	Dry			.188	
	DORM2915	NRCC DORM-2	Dry			.321	
Zn	DOLT2905	NRCC DOLT-2	Dry	85.8	2.5	80.1	93.4
	DORM2910	NRCC DORM-2	Dry	25.6	2.3	19.7	77.0
	DORM2915	NRCC DORM-2	Dry	25.6	2.3	23.6	92.2

S.R.M. NAMES

S.R.M. ID	S.R.M. Name
NRCC DOLT-2	Dogfish Liver
NRCC DORM-2	Dogfish Muscle

REFERENCE MATERIALS

Analyte	Lab Sample Number	S.R.M. ID	Wet Dry %	Certified Reference Value	95% Confidence Interval	Result (ppm/%)	Percent Recovery
Ag	DOLT2905	NRCC DOLT-2	Dry			.541	
	DORM2910	NRCC DORM-2	Dry	.041	.013	.0417	102.
	DORM2915	NRCC DORM-2	Dry	.041	.013	.0394	96.1
Al	DOLT2905	NRCC DOLT-2	Dry	25.2	2.4	18.7	74.2
	DORM2910	NRCC DORM-2	Dry	10.9	1.7	9.55	87.6
	DORM2915	NRCC DORM-2	Dry	10.9	1.7	11.7	107.
As	DOLT2905	NRCC DOLT-2	Dry	16.6	1.1	13.2	79.5
	DORM2910	NRCC DORM-2	Dry	18	1.1	14.9	82.8
	DORM2915	NRCC DORM-2	Dry	18	1.1	17.4	96.7
Cd	DOLT2905	NRCC DOLT-2	Dry	20.8	.5	16.2	77.9
	DORM2910	NRCC DORM-2	Dry	.043	.008	.0502	117.
	DORM2915	NRCC DORM-2	Dry	.043	.008	.0364	84.6
Co	DOLT2905	NRCC DOLT-2	Dry	.24	.05	.238	99.2
	DORM2910	NRCC DORM-2	Dry	.182	.031	.198	109.
	DORM2915	NRCC DORM-2	Dry	.182	.031	.142	78.0
Cr	DOLT2905	NRCC DOLT-2	Dry	.37	.08	.313	84.6
	DORM2910	NRCC DORM-2	Dry	34.7	5.5	29.8	85.9
	DORM2915	NRCC DORM-2	Dry	34.7	5.5	23.7	68.3
Cu	DOLT2905	NRCC DOLT-2	Dry	25.8	1.1	25.4	98.4
	DORM2910	NRCC DORM-2	Dry	2.34	.16	2.12	90.6
	DORM2915	NRCC DORM-2	Dry	2.34	.16	2.09	89.3
Fe	DOLT2905	NRCC DOLT-2	Dry	1103	47	995.	90.2
	DORM2910	NRCC DORM-2	Dry	142	10	154.	108.
	DORM2915	NRCC DORM-2	Dry	142	10	120.	84.5
Hg	DOLT2954	NRCC DOLT-2	Dry	2.14	.28	2.02	94.4
	DORM3096	NRCC DORM-2	Dry	4.64	.26	4.76	103.
	DORM3102	NRCC DORM-2	Dry	4.64	.26	4.20	90.5
Mn	DOLT2905	NRCC DOLT-2	Dry	6.88	.56	6.71	97.5
	DORM2910	NRCC DORM-2	Dry	3.66	.34	3.86	105.
	DORM2915	NRCC DORM-2	Dry	3.66	.34	3.24	88.5
Ni	DOLT2905	NRCC DOLT-2	Dry	.2	.02	.207	104.
	DORM2910	NRCC DORM-2	Dry	19.4	3.1	15.1	77.8

DUPLICATES (Cont.)

Analyte	Sample Number	Sample Matrix	Wet Dry %	Initial Result (ppm/%)	Duplicate Result (ppm/%)	Average	Relative Percent Diff.
Pb	DnMWFm14	Muscle	Dry	.0180	.0221	.0200	20.4
	UpMWFm06	Muscle	Dry	.0109	.00616	.00853	55.6
Se	06BTIS01	Invertebrate	Dry	.397	.329	.363	18.7
	DnMWFm14	Muscle	Dry	1.08	1.21	1.14	11.4
	UpMWFm06	Muscle	Dry	.889	.892	.890	.340
V	06BTIS01	Invertebrate	Dry	5.28	5.68	5.48	7.30
	DnMWFm14	Muscle	Dry	.125	.121	.123	3.25
	UpMWFm06	Muscle	Dry	.188	.155	.172	19.2
Zn	06BTIS01	Invertebrate	Dry	108.	105.	106.	2.82
	DnMWFm14	Muscle	Dry	19.3	15.3	17.3	23.1
	UpMWFm06	Muscle	Dry	12.7	12.8	12.8	.780

DUPLICATES

Analyte	Sample Number	Sample Matrix	Wet Dry %	Initial Result (ppm/%)	Duplicate Result (ppm/%)	Average	Relative Percent Diff.
Ag	06BTIS01	Invertebrate	Dry	.0353	.0320	.0336	9.81
	DnMWFm14	Muscle	Dry	.00590	.00490	.00540	18.5
	UpMWFm06	Muscle	Dry	< .00500	.00921	.00586	115.
Al	06BTIS01	Invertebrate	Dry	1000	1140	1070	13.1
	DnMWFm14	Muscle	Dry	1.85	< .969	1.17	117.
	UpMWFm06	Muscle	Dry	1.25	< 1.01	.878	84.9
As	06BTIS01	Invertebrate	Dry	1.10	1.07	1.08	2.76
	DnMWFm14	Muscle	Dry	< .478	< .223	.175	72.8
	UpMWFm06	Muscle	Dry	< .500	.202	.226	21.2
Cd	06BTIS01	Invertebrate	Dry	.0833	.0797	.0815	4.42
	DnMWFm14	Muscle	Dry	.00760	.00708	.00734	7.08
	UpMWFm06	Muscle	Dry	< .00500	< .00503	.00251	.600
Co	06BTIS01	Invertebrate	Dry	3.37	3.22	3.30	4.55
	DnMWFm14	Muscle	Dry	.364	.297	.330	20.3
	UpMWFm06	Muscle	Dry	.238	.239	.238	.420
Cr	06BTIS01	Invertebrate	Dry	3.68	3.74	3.71	1.62
	DnMWFm14	Muscle	Dry	.676	.671	.674	.740
	UpMWFm06	Muscle	Dry	.772	.701	.736	9.64
Cu	06BTIS01	Invertebrate	Dry	16.5	16.1	16.3	2.45
	DnMWFm14	Muscle	Dry	2.94	2.52	2.73	15.4
	UpMWFm06	Muscle	Dry	2.00	2.00	2.00	0.000
Fe	06BTIS01	Invertebrate	Dry	1550	1640	1595	5.64
	DnMWFm14	Muscle	Dry	35.5	30.2	32.8	16.1
	UpMWFm06	Muscle	Dry	22.7	18.4	20.6	20.9
Hg	06BTIS01	Invertebrate	Dry	.0840	.0853	.0846	1.54
	DnMWFm14	Muscle	Dry	.612	.534	.573	13.6
	UpMWFm06	Muscle	Dry	.647	.658	.652	1.69
Mn	06BTIS01	Invertebrate	Dry	544.	538.	541.	1.11
	DnMWFm14	Muscle	Dry	.774	1.59	1.18	69.0
	UpMWFm06	Muscle	Dry	1.04	.731	.886	34.9
Ni	06BTIS01	Invertebrate	Dry	1.54	1.58	1.56	2.56
	DnMWFm14	Muscle	Dry	.0569	.168	.112	98.8
	UpMWFm06	Muscle	Dry	.0555	< .0503	.0403	75.3
Pb	06BTIS01	Invertebrate	Dry	.617	.632	.624	2.40

PROCEDURAL BLANKS (Cont.)

Analyte	Lab Sample Number	Lab Sample Matrix	Result Total UG
Pb	Blan2908	Animal Tissue	.00306
	Blan2913	Animal Tissue	.00159
Se	Blan2903	Animal Tissue	.00725
	Blan2908	Animal Tissue	.000209
	Blan2913	Animal Tissue	.0234
V	Blan2903	Animal Tissue	-.000130
	Blan2908	Animal Tissue	.000741
	Blan2913	Animal Tissue	.0205
Zn	Blan2903	Animal Tissue	.114
	Blan2908	Animal Tissue	.0664
	Blan2913	Animal Tissue	.00109

PROCEDURAL BLANKS

Analyte	Lab Sample Number	Lab Sample Matrix	Result Total UG
Ag	Blan2903	Animal Tissue	.000509
	Blan2908	Animal Tissue	.0130
	Blan2913	Animal Tissue	.000143
Al	Blan2903	Animal Tissue	.165
	Blan2908	Animal Tissue	.402
	Blan2913	Animal Tissue	.109
As	Blan2903	Animal Tissue	-.0439
	Blan2908	Animal Tissue	-.0195
	Blan2913	Animal Tissue	-.142
Cd	Blan2903	Animal Tissue	.000139
	Blan2908	Animal Tissue	.000603
	Blan2913	Animal Tissue	.000332
Co	Blan2903	Animal Tissue	.0000540
	Blan2908	Animal Tissue	.000169
	Blan2913	Animal Tissue	.000251
Cr	Blan2903	Animal Tissue	-.0000804
	Blan2908	Animal Tissue	.0143
	Blan2913	Animal Tissue	.0705
Cu	Blan2903	Animal Tissue	.00832
	Blan2908	Animal Tissue	.00214
	Blan2913	Animal Tissue	.00314
Fe	Blan2903	Animal Tissue	.00987
	Blan2908	Animal Tissue	.0429
	Blan2913	Animal Tissue	.328
Hg	Blan2952	Animal Tissue	.000602
	Blan3094	Animal Tissue	.00148
	Blan3100	Animal Tissue	.000970
Mn	Blan2903	Animal Tissue	.000285
	Blan2908	Animal Tissue	.00318
	Blan2913	Animal Tissue	.00281
Ni	Blan2903	Animal Tissue	-.000878
	Blan2908	Animal Tissue	.00185
	Blan2913	Animal Tissue	.00176
Pb	Blan2903	Animal Tissue	.000257

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Zn	01BTIS01	Invertebrate	166.	3.86	25.1	.583
	01BTIS02	Invertebrate	94.0	3.09	38.9	1.28
	03BTIS01	Invertebrate	172.	2.02	33.7	.396
	03BTIS02	Invertebrate	211.	1.70	36.3	.292
	06BTIS01	Invertebrate	108.	.966	26.0	.233
	06BTIS02	Invertebrate	74.9	.885	15.7	.185
	07BTIS01	Invertebrate	186.	4.32	38.7	.899
	07BTIS02	Invertebrate	771.	2.42	149.	.467
	08BTIS01	Invertebrate	235.	8.68	47.9	1.77
	08BTIS02	Invertebrate	830.	1.09	135.	.178
	09BTIS01	Invertebrate	165.	1.18	26.6	.190
	09BTIS02	Invertebrate	651.	2.05	69.0	.217
	10BTIS01	Invertebrate	138.	.710	27.0	.139
	10BTIS02	Invertebrate	374.	1.62	103.	.446
	11BTIS01	Invertebrate	125.	1.24	25.8	.255
	11BTIS02	Invertebrate	42.2	4.07	22.1	2.13
	12BTIS01	Invertebrate	135.	1.89	30.0	.420
	12BTIS02	Invertebrate	138.	2.32	33.1	.557
	13BTIS01	Invertebrate	123.	.811	21.0	.139
	13BTIS02	Invertebrate	172.	2.04	35.6	.422
	14BTIS01	Invertebrate	108.	.955	18.9	.167
	14BTIS02	Invertebrate	131.	11.7	28.3	2.53
	DnMWFL13	Liver	85.6	.801	11.8	.111
	RuMWFL15	Liver	103.	.828	11.4	.0919
	RuMWFL17	Liver	91.7	.709	16.6	.128
	RuMWFL19	Liver	114.	.834	19.7	.144
	RuMWFL21	Liver	95.4	.846	15.6	.138
	RuMWFL23	Liver	85.9	.909	15.9	.168
	UpMWFL01	Liver	87.4	.768	16.3	.144
	UpMWFL03	Liver	85.8	.941	14.4	.158
	UpMWFL05	Liver	90.7	.756	18.1	.151
	UpMWFL07	Liver	74.9	.798	11.7	.124
	UpMWFL09	Liver	84.4	.801	14.9	.141
	UpMWFL11	Liver	75.0	.810	10.4	.113
	DnMWFm14	Muscle	19.3	.837	3.80	.165
	RuMWFm16	Muscle	19.0	.700	3.25	.120
	RuMWFm18	Muscle	17.0	.832	3.71	.181
	RuMWFm20	Muscle	15.6	.822	2.71	.143
	RuMWFm22	Muscle	23.1	.854	4.27	.158
	RuMWFm24	Muscle	15.3	.756	3.32	.164
	UpMWFm02	Muscle	14.8	.664	3.26	.146
	UpMWFm04	Muscle	15.0	.801	2.58	.138
	UpMWFm06	Muscle	12.7	.749	2.65	.157
	UpMWFm08	Muscle	14.0	.789	2.65	.149
	UpMWFm10	Muscle	13.0	.862	3.25	.216
	UpMWFm12	Muscle	14.9	.787	3.35	.177

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
V	01BTIS01	Invertebrate	7.58	.129	1.14	.0195
	01BTIS02	Invertebrate	15.3	.206	6.33	.0853
	03BTIS01	Invertebrate	1.35	.135	.265	.0265
	03BTIS02	Invertebrate	10.5	.113	1.81	.0194
	06BTIS01	Invertebrate	5.28	.0644	1.27	.0155
	06BTIS02	Invertebrate	7.90	.0590	1.65	.0123
	07BTIS01	Invertebrate	7.58	.288	1.58	.0599
	07BTIS02	Invertebrate	10.2	.161	1.97	.0311
	08BTIS01	Invertebrate	1.43	.579	.292	.118
	08BTIS02	Invertebrate	9.90	.0728	1.61	.0119
	09BTIS01	Invertebrate	7.70	.0790	1.24	.0127
	09BTIS02	Invertebrate	17.0	.137	1.80	.0145
	10BTIS01	Invertebrate	3.52	.0473	.690	.00927
	10BTIS02	Invertebrate	9.14	.108	2.51	.0297
	11BTIS01	Invertebrate	9.74	.0829	2.01	.0171
	11BTIS02	Invertebrate	27.1	.272	14.2	.142
	12BTIS01	Invertebrate	9.08	.126	2.02	.0280
	12BTIS02	Invertebrate	11.4	.155	2.74	.0372
	13BTIS01	Invertebrate	10.3	.0541	1.76	.00925
	13BTIS02	Invertebrate	9.08	.136	1.88	.0282
	14BTIS01	Invertebrate	13.0	.0636	2.28	.0111
	14BTIS02	Invertebrate	3.99	.780	.862	.168
	DnMWFL13	Liver	.223	.0534	.0308	.00737
	RuMWFL15	Liver	.625	.0552	.0694	.00613
	RuMWFL17	Liver	1.27	.0473	.230	.00856
	RuMWFL19	Liver	1.93	.0556	.334	.00962
	RuMWFL21	Liver	.802	.0564	.131	.00919
	RuMWFL23	Liver	.351	.0606	.0649	.0112
	UpMWFL01	Liver	.454	.0512	.0849	.00957
	UpMWFL03	Liver	.365	.0627	.0613	.0105
	UpMWFL05	Liver	.547	.0504	.109	.0101
	UpMWFL07	Liver	2.00	.0532	.312	.00830
	UpMWFL09	Liver	1.02	.0534	.180	.00940
	UpMWFL11	Liver	2.89	.0540	.402	.00751
	DnMWFm14	Muscle	.125	.0558	.0246	.0110
	RuMWFm16	Muscle	.303	.0467	.0518	.00799
	RuMWFm18	Muscle	.196	.0555	.0427	.0121
	RuMWFm20	Muscle	.247	.0548	.0430	.00954
	RuMWFm22	Muscle	.319	.0569	.0590	.0105
	RuMWFm24	Muscle	.153	.0504	.0332	.0109
	UpMWFm02	Muscle	.162	.0443	.0356	.00975
	UpMWFm04	Muscle	.155	.0534	.0267	.00918
	UpMWFm06	Muscle	.188	.0500	.0393	.0104
	UpMWFm08	Muscle	.219	.0526	.0414	.00994
	UpMWFm10	Muscle	.149	.0575	.0372	.0144
	UpMWFm12	Muscle	.195	.0525	.0439	.0118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Se	01BTIS01	Invertebrate	5.09	1.03	.769	.156
	01BTIS02	Invertebrate	5.74	.823	2.38	.341
	03BTIS01	Invertebrate	2.68	.538	.525	.105
	03BTIS02	Invertebrate	1.49	.453	.256	.0779
	06BTIS01	Invertebrate	.397	.258	.0957	.0622
	06BTIS02	Invertebrate	.506	.236	.106	.0493
	07BTIS01	Invertebrate	1.67	1.15	.347	.239
	07BTIS02	Invertebrate	4.93	.646	.951	.125
	08BTIS01	Invertebrate	6.55	2.31	1.34	.471
	08BTIS02	Invertebrate	2.32	.582	.378	.0949
	09BTIS01	Invertebrate	1.06	.316	.171	.0509
	09BTIS02	Invertebrate	7.56	1.09	.801	.116
	10BTIS01	Invertebrate	1.84	.189	.361	.0370
	10BTIS02	Invertebrate	.858	.431	.236	.119
	11BTIS01	Invertebrate	< .332	.332	< .0684	.0684
	11BTIS02	Invertebrate	< 1.09	1.09	< .570	.570
	12BTIS01	Invertebrate	< .503	.503	< .112	.112
	12BTIS02	Invertebrate	< .618	.618	< .148	.148
	13BTIS01	Invertebrate	< .216	.216	< .0369	.0369
	13BTIS02	Invertebrate	< .544	.544	< .113	.113
	14BTIS01	Invertebrate	< .509	.509	< .0891	.0891
	14BTIS02	Invertebrate	< 3.12	3.12	< .674	.674
	DnMWFL13	Liver	14.6	.641	2.01	.0885
	RuMWFL15	Liver	6.52	.442	.724	.0491
	RuMWFL17	Liver	17.7	.568	3.20	.103
	RuMWFL19	Liver	9.61	.445	1.66	.0770
	RuMWFL21	Liver	8.52	.451	1.39	.0735
	RuMWFL23	Liver	8.73	.485	1.62	.0897
	UpMWFL01	Liver	7.39	.409	1.38	.0765
	UpMWFL03	Liver	9.57	.502	1.61	.0843
	UpMWFL05	Liver	17.0	.605	3.40	.121
	UpMWFL07	Liver	15.5	.638	2.42	.0995
	UpMWFL09	Liver	22.0	.641	3.87	.113
	UpMWFL11	Liver	9.93	.432	1.38	.0600
	DnMWFm14	Muscle	1.08	.191	.213	.0376
	RuMWFm16	Muscle	.874	.187	.149	.0320
	RuMWFm18	Muscle	1.48	.222	.323	.0484
	RuMWFm20	Muscle	.815	.219	.142	.0381
	RuMWFm22	Muscle	1.25	.228	.231	.0422
	RuMWFm24	Muscle	1.43	.202	.310	.0438
	UpMWFm02	Muscle	.579	.177	.127	.0389
	UpMWFm04	Muscle	1.04	.214	.179	.0368
	UpMWFm06	Muscle	.889	.200	.186	.0418
	UpMWFm08	Muscle	.821	.210	.155	.0397
	UpMWFm10	Muscle	1.26	.230	.315	.0575
	UpMWFm12	Muscle	.863	.210	.194	.0472

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Pb	01BTIS01	Invertebrate	2.07	.0129	.313	.00195
	01BTIS02	Invertebrate	9.55	.0206	3.95	.00853
	03BTIS01	Invertebrate	.423	.0135	.0829	.00265
	03BTIS02	Invertebrate	2.03	.0113	.349	.00194
	06BTIS01	Invertebrate	.617	.00644	.149	.00155
	06BTIS02	Invertebrate	.577	.00590	.121	.00123
	07BTIS01	Invertebrate	.299	.0288	.0622	.00599
	07BTIS02	Invertebrate	.481	.0161	.0928	.00311
	08BTIS01	Invertebrate	.192	.0579	.0392	.0118
	08BTIS02	Invertebrate	1.48	.00728	.241	.00119
	09BTIS01	Invertebrate	.338	.00790	.0544	.00127
	09BTIS02	Invertebrate	1.52	.0137	.161	.00145
	10BTIS01	Invertebrate	.395	.00473	.0774	.000927
	10BTIS02	Invertebrate	2.00	.0108	.550	.00297
	11BTIS01	Invertebrate	2.19	.00829	.451	.00171
	11BTIS02	Invertebrate	2.30	.0272	1.20	.0142
	12BTIS01	Invertebrate	2.00	.0126	.444	.00280
	12BTIS02	Invertebrate	1.87	.0155	.449	.00372
	13BTIS01	Invertebrate	1.95	.00541	.333	.000925
	13BTIS02	Invertebrate	1.54	.0136	.319	.00282
	14BTIS01	Invertebrate	2.85	.00636	.499	.00111
	14BTIS02	Invertebrate	1.70	.0780	.367	.0168
	DnMWFL13	Liver	.0178	.00534	.00246	.000737
	RuMWFL15	Liver	.0295	.00552	.00327	.000613
	RuMWFL17	Liver	.0293	.00473	.00530	.000856
	RuMWFL19	Liver	.0276	.00556	.00477	.000962
	RuMWFL21	Liver	.0310	.00564	.00505	.000919
	RuMWFL23	Liver	.0264	.00606	.00488	.00112
	UpMWFL01	Liver	.0137	.00512	.00256	.000957
	UpMWFL03	Liver	.106	.00627	.0178	.00105
	UpMWFL05	Liver	.0235	.00504	.00470	.00101
	UpMWFL07	Liver	.0413	.00532	.00644	.000830
	UpMWFL09	Liver	.0401	.00534	.00706	.000940
	UpMWFL11	Liver	.0462	.00540	.00642	.000751
	DnMWFm14	Muscle	.0180	.00558	.00355	.00110
	RuMWFm16	Muscle	.0124	.00467	.00212	.000799
	RuMWFm18	Muscle	.0221	.00555	.00482	.00121
	RuMWFm20	Muscle	.0241	.00548	.00419	.000954
	RuMWFm22	Muscle	.0188	.00569	.00348	.00105
	RuMWFm24	Muscle	.0305	.00504	.00662	.00109
	UpMWFm02	Muscle	.0143	.00443	.00315	.000975
	UpMWFm04	Muscle	.0171	.00534	.00294	.000918
	UpMWFm06	Muscle	.0109	.00500	.00228	.00104
	UpMWFm08	Muscle	.0112	.00526	.00212	.000994
	UpMWFm10	Muscle	.0142	.00575	.00355	.00144
	UpMWFm12	Muscle	.0303	.00525	.00682	.00118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Ni	01BTIS01	Invertebrate	4.37	.129	.660	.0195
	01BTIS02	Invertebrate	3.86	.206	1.60	.0853
	03BTIS01	Invertebrate	.575	.135	.113	.0265
	03BTIS02	Invertebrate	1.52	.113	.261	.0194
	06BTIS01	Invertebrate	1.54	.0644	.371	.0155
	06BTIS02	Invertebrate	2.38	.0590	.497	.0123
	07BTIS01	Invertebrate	25.6	.288	5.32	.0599
	07BTIS02	Invertebrate	42.2	.161	8.14	.0311
	08BTIS01	Invertebrate	45.1	.579	9.20	.118
	08BTIS02	Invertebrate	124.	.0728	20.2	.0119
	09BTIS01	Invertebrate	132.	.0790	21.3	.0127
	09BTIS02	Invertebrate	114.	.137	12.1	.0145
	10BTIS01	Invertebrate	52.7	.0473	10.3	.00927
	10BTIS02	Invertebrate	43.4	.108	11.9	.0297
	11BTIS01	Invertebrate	5.55	.0829	1.14	.0171
	11BTIS02	Invertebrate	5.55	.272	2.90	.142
	12BTIS01	Invertebrate	6.06	.126	1.35	.0280
	12BTIS02	Invertebrate	6.10	.155	1.46	.0372
	13BTIS01	Invertebrate	6.80	.0541	1.16	.00925
	13BTIS02	Invertebrate	5.01	.136	1.04	.0282
	14BTIS01	Invertebrate	7.17	.0636	1.25	.0111
	14BTIS02	Invertebrate	2.12	.780	.458	.168
	DnMWFL13	Liver	.405	.0534	.0559	.00737
	RuMWFL15	Liver	.801	.0552	.0889	.00613
	RuMWFL17	Liver	.127	.0473	.0230	.00856
	RuMWFL19	Liver	.239	.0556	.0413	.00962
	RuMWFL21	Liver	.548	.0564	.0893	.00919
	RuMWFL23	Liver	.224	.0606	.0414	.0112
	UpMWFL01	Liver	.0535	.0512	.0100	.00957
	UpMWFL03	Liver	.208	.0627	.0349	.0105
	UpMWFL05	Liver	.152	.0504	.0304	.0101
	UpMWFL07	Liver	.0844	.0532	.0132	.00830
	UpMWFL09	Liver	.0562	.0534	.00989	.00940
	UpMWFL11	Liver	.139	.0540	.0193	.00751
	DnMWFm14	Muscle	.0569	.0558	.0112	.0110
	RuMWFm16	Muscle	.137	.0467	.0234	.00799
	RuMWFm18	Muscle	< .0555	.0555	< .0121	.0121
	RuMWFm20	Muscle	.0640	.0548	.0111	.00954
	RuMWFm22	Muscle	.304	.0569	.0562	.0105
	RuMWFm24	Muscle	.0872	.0504	.0189	.0109
	UpMWFm02	Muscle	< .0443	.0443	< .00975	.00975
	UpMWFm04	Muscle	< .0534	.0534	< .00918	.00918
	UpMWFm06	Muscle	.0555	.0500	.0116	.0104
	UpMWFm08	Muscle	< .0526	.0526	< .00994	.00994
	UpMWFm10	Muscle	< .0575	.0575	< .0144	.0144
	UpMWFm12	Muscle	< .0525	.0525	< .0118	.0118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Mn	01BTIS01	Invertebrate	955.	.257	144.	.0388
	01BTIS02	Invertebrate	357.	.411	148.	.170
	03BTIS01	Invertebrate	107.	.269	21.0	.0527
	03BTIS02	Invertebrate	395.	.227	67.9	.0390
	06BTIS01	Invertebrate	544.	.129	131.	.0311
	06BTIS02	Invertebrate	306.	.118	64.0	.0247
	07BTIS01	Invertebrate	316.	.576	65.7	.120
	07BTIS02	Invertebrate	468.	.323	90.3	.0623
	08BTIS01	Invertebrate	426.	1.16	86.9	.237
	08BTIS02	Invertebrate	2280	.146	372.	.0238
	09BTIS01	Invertebrate	5940	.158	956.	.0254
	09BTIS02	Invertebrate	3110	.273	330.	.0289
	10BTIS01	Invertebrate	1960	.0950	384.	.0186
	10BTIS02	Invertebrate	1200	.216	330.	.0594
	11BTIS01	Invertebrate	1640	.166	338.	.0342
	11BTIS02	Invertebrate	442.	.543	231.	.284
	12BTIS01	Invertebrate	1740	.252	386.	.0559
	12BTIS02	Invertebrate	554.	.309	133.	.0742
	13BTIS01	Invertebrate	1010	.108	173.	.0185
	13BTIS02	Invertebrate	425.	.272	88.0	.0563
	14BTIS01	Invertebrate	1030	.127	180.	.0222
	14BTIS02	Invertebrate	198.	1.56	42.8	.337
	DnMWFL13	Liver	6.94	.107	.958	.0148
	RuMWFL15	Liver	33.1	.110	3.67	.0122
	RuMWFL17	Liver	6.76	.0950	1.22	.0172
	RuMWFL19	Liver	11.1	.111	1.92	.0192
	RuMWFL21	Liver	31.9	.113	5.20	.0184
	RuMWFL23	Liver	7.10	.121	1.31	.0224
	UpMWFL01	Liver	11.4	.102	2.13	.0191
	UpMWFL03	Liver	14.4	.125	2.42	.0210
	UpMWFL05	Liver	22.9	.101	4.58	.0202
	UpMWFL07	Liver	4.13	.106	.644	.0165
	UpMWFL09	Liver	6.15	.107	1.08	.0188
	UpMWFL11	Liver	8.12	.108	1.13	.0150
	DnMWFm14	Muscle	.774	.112	.152	.0221
	RuMWFm16	Muscle	1.90	.0930	.325	.0159
	RuMWFm18	Muscle	.842	.111	.184	.0242
	RuMWFm20	Muscle	.627	.110	.109	.0191
	RuMWFm22	Muscle	5.66	.114	1.05	.0211
	RuMWFm24	Muscle	1.19	.101	.258	.0219
	UpMWFm02	Muscle	.722	.0890	.159	.0196
	UpMWFm04	Muscle	1.51	.107	.260	.0184
	UpMWFm06	Muscle	1.04	.100	.217	.0209
	UpMWFm08	Muscle	.593	.105	.112	.0198
	UpMWFm10	Muscle	.644	.115	.161	.0288
	UpMWFm12	Muscle	.707	.105	.159	.0236

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Hg	01BTIS01	Invertebrate	.244	.0129	.0368	.00195
	01BTIS02	Invertebrate	1.35	.0823	.559	.0341
	03BTIS01	Invertebrate	.195	.0135	.0382	.00265
	03BTIS02	Invertebrate	.0933	.0113	.0160	.00194
	06BTIS01	Invertebrate	.0840	.00644	.0202	.00155
	06BTIS02	Invertebrate	.0352	.00590	.00736	.00123
	07BTIS01	Invertebrate	.115	.0288	.0239	.00599
	07BTIS02	Invertebrate	.0645	.0161	.0124	.00311
	08BTIS01	Invertebrate	.0837	.0579	.0171	.0118
	08BTIS02	Invertebrate	.0600	.00728	.00978	.00119
	09BTIS01	Invertebrate	.0919	.00790	.0148	.00127
	09BTIS02	Invertebrate	.182	.0137	.0193	.00145
	10BTIS01	Invertebrate	.0872	.00473	.0171	.000927
	10BTIS02	Invertebrate	.0735	.0108	.0202	.00297
	11BTIS01	Invertebrate	.249	.00829	.0513	.00171
	11BTIS02	Invertebrate	.0470	.0272	.0246	.0142
	12BTIS01	Invertebrate	.249	.0126	.0553	.00280
	12BTIS02	Invertebrate	.149	.0155	.0358	.00372
	13BTIS01	Invertebrate	.161	.00541	.0275	.000925
	13BTIS02	Invertebrate	.135	.0136	.0279	.00282
	14BTIS01	Invertebrate	.175	.00636	.0306	.00111
	14BTIS02	Invertebrate	.223	.0780	.0482	.0168
	DnMWFL13	Liver	1.36	.0214	.188	.00295
	RuMWFL15	Liver	3.36	.0608	.373	.00675
	RuMWFL17	Liver	3.32	.0993	.601	.0180
	RuMWFL19	Liver	4.51	.117	.780	.0202
	RuMWFL21	Liver	1.58	.118	.258	.0192
	RuMWFL23	Liver	.665	.127	.123	.0235
	UpMWFL01	Liver	2.22	.0563	.415	.0105
	UpMWFL03	Liver	.605	.0125	.102	.00210
	UpMWFL05	Liver	1.88	.0554	.376	.0111
	UpMWFL07	Liver	8.77	.117	1.37	.0183
	UpMWFL09	Liver	4.91	.118	.864	.0208
	UpMWFL11	Liver	7.88	.119	1.10	.0165
	DnMWFm14	Muscle	.612	.0112	.121	.00221
	RuMWFm16	Muscle	.902	.0140	.154	.00239
	RuMWFm18	Muscle	1.18	.0166	.257	.00362
	RuMWFm20	Muscle	2.07	.0603	.360	.0105
	RuMWFm22	Muscle	.896	.0171	.166	.00316
	RuMWFm24	Muscle	.235	.0101	.0510	.00219
	UpMWFm02	Muscle	.761	.0133	.167	.00293
	UpMWFm04	Muscle	.328	.0160	.0564	.00275
	UpMWFm06	Muscle	.647	.0150	.135	.00314
	UpMWFm08	Muscle	2.35	.0579	.444	.0109
	UpMWFm10	Muscle	1.37	.0632	.342	.0158
	UpMWFm12	Muscle	1.34	.0577	.302	.0130

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Fe	01BTIS01	Invertebrate	3000	2.57	453.	.388
	01BTIS02	Invertebrate	6480	4.11	2683	1.70
	03BTIS01	Invertebrate	473.	2.69	92.7	.527
	03BTIS02	Invertebrate	3100	2.27	533.	.390
	06BTIS01	Invertebrate	1550	1.29	374.	.311
	06BTIS02	Invertebrate	1950	1.18	408.	.247
	07BTIS01	Invertebrate	14300	5.76	2974	1.20
	07BTIS02	Invertebrate	12800	3.23	2470	.623
	08BTIS01	Invertebrate	935.	11.6	191.	2.37
	08BTIS02	Invertebrate	6830	1.46	1113	.238
	09BTIS01	Invertebrate	1970	1.58	317.	.254
	09BTIS02	Invertebrate	8020	2.73	850.	.289
	10BTIS01	Invertebrate	2550	.946	500.	.185
	10BTIS02	Invertebrate	4940	2.16	1358	.594
	11BTIS01	Invertebrate	5110	1.66	1053	.342
	11BTIS02	Invertebrate	9260	5.43	4843	2.84
	12BTIS01	Invertebrate	3980	2.52	884.	.559
	12BTIS02	Invertebrate	6510	3.09	1562	.742
	13BTIS01	Invertebrate	4440	1.08	759.	.185
	13BTIS02	Invertebrate	3540	2.72	733.	.563
	14BTIS01	Invertebrate	6210	1.27	1087	.222
	14BTIS02	Invertebrate	1700	15.6	367.	3.37
	DnMWFL13	Liver	475.	1.07	65.6	.148
	RuMWFL15	Liver	410.	1.10	45.5	.122
	RuMWFL17	Liver	776.	.946	140.	.171
	RuMWFL19	Liver	534.	1.11	92.4	.192
	RuMWFL21	Liver	431.	1.13	70.3	.184
	RuMWFL23	Liver	536.	1.21	99.2	.224
	UpMWFL01	Liver	591.	1.02	111.	.191
	UpMWFL03	Liver	477.	1.25	80.1	.210
	UpMWFL05	Liver	666.	1.01	133.	.202
	UpMWFL07	Liver	1100	1.06	172.	.165
	UpMWFL09	Liver	858.	1.07	151.	.188
	UpMWFL11	Liver	745.	1.08	104.	.150
	DnMWFm14	Muscle	35.5	1.12	6.99	.221
	RuMWFm16	Muscle	36.6	.933	6.26	.160
	RuMWFm18	Muscle	44.8	1.11	9.77	.242
	RuMWFm20	Muscle	32.8	1.10	5.71	.191
	RuMWFm22	Muscle	50.5	1.14	9.34	.211
	RuMWFm24	Muscle	22.7	1.01	4.93	.219
	UpMWFm02	Muscle	26.6	.886	5.85	.195
	UpMWFm04	Muscle	16.7	1.07	2.87	.184
	UpMWFm06	Muscle	22.7	.999	4.74	.209
	UpMWFm08	Muscle	27.9	1.05	5.27	.198
	UpMWFm10	Muscle	23.8	1.15	5.95	.288
	UpMWFm12	Muscle	38.5	1.05	8.66	.236

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Cu	01BTIS01	Invertebrate	24.7	.0515	3.73	.00778
	01BTIS02	Invertebrate	20.3	.0823	8.40	.0341
	03BTIS01	Invertebrate	14.8	.0538	2.90	.0105
	03BTIS02	Invertebrate	16.1	.0453	2.77	.00779
	06BTIS01	Invertebrate	16.5	.0258	3.98	.00622
	06BTIS02	Invertebrate	15.4	.0236	3.22	.00493
	07BTIS01	Invertebrate	91.8	.115	19.1	.0239
	07BTIS02	Invertebrate	118.	.0646	22.8	.0125
	08BTIS01	Invertebrate	45.6	.231	9.30	.0471
	08BTIS02	Invertebrate	113.	.0291	18.4	.00474
	09BTIS01	Invertebrate	36.0	.0316	5.80	.00509
	09BTIS02	Invertebrate	117.	.0546	12.4	.00579
	10BTIS01	Invertebrate	18.9	.0189	3.70	.00370
	10BTIS02	Invertebrate	39.5	.0431	10.9	.0119
	11BTIS01	Invertebrate	17.7	.0332	3.65	.00684
	11BTIS02	Invertebrate	9.55	.109	4.99	.0570
	12BTIS01	Invertebrate	18.0	.0503	4.00	.0112
	12BTIS02	Invertebrate	23.2	.0618	5.57	.0148
	13BTIS01	Invertebrate	17.6	.0216	3.01	.00369
	13BTIS02	Invertebrate	24.0	.0544	4.97	.0113
	14BTIS01	Invertebrate	17.4	.0255	3.04	.00446
	14BTIS02	Invertebrate	27.6	.312	5.96	.0674
	DnMWFL13	Liver	10.0	.0214	1.38	.00295
	RuMWFL15	Liver	31.3	.0221	3.47	.00245
	RuMWFL17	Liver	6.17	.0189	1.12	.00342
	RuMWFL19	Liver	57.8	.0222	10.0	.00384
	RuMWFL21	Liver	20.9	.0226	3.41	.00368
	RuMWFL23	Liver	7.94	.0242	1.47	.00448
	UpMWFL01	Liver	9.67	.0205	1.81	.00383
	UpMWFL03	Liver	6.06	.0251	1.02	.00422
	UpMWFL05	Liver	23.5	.0202	4.70	.00404
	UpMWFL07	Liver	6.41	.0213	1.00	.00332
	UpMWFL09	Liver	7.07	.0214	1.24	.00377
	UpMWFL11	Liver	6.03	.0216	.838	.00300
	DnMWFm14	Muscle	2.94	.0223	.579	.00439
	RuMWFm16	Muscle	2.25	.0187	.385	.00320
	RuMWFm18	Muscle	4.00	.0222	.872	.00484
	RuMWFm20	Muscle	2.01	.0219	.350	.00381
	RuMWFm22	Muscle	3.01	.0228	.557	.00422
	RuMWFm24	Muscle	2.23	.0202	.484	.00438
	UpMWFm02	Muscle	2.30	.0177	.506	.00389
	UpMWFm04	Muscle	1.65	.0214	.284	.00368
	UpMWFm06	Muscle	2.00	.0200	.418	.00418
	UpMWFm08	Muscle	1.67	.0210	.316	.00397
	UpMWFm10	Muscle	2.07	.0230	.518	.00575
	UpMWFm12	Muscle	2.23	.0210	.502	.00472

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Cr	01BTIS01	Invertebrate	4.90	.129	.740	.0195
	01BTIS02	Invertebrate	5.79	.206	2.40	.0853
	03BTIS01	Invertebrate	2.84	.135	.557	.0265
	03BTIS02	Invertebrate	4.33	.113	.745	.0194
	06BTIS01	Invertebrate	3.68	.0644	.887	.0155
	06BTIS02	Invertebrate	3.56	.0590	.744	.0123
	07BTIS01	Invertebrate	3.84	.288	.799	.0599
	07BTIS02	Invertebrate	3.86	.161	.745	.0311
	08BTIS01	Invertebrate	3.10	.579	.632	.118
	08BTIS02	Invertebrate	5.34	.0728	.870	.0119
	09BTIS01	Invertebrate	3.23	.0790	.520	.0127
	09BTIS02	Invertebrate	8.90	.137	.943	.0145
	10BTIS01	Invertebrate	3.40	.0473	.666	.00927
	10BTIS02	Invertebrate	5.36	.108	1.47	.0297
	11BTIS01	Invertebrate	4.50	.0829	.927	.0171
	11BTIS02	Invertebrate	4.24	.272	2.22	.142
	12BTIS01	Invertebrate	4.39	.126	.975	.0280
	12BTIS02	Invertebrate	5.54	.155	1.33	.0372
	13BTIS01	Invertebrate	4.25	.0541	.727	.00925
	13BTIS02	Invertebrate	4.59	.136	.950	.0282
	14BTIS01	Invertebrate	4.91	.0636	.859	.0111
	14BTIS02	Invertebrate	4.44	.780	.959	.168
	DnMWFL13	Liver	1.27	.0534	.175	.00737
	RuMWFL15	Liver	1.44	.0552	.160	.00613
	RuMWFL17	Liver	1.25	.0473	.226	.00856
	RuMWFL19	Liver	1.48	.0556	.256	.00962
	RuMWFL21	Liver	1.39	.0564	.227	.00919
	RuMWFL23	Liver	1.28	.0606	.237	.0112
	UpMWFL01	Liver	1.35	.0512	.252	.00957
	UpMWFL03	Liver	1.25	.0627	.210	.0105
	UpMWFL05	Liver	1.36	.0504	.272	.0101
	UpMWFL07	Liver	1.79	.0532	.279	.00830
	UpMWFL09	Liver	1.56	.0534	.275	.00940
	UpMWFL11	Liver	1.73	.0540	.240	.00751
	DnMWFm14	Muscle	.676	.0558	.133	.0110
	RuMWFm16	Muscle	1.09	.0467	.186	.00799
	RuMWFm18	Muscle	.854	.0555	.186	.0121
	RuMWFm20	Muscle	.934	.0548	.163	.00954
	RuMWFm22	Muscle	.960	.0569	.178	.0105
	RuMWFm24	Muscle	.774	.0504	.168	.0109
	UpMWFm02	Muscle	.654	.0443	.144	.00975
	UpMWFm04	Muscle	.665	.0534	.114	.00918
	UpMWFm06	Muscle	.772	.0500	.161	.0104
	UpMWFm08	Muscle	.782	.0526	.148	.00994
	UpMWFm10	Muscle	.737	.0575	.184	.0144
	UpMWFm12	Muscle	.652	.0525	.147	.0118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Co	01BTIS01	Invertebrate	4.68	.0129	.707	.00195
	01BTIS02	Invertebrate	5.14	.0206	2.13	.00853
	03BTIS01	Invertebrate	.861	.0135	.169	.00265
	03BTIS02	Invertebrate	5.03	.0113	.865	.00194
	06BTIS01	Invertebrate	3.37	.00644	.812	.00155
	06BTIS02	Invertebrate	6.70	.00590	1.40	.00123
	07BTIS01	Invertebrate	18.6	.0288	3.87	.00599
	07BTIS02	Invertebrate	69.3	.0161	13.4	.00311
	08BTIS01	Invertebrate	66.7	.0579	13.6	.0118
	08BTIS02	Invertebrate	353.	.00728	57.5	.00119
	09BTIS01	Invertebrate	157.	.00790	25.3	.00127
	09BTIS02	Invertebrate	190.	.0137	20.1	.00145
	10BTIS01	Invertebrate	40.5	.00473	7.94	.000927
	10BTIS02	Invertebrate	49.0	.0108	13.5	.00297
	11BTIS01	Invertebrate	7.90	.00829	1.63	.00171
	11BTIS02	Invertebrate	7.74	.0272	4.05	.0142
	12BTIS01	Invertebrate	8.49	.0126	1.88	.00280
	12BTIS02	Invertebrate	15.1	.0155	3.62	.00372
	13BTIS01	Invertebrate	10.6	.00541	1.81	.000925
	13BTIS02	Invertebrate	39.2	.0136	8.11	.00282
	14BTIS01	Invertebrate	8.02	.00636	1.40	.00111
	14BTIS02	Invertebrate	21.6	.0780	4.67	.0168
	DnMWFL13	Liver	2.56	.00534	.353	.000737
	RuMWFL15	Liver	4.27	.00552	.474	.000613
	RuMWFL17	Liver	4.25	.00473	.769	.000856
	RuMWFL19	Liver	3.84	.00556	.664	.000962
	RuMWFL21	Liver	3.13	.00564	.510	.000919
	RuMWFL23	Liver	1.42	.00606	.263	.00112
	UpMWFL01	Liver	2.59	.00512	.484	.000957
	UpMWFL03	Liver	1.22	.00627	.205	.00105
	UpMWFL05	Liver	2.65	.00504	.530	.00101
	UpMWFL07	Liver	2.08	.00532	.324	.000830
	UpMWFL09	Liver	2.75	.00534	.484	.000940
	UpMWFL11	Liver	1.49	.00540	.207	.000751
	DnMWFm14	Muscle	.364	.00558	.0717	.00110
	RuMWFm16	Muscle	.778	.00467	.133	.000799
	RuMWFm18	Muscle	.414	.00555	.0903	.00121
	RuMWFm20	Muscle	.610	.00548	.106	.000954
	RuMWFm22	Muscle	.698	.00569	.129	.00105
	RuMWFm24	Muscle	.163	.00504	.0354	.00109
	UpMWFm02	Muscle	.226	.00443	.0497	.000975
	UpMWFm04	Muscle	.106	.00534	.0182	.000918
	UpMWFm06	Muscle	.238	.00500	.0497	.00104
	UpMWFm08	Muscle	.270	.00526	.0510	.000994
	UpMWFm10	Muscle	.204	.00575	.0510	.00144
	UpMWFm12	Muscle	.252	.00525	.0567	.00118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Cd	01BTIS01	Invertebrate	.288	.0129	.0435	.00195
	01BTIS02	Invertebrate	.549	.0206	.227	.00853
	03BTIS01	Invertebrate	.119	.0135	.0233	.00265
	03BTIS02	Invertebrate	.276	.0113	.0475	.00194
	06BTIS01	Invertebrate	.0833	.00644	.0201	.00155
	06BTIS02	Invertebrate	.350	.00590	.0732	.00123
	07BTIS01	Invertebrate	.641	.0288	.133	.00599
	07BTIS02	Invertebrate	5.32	.0161	1.03	.00311
	08BTIS01	Invertebrate	2.49	.0579	.508	.0118
	08BTIS02	Invertebrate	7.85	.00728	1.28	.00119
	09BTIS01	Invertebrate	1.48	.00790	.238	.00127
	09BTIS02	Invertebrate	10.6	.0137	1.12	.00145
	10BTIS01	Invertebrate	.978	.00473	.192	.000927
	10BTIS02	Invertebrate	5.60	.0108	1.54	.00297
	11BTIS01	Invertebrate	.380	.00829	.0783	.00171
	11BTIS02	Invertebrate	.386	.0272	.202	.0142
	12BTIS01	Invertebrate	.381	.0126	.0846	.00280
	12BTIS02	Invertebrate	2.19	.0155	.526	.00372
	13BTIS01	Invertebrate	.592	.00541	.101	.000925
	13BTIS02	Invertebrate	5.75	.0136	1.19	.00282
	14BTIS01	Invertebrate	.442	.00636	.0774	.00111
	14BTIS02	Invertebrate	3.69	.0780	.797	.0168
	DnMWFL13	Liver	.129	.00534	.0178	.000737
	RuMWFL15	Liver	1.04	.00552	.115	.000613
	RuMWFL17	Liver	.425	.00473	.0769	.000856
	RuMWFL19	Liver	4.23	.00556	.732	.000962
	RuMWFL21	Liver	1.04	.00564	.170	.000919
	RuMWFL23	Liver	.0905	.00606	.0167	.00112
	UpMWFL01	Liver	.225	.00512	.0421	.000957
	UpMWFL03	Liver	.113	.00627	.0190	.00105
	UpMWFL05	Liver	.422	.00504	.0844	.00101
	UpMWFL07	Liver	.335	.00532	.0523	.000830
	UpMWFL09	Liver	.166	.00534	.0292	.000940
	UpMWFL11	Liver	.626	.00540	.0870	.000751
	DnMWFm14	Muscle	.00760	.00558	.00150	.00110
	RuMWFm16	Muscle	.0288	.00467	.00492	.000799
	RuMWFm18	Muscle	.00974	.00555	.00212	.00121
	RuMWFm20	Muscle	.0254	.00548	.00442	.000954
	RuMWFm22	Muscle	.0445	.00569	.00823	.00105
	RuMWFm24	Muscle	.00852	.00504	.00185	.00109
	UpMWFm02	Muscle	.00510	.00443	.00112	.000975
	UpMWFm04	Muscle	.00810	.00534	.00139	.000918
	UpMWFm06	Muscle	< .00500	.00500	< .00104	.00104
	UpMWFm08	Muscle	< .00526	.00526	< .000994	.000994
	UpMWFm10	Muscle	< .00575	.00575	< .00144	.00144
	UpMWFm12	Muscle	.00757	.00525	.00170	.00118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
As	01BTIS01	Invertebrate	< 2.57	2.57	< .388	.388
	01BTIS02	Invertebrate	5.28	2.06	2.19	.853
	03BTIS01	Invertebrate	< 1.35	1.35	< .265	.265
	03BTIS02	Invertebrate	2.32	1.13	.399	.194
	06BTIS01	Invertebrate	1.10	.644	.265	.155
	06BTIS02	Invertebrate	2.51	.590	.525	.123
	07BTIS01	Invertebrate	8.21	2.88	1.71	.599
	07BTIS02	Invertebrate	11.7	1.61	2.26	.311
	08BTIS01	Invertebrate	< 5.79	5.79	< 1.18	1.18
	08BTIS02	Invertebrate	28.0	2.91	4.56	.474
	09BTIS01	Invertebrate	6.50	1.58	1.05	.254
	09BTIS02	Invertebrate	41.5	5.46	4.40	.579
	10BTIS01	Invertebrate	9.80	1.89	1.92	.370
	10BTIS02	Invertebrate	13.4	1.08	3.68	.297
	11BTIS01	Invertebrate	5.77	.829	1.19	.171
	11BTIS02	Invertebrate	5.45	2.72	2.85	1.42
	12BTIS01	Invertebrate	6.28	1.26	1.39	.280
	12BTIS02	Invertebrate	7.39	1.55	1.77	.372
	13BTIS01	Invertebrate	5.05	.541	.864	.0925
	13BTIS02	Invertebrate	4.53	1.36	.938	.282
	14BTIS01	Invertebrate	6.11	.636	1.07	.111
	14BTIS02	Invertebrate	< 7.80	7.80	< 1.68	1.68
	DnMWFL13	Liver	< .534	.534	< .0737	.0737
	RuMWFL15	Liver	< .552	.552	< .0613	.0613
	RuMWFL17	Liver	< .473	.473	< .0856	.0856
	RuMWFL19	Liver	< .556	.556	< .0962	.0962
	RuMWFL21	Liver	< .564	.564	< .0919	.0919
	RuMWFL23	Liver	< .606	.606	< .112	.112
	UpMWFL01	Liver	< .512	.512	< .0957	.0957
	UpMWFL03	Liver	< .627	.627	< .105	.105
	UpMWFL05	Liver	< .504	.504	< .101	.101
	UpMWFL07	Liver	< .532	.532	< .0830	.0830
	UpMWFL09	Liver	< .534	.534	< .0940	.0940
	UpMWFL11	Liver	< .540	.540	< .0751	.0751
	DnMWFm14	Muscle	< .478	.478	< .0942	.0942
	RuMWFm16	Muscle	< .467	.467	< .0799	.0799
	RuMWFm18	Muscle	< .555	.555	< .121	.121
	RuMWFm20	Muscle	< .548	.548	< .0954	.0954
	RuMWFm22	Muscle	< .569	.569	< .105	.105
	RuMWFm24	Muscle	< .504	.504	< .109	.109
	UpMWFm02	Muscle	< .443	.443	< .0975	.0975
	UpMWFm04	Muscle	< .534	.534	< .0918	.0918
	UpMWFm06	Muscle	< .500	.500	< .104	.104
	UpMWFm08	Muscle	< .526	.526	< .0994	.0994
	UpMWFm10	Muscle	< .575	.575	< .144	.144
	UpMWFm12	Muscle	< .525	.525	< .118	.118

CONTAMINANT CONCENTRATIONS (Cont.)

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Al	01BTIS01	Invertebrate	1330	5.15	201.	.778
	01BTIS02	Invertebrate	3080	4.11	1275	1.70
	03BTIS01	Invertebrate	191.	2.69	37.4	.527
	03BTIS02	Invertebrate	1630	2.27	280.	.390
	06BTIS01	Invertebrate	1000	1.29	241.	.311
	06BTIS02	Invertebrate	986.	1.18	206.	.247
	07BTIS01	Invertebrate	2890	5.76	601.	1.20
	07BTIS02	Invertebrate	3130	3.23	604.	.623
	08BTIS01	Invertebrate	789.	11.6	161.	2.37
	08BTIS02	Invertebrate	4130	1.46	673.	.238
	09BTIS01	Invertebrate	1170	1.58	188.	.254
	09BTIS02	Invertebrate	3850	2.73	408.	.289
	10BTIS01	Invertebrate	2060	.946	404.	.185
	10BTIS02	Invertebrate	3720	2.16	1023	.594
	11BTIS01	Invertebrate	3000	1.66	618.	.342
	11BTIS02	Invertebrate	5990	5.43	3133	2.84
	12BTIS01	Invertebrate	2270	2.52	504.	.559
	12BTIS02	Invertebrate	3570	3.09	857.	.742
	13BTIS01	Invertebrate	2890	1.08	494.	.185
	13BTIS02	Invertebrate	1990	2.72	412.	.563
	14BTIS01	Invertebrate	4120	1.27	721.	.222
	14BTIS02	Invertebrate	1040	15.6	225.	3.37
	DnMWFL13	Liver	1.60	1.07	.221	.148
	RuMWFL15	Liver	14.8	1.10	1.64	.122
	RuMWFL17	Liver	2.28	.946	.413	.171
	RuMWFL19	Liver	14.5	1.11	2.51	.192
	RuMWFL21	Liver	3.13	1.13	.510	.184
	RuMWFL23	Liver	< 1.21	1.21	< .224	.224
	UpMWFL01	Liver	< 1.02	1.02	< .191	.191
	UpMWFL03	Liver	2.21	1.25	.371	.210
	UpMWFL05	Liver	2.40	1.01	.480	.202
	UpMWFL07	Liver	5.76	1.06	.899	.165
	UpMWFL09	Liver	< 1.07	1.07	< .188	.188
	UpMWFL11	Liver	21.0	1.08	2.92	.150
	DnMWFm14	Muscle	1.85	1.12	.364	.221
	RuMWFm16	Muscle	2.22	.933	.380	.160
	RuMWFm18	Muscle	< 1.11	1.11	< .242	.242
	RuMWFm20	Muscle	1.45	1.10	.252	.191
	RuMWFm22	Muscle	< 1.14	1.14	< .211	.211
	RuMWFm24	Muscle	< 1.01	1.01	< .219	.219
	UpMWFm02	Muscle	< .886	.886	< .195	.195
	UpMWFm04	Muscle	< 1.07	1.07	< .184	.184
	UpMWFm06	Muscle	1.25	.999	.261	.209
	UpMWFm08	Muscle	< 1.05	1.05	< .198	.198
	UpMWFm10	Muscle	< 1.15	1.15	< .288	.288
	UpMWFm12	Muscle	1.32	1.05	.297	.236

CONTAMINANT CONCENTRATIONS

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
Ag	01BTIS01	Invertebrate	.0806	.0129	.0122	.00195
	01BTIS02	Invertebrate	.133	.0206	.0551	.00853
	03BTIS01	Invertebrate	.0615	.0135	.0121	.00265
	03BTIS02	Invertebrate	.0942	.0113	.0162	.00194
	06BTIS01	Invertebrate	.0353	.00644	.00851	.00155
	06BTIS02	Invertebrate	.0463	.00590	.00968	.00123
	07BTIS01	Invertebrate	.0553	.0288	.0115	.00599
	07BTIS02	Invertebrate	.0379	.0161	.00731	.00311
	08BTIS01	Invertebrate	.0781	.0579	.0159	.0118
	08BTIS02	Invertebrate	.0230	.00728	.00375	.00119
	09BTIS01	Invertebrate	.0151	.00790	.00243	.00127
	09BTIS02	Invertebrate	.0356	.0137	.00377	.00145
	10BTIS01	Invertebrate	.0133	.00473	.00261	.000927
	10BTIS02	Invertebrate	.0172	.0108	.00473	.00297
	11BTIS01	Invertebrate	.0763	.00829	.0157	.00171
	11BTIS02	Invertebrate	.0630	.0272	.0329	.0142
	12BTIS01	Invertebrate	.0808	.0126	.0179	.00280
	12BTIS02	Invertebrate	.0950	.0155	.0228	.00372
	13BTIS01	Invertebrate	.0796	.00541	.0136	.000925
	13BTIS02	Invertebrate	.0661	.0136	.0137	.00282
	14BTIS01	Invertebrate	.0759	.00636	.0133	.00111
	14BTIS02	Invertebrate	.0850	.0780	.0184	.0168
	DnMWFL13	Liver	.168	.00534	.0232	.000737
	RuMWFL15	Liver	.281	.00552	.0312	.000613
	RuMWFL17	Liver	.0222	.00473	.00402	.000856
	RuMWFL19	Liver	1.01	.00556	.175	.000962
	RuMWFL21	Liver	.380	.00564	.0619	.000919
	RuMWFL23	Liver	.0174	.00606	.00322	.00112
	UpMWFL01	Liver	.103	.00512	.0193	.000957
	UpMWFL03	Liver	.0156	.00627	.00262	.00105
	UpMWFL05	Liver	.308	.00504	.0616	.00101
	UpMWFL07	Liver	.0383	.00532	.00597	.000830
	UpMWFL09	Liver	.0219	.00534	.00385	.000940
	UpMWFL11	Liver	.156	.00540	.0217	.000751
	DnMWFm14	Muscle	.00590	.00558	.00116	.00110
	RuMWFm16	Muscle	< .00467	.00467	< .000799	.000799
	RuMWFm18	Muscle	.00980	.00555	.00214	.00121
	RuMWFm20	Muscle	< .00548	.00548	< .000954	.000954
	RuMWFm22	Muscle	.00613	.00569	.00113	.00105
	RuMWFm24	Muscle	< .00504	.00504	< .00109	.00109
	UpMWFm02	Muscle	< .00443	.00443	< .000975	.000975
	UpMWFm04	Muscle	< .00534	.00534	< .000918	.000918
	UpMWFm06	Muscle	< .00500	.00500	< .00104	.00104
	UpMWFm08	Muscle	.00538	.00526	.00102	.000994
	UpMWFm10	Muscle	< .00575	.00575	< .00144	.00144
	UpMWFm12	Muscle	< .00525	.00525	< .00118	.00118

WEIGHT, % MOISTURE, ETC. (Cont.)

Sample Number	Sample Matrix	Sample Weight(g)	Percent Moisture
RuMWFL15	Liver	5.079	88.9
RuMWFL17	Liver	4.223	81.9
RuMWFL19	Liver	9.519	82.7
RuMWFL21	Liver	3.036	83.7
RuMWFL23	Liver	1.533	81.5
UpMWFL01	Liver	6.898	81.3
UpMWFL03	Liver	1.4	83.2
UpMWFL05	Liver	5.379	80.0
UpMWFL07	Liver	13.217	84.4
UpMWFL09	Liver	7.621	82.4
UpMWFL11	Liver	10.488	86.1
DnMWFm14	Muscle	304	80.3
RuMWFm16	Muscle	258	82.9
RuMWFm18	Muscle	437	78.2
RuMWFm20	Muscle	1021	82.6
RuMWFm22	Muscle	253	81.5
RuMWFm24	Muscle	167	78.3
UpMWFm02	Muscle	479	78.0
UpMWFm04	Muscle	178	82.8
UpMWFm06	Muscle	460	79.1
UpMWFm08	Muscle	866	81.1
UpMWFm10	Muscle	782	75.0
UpMWFm12	Muscle	931	77.5

Catalog: 1080168 PO Number: 92223-99-Y317 Lab: TERL

WEIGHT, % MOISTURE, ETC.

Sample Number	Sample Matrix	Sample Weight(g)	Percent Moisture
01BTIS01	Invertebrate	.435	84.9
01BTIS02	Invertebrate	.126	58.6
03BTIS01	Invertebrate	.349	80.4
03BTIS02	Invertebrate	.504	82.8
06BTIS01	Invertebrate	1.387	75.9
06BTIS02	Invertebrate	.779	79.1
07BTIS01	Invertebrate	.147	79.2
07BTIS02	Invertebrate	.304	80.7
08BTIS01	Invertebrate	.068	79.6
08BTIS02	Invertebrate	1.239	83.7
09BTIS01	Invertebrate	1.541	83.9
09BTIS02	Invertebrate	.927	89.4
10BTIS01	Invertebrate	1.588	80.4
10BTIS02	Invertebrate	.325	72.5
11BTIS01	Invertebrate	.54	79.4
11BTIS02	Invertebrate	.072	47.7
12BTIS01	Invertebrate	.33	77.8
12BTIS02	Invertebrate	.253	76.0
13BTIS01	Invertebrate	1.156	82.9
13BTIS02	Invertebrate	.379	79.3
14BTIS01	Invertebrate	1.306	82.5
14BTIS02	Invertebrate	.053	78.4
DnMWFL13	Liver	4.378	86.2

Appendix E. Analytical report from the Environmental Contaminants Data Management System (ECDMS) of the U.S. Fish and Wildlife Service containing metal and trace element concentrations in aquatic insects and fish collected near the Leviathan Mine, 1998.

ECDMS ANALYTICAL REPORT
06/14/99

Catalog	Regional Study Id	Purchase Order	User Id	Lab Id
1080168	99R19812-004	92223-99-Y317	R1SFO	TERL

- Catalog Submitter: Dan Welsh - Sacramento, CA

- Lab Name: Trace Element Research Laboratory, Texas A&M Research Foundation (TERL)

- Sections included in the report:

  - WEIGHT, % MOISTURE, ETC.
  - PROCEDURAL BLANKS
  - REFERENCE MATERIALS
  - QA/QC ANOMALIES
  - CONTAMINANT CONCENTRATIONS
  - DUPLICATES
  - SPIKE RECOVERIES
  - ANALYTICAL METHODS

- Sections NOT included (NO DATA were found):

  - SOIL/SEDIMENT PARAMETERS
  - RESULT MODIFERS

- Report Status:

  - ALL results are reported as 3 significant digits.

Pages	Results Rounded	Results too Large to Print	Lines Per Page	Columns Per Row
34	0	0	53	78

---------- Symbols and Abbreviations Used ----------

- The following may appear before a reported result (ex. < 1.234).

  < = Actual result is less than the reported detection limit.
  > = Actual result is greater than the result reported.

- Rounded results are preceded by an '*' (example: *.0253). Results were rounded in order to fit within the column and line widths used in the report.

- Results too large to print are represented by a series of '*' (example: ********). These values could not be rounded small enough to fit within the column and line widths used in the report.

Appendix D. Chain-of-custody forms used to document the transfer of fish samples to the Trace Element Research Laboratory.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
DIVISION OF LAW ENFORCEMENT

CHAIN OF CUSTODY RECORD

FILE NO.
INV.

DATE AND TIME OF SEIZURE:	REGION:	EVIDENCE/PROPERTY SEIZED BY:
10/98.	R1	Larry Thompson

SOURCE OF EVIDENCE/PROPERTY (person and/or location):
☒ TAKEN FROM:
☐ RECEIVED FROM:
☐ FOUND AT: Area around Leviathan mine

CASE TITLE AND REMARKS:
Leviathan mine NRDA

ITEM NO.	DESCRIPTION OF EVIDENCE/PROPERTY (include Seizure Tag Numbers and any serial numbers):
DnMWFL13 DnMWFL14 RuMWFL15 RuMWFL17 RuMWFL19 RuMWFL21 RuMWFL23 RuMWFm16 RuMWFm18 RuMWFm20 RuMWFm22 RuMWFm24 UpMWFL01 UpMWFL03 UpMWFL05 UpMWFL07 UpMWFL09 UpMWFL11	UpMWFm02 UpMWFm04 UpMWFm06 UpMWFm08 UpMWFm10 UpMWFm12 All samples collected from area around Leviathan mine TERL: SAMPLES ARRIVED FROZEN AND IN GOOD CONDITION. BLB 11/12/98

ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED
DnMWFL13 ↓ UpMWFm12	Carmen Thomas U.S. Fish & Wildlife Svc.	Carmen Thomas	11/10/98	☐ U.S. MAIL ☐ IN PERSON
	TO: (PRINT NAME, AGENCY)	RECEIPT SIGNATURE:	RECEIPT DATE	☒ OTHER: Fed-ex priority overnight
	Bryan Brattin TERL	[signature]	11/12/98	
ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED
				☐ U.S. MAIL ☐ IN PERSON
	TO: (PRINT NAME, AGENCY)	RECEIPT SIGNATURE:	RECEIPT DATE	☐ OTHER:
ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED
				☐ U.S. MAIL ☐ IN PERSON
	TO: (PRINT NAME, AGENCY)	RECEIPT SIGNATURE:	RECEIPT DATE	☐ OTHER:

☐ ADDITIONAL TRANSFERS ON REVERSE SIDE

FORM

Appendix C. Field-measured length and weight of mountain whitefish (*Prosopium williamsoni*) captured in the East Fork Carson River for analyses of metal and trace element concentrations in liver and muscle tissues.

Sample Number	Length (inches)	Weight (grams)	Tissue Dissected	Site Number[a]	Date Sampled
UpMWF01	14.6	479	Liver	11	10/27/98
UpMWF02	14.6	479	Muscle	11	10/27/98
UpMWF03	10.4	178	Liver	11	10/27/98
UpMWF04	10.4	178	Muscle	11	10/27/98
UpMWF05	13.5	460	Liver	11	10/27/98
UpMWF06	13.5	460	Muscle	11	10/27/98
UpMWF07	17.2	866	Liver	11	10/27/98
UpMWF08	17.2	866	Muscle	11	10/27/98
UpMWF09	16.3	782	Liver	11	10/27/98
UpMWF10	16.3	782	Muscle	11	10/27/98
UpMWF11	16.5	931	Liver	11	10/27/98
UpMWF12	16.5	931	Muscle	11	10/27/98
DnMWF13	12.2	304	Liver	12	10/28/98
DnMWF14	12.2	304	Muscle	12	10/28/98
RuMWF15	12.7	258	Liver	13	10/28/98
RuMWF16	12.7	258	Muscle	13	10/28/98
RuMWF17	14.2	437	Liver	13	10/28/98
RuMWF18	14.2	437	Muscle	13	10/28/98
RuMWF19	17.4	1021	Liver	13	10/28/98
RuMWF20	17.4	1021	Muscle	13	10/28/98
RuMWF21	11.8	253	Liver	13	10/28/98
RuMWF22	11.8	253	Muscle	13	10/28/98
RuMWF23	9.8	167	Liver	13	10/28/98
RuMWF24	9.8	167	Muscle	13	10/28/98

[a] Site locations are illustrated by number in Figure 1.

Appendix B. Chain-of-custody forms used to document the transfer of aquatic insect samples to the Trace Element Research Laboratory.

DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
DIVISION OF LAW ENFORCEMENT

CHAIN OF CUSTODY RECORD

FILE NO.
INV.

DATE AND TIME OF SEIZURE:	REGION:	EVIDENCE/PROPERTY SEIZED BY:
Sept. 21-24, 1998	California	David B. Herbst

SOURCE OF EVIDENCE/PROPERTY (person and/or location):	CASE TITLE AND REMARKS:
☒ TAKEN FROM: Leviathan Mine Watershed ☐ RECEIVED FROM: ☐ FOUND AT: Leviathan Creek, Aspen Creek, Mountaineer Creek, Bryant Creek, East Fork Carson River Alpine County, California	Leviathan Mine Acid Mine Drainage Study - ARCO

ITEM NO.	DESCRIPTION OF EVIDENCE/PROPERTY (Include Seizure Tag Numbers and any serial numbers):
	Insect tissue from control and AMD contaminated streams. Code system: 00-BTIS-000 01-14 = site number; benthic tissue 001 = Hydropsyche 002 = Baetis No samples from site 02, 04, 05 due to level of contamination eliminating target species. 22 samples total. All samples frozen in field and maintained frozen in lab freezer. Specimen field-collected without rinsing of external surfaces except in site location water.

ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED V
	David Herbst, State Nevada Aquatic Research Lab	David B. Herbst	Nov. 3, 1998	☒ U.S. MAIL (BC)
	TO: (PRINT NAME, AGENCY) Robert Taylor, Texas A&M, Trace Element Research Lab	RECEIPT SIGNATURE: Robert J. Taylor	RECEIPT DATE Nov. 4, 1998	☐ IN PERSON ☒ OTHER: ~~Fed Ex~~
ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED V
				☐ U.S. MAIL
	TO: (PRINT NAME, AGENCY)	RECEIPT SIGNATURE:	RECEIPT DATE	☐ IN PERSON ☐ OTHER:
ITEM NO.	FROM: (PRINT NAME, AGENCY)	RELEASE SIGNATURE:	RELEASE DATE	DELIVERED V
				☐ U.S. MAIL
	TO: (PRINT NAME, AGENCY)	RECEIPT SIGNATURE:	RECEIPT DATE	☐ IN PERSON ☐ OTHER:

☐ ADDITIONAL TRANSFERS ON REVERSE SIDE

FORM

METHYL-MERCURY IN WATER AND BOTTOM SEDIMENT ALONG THE CARSON RIVER SYSTEM, NEVADA AND CALIFORNIA, SEPTEMBER 1998

(Hoffman and Thomas, 2000)

Surface Water Results from the Project Database
Hoffman and Thomas (2000)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
EFC-Ruhen	9/14/1998	Flow	150	cfs	Field	HOF-001
EFC-Ruhen	9/14/1998	Hg	3.42	mg/L	Total	HOF-001
EFC-Ruhen	9/14/1998	Methyl-Hg	0.16	mg/L	Total	HOF-001
EFC-Ruhen	9/14/1998	pH	8.3	su	Field	HOF-001
EFC-Ruhen	9/14/1998	Temp	20	C	Field	HOF-001
EFC-Ruhen	9/14/1998	TOC	1.5	mg/L	Total	HOF-001
EFC-upstr	9/14/1998	Flow	130	cfs	Field	HOF-001
EFC-upstr	9/14/1998	Hg	4.74	mg/L	Total	HOF-001
EFC-upstr	9/14/1998	Methyl-Hg	0.08	mg/L	Total	HOF-001
EFC-upstr	9/14/1998	pH	8.3	su	Field	HOF-001
EFC-upstr	9/14/1998	Temp	16	C	Field	HOF-001
EFC-upstr	9/14/1998	TOC	1.3	mg/L	Total	HOF-001

Notes:

Informaton obtained from database source code HOF-001 within the project database. The original source was from *Methylmercury in Water and Bottom Sediment along the Carson River System, Nevada and california, September 1998*. By Hoffman and Thomas (2000).

Hg = Mercury, Methyl-Hg = Methyl mercury, TOC = total organic carbon, Temp = Temperature, C = Celcius, ppm = parts per million, mg/L = milligrams per liter, cfs = cubic feet per second, su = standard units

(Lehr, 2000)

SDMS Doc ID 2023851

2023851

STATE OF CALIFORNIA - THE RESOURCES AGENCY

GRAY DAVIS, Governor

DEPARTMENT OF FISH AND GAME
Sacramento Valley - Central Sierra Region
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CALIFORNIA 95670
(530) 626-3687

November 15, 2000

Mr. Dan Ferriter
ARCO Environmental Remediation, LLC
307 East Park Avenue, Suite 400
Anaconda, Montana 59711

Dear Mr. Ferriter

The California Department of Fish and Game is providing you with two copies of the final report titled "Leviathan Mine Natural Resources Damage Assessment Phase 1 Fisheries Assessment: October 2000". This report documents the status of fisheries populations in the Leviathan-Bryant Creek watershed in October 1998.

Should you have any questions about this report please contact me at (530) 626-3687.

Sincerely,

Stafford Lehr
Associate Fishery Biologist

Enclosure

cc: enclosed list with enclosures

Mr. Timothy Seward
Legal Counsel
Washoe Tribe of Nevada and California
919 U.S. Hwy 395 South
Gardnerville, NV 89410

Mr. Charles McKinley
U.S. Department of the Interior
Office of the Solicitor
San Francisco Field Office
600 Harrison Street, Suite 545
San Francisco, CA 94107-1373

Mr. John Krause
Bureau of Indian Affairs
Western Regional Office
Environmental Restoration & Compliance
P.O. Box 10
Phoenix, AZ 85001

Ms. Janet Wong
Office of the Field Solicitor
Phoenix Field Office
One Renaissance Square
Two North Central, Suite 1130
Phoenix, AZ 85004

Mr. Dan Welsh
U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
2800 Cottage Way, W-2605
Sacramento, CA 95825

Mr. Stan Wiemeyer
U.S. Fish and Wildlife Service
Nevada Fish and Wildlife Office
1340 Financial Blvd., Suite 234
Reno, NV 89502

Ms. Mary Beth Marks
On-Scene Coordinator/Program Manager
Humboldt-Toiyabe National Forest
Northeast Nevada Ecounit Office
2035 Last Chance Road
Elko, NV 89801-4938

Ms. Maggie Manderbach
Regional Forester Representative
Intermountain Region
Bio-Physical Resources Group
324 25th Street
Ogden, UT 84401

Mr. Allen Biaggi
Administrator
Nevada Division of Environmental Protection
333 West Nye Lane
Carson City, NV 89706-0851

Mr. Jim Lukasko
Nevada Division of Environmental Protection
333 West Nye Lane
Carson City, NV 89706-0851

Dr. Steve Hampton
Resource Economist
Office of Spill Prevention and Response
California Department of Fish and Game
P.O. Box 944209
Sacramento, CA 94244-2090

Mr. Randy Imai
Office of Spill Prevention and Response
California Department of Fish and Game
P.O. Box 944209
Sacramento, CA 94244-2090

Ms. Janna R. Herren
Environmental Specialist III
California Department of Fish and Game
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670

Mr. Jon Mueller
Department of Justice
Environmental Enforcement Division
P.O. Box 7611
Washington, D.C. 20044

Mr. Joshua Wirtschafter
Office of Regional Counsel
EPA Region IX
75 Hawthorne Street
San Francisco, CA 94105

Mr. Kevin Mayer
Leviathan Mine Remedial Project Manager
Superfund Division (SFD-7-2)
75 Hawthorne Street
San Francisco, CA 94105

Mr. Ned Black
Superfund Division (SFD-8)
75 Hawthorne Street
San Francisco, CA 94105

Mr. Michael D. Sevon
Supervising Fisheries Biologist
Nevada Division of Wildlife
380 West B Street
Fallon, NV 89406

Mr. Patrick Sollberger
Nevada Division of Wildlife
1060 Mallory Way
Carson City, NV 89701

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
Mtn-1	10/21/1998	Fish population	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population	0	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population	3446	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population	288	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population	216	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population	0	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population	0	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population	139	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population	129	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population	11	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population	0	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population	64	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population	16	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population	19	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population	24	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population	0	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population	1441	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population	721	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population	915	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population	0	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population	179	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population	821	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population	382	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population	0	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	1	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	0	number		LEH-001
EFC 1	10/27/1998	Number of Fish	0	number		LEH-001
EFC 2	10/28/1998	Number of Fish	0	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
Sta 24	10/22/1998	Number of Fish	17	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	10	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	1	number		LEH-001
Sta 29	10/15/1998	Number of Fish	1	number		LEH-001
EFC 1	10/27/1998	Number of Fish	1	number		LEH-001
EFC 2	10/28/1998	Number of Fish	4	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	2	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	155	number		LEH-001
EFC 1	10/27/1998	Number of Fish	43	number		LEH-001
EFC 2	10/28/1998	Number of Fish	30	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	7	number		LEH-001
EFC 1	10/27/1998	Number of Fish	15	number		LEH-001
EFC 2	10/28/1998	Number of Fish	2	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	4	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	1	number		LEH-001
Sta 29	10/15/1998	Number of Fish	1	number		LEH-001
EFC 1	10/27/1998	Number of Fish	5	number		LEH-001
EFC 2	10/28/1998	Number of Fish	0	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	83	number		LEH-001
Sta 1	10/23/1998	Number of Fish	41	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	52	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	9	number		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
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Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
EFC 1	10/27/1998	Number of Fish	66	number		LEH-001
EFC 2	10/28/1998	Number of Fish	41	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	1.93	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 24	10/22/1998	Standing crop estimates	17.27	pounds/surface area		LEH-001
Sta 1	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	26.76	pounds/surface area		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	8.65	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	1.41	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	0.02	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0.12	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 16	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population estimates	16	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
Sta 29	10/15/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population estimates	284	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population estimates	176	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population estimates	16	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population estimates	19	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population estimates	4	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population estimates	22	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
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Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
Sta 24	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population estimates	17	#fish/mile		LEH-001
Mtn-1	10/21/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 16	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 25	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001
BC-BRC	10/23/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 26	10/16/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 29	10/15/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 1	10/27/1998	Fish population estimates	0	#fish/mile		LEH-001
EFC 2	10/28/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 23	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 24	10/22/1998	Fish population estimates	0	#fish/mile		LEH-001
Sta 1	10/23/1998	Fish population estimates	35	#fish/mile		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	1	number		LEH-001
EFC 1	10/27/1998	Number of Fish	0	number		LEH-001
EFC 2	10/28/1998	Number of Fish	0	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	0	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	0	number		LEH-001
EFC 1	10/27/1998	Number of Fish	0	number		LEH-001
EFC 2	10/28/1998	Number of Fish	0	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Number of Fish	0	number		LEH-001
Sta 1	10/23/1998	Number of Fish	1	number		LEH-001
Mtn-1	10/21/1998	Number of Fish	0	number		LEH-001
Sta 16	10/23/1998	Number of Fish	0	number		LEH-001
Sta 25	10/16/1998	Number of Fish	0	number		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
BC-BRC	10/23/1998	Number of Fish	0	number		LEH-001
Sta 26	10/16/1998	Number of Fish	0	number		LEH-001
Sta 29	10/15/1998	Number of Fish	0	number		LEH-001
EFC 1	10/27/1998	Number of Fish	0	number		LEH-001
EFC 2	10/28/1998	Number of Fish	0	number		LEH-001
Sta 23	10/22/1998	Number of Fish	0	number		LEH-001
Sta 24	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 1	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 24	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 1	10/23/1998	Standing crop estimates	9.6	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	0	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 24	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001

Bioassessment Results from the Project Database
Lehr (2000)
Leviathan Mine Site
Alpine County, California

Biological Station	Sample Date	Parameter	Value	Units	Comments	SourceCode
Sta 1	10/23/1998	Standing crop estimates	5.12	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	3.79	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	5.49	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0.3	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 24	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 1	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 16	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 25	10/16/1998	Standing crop estimates	0.41	pounds/surface area		LEH-001
BC-BRC	10/23/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 26	10/16/1998	Standing crop estimates	3.39	pounds/surface area		LEH-001
Sta 29	10/15/1998	Standing crop estimates	8.11	pounds/surface area		LEH-001
EFC 1	10/27/1998	Standing crop estimates	1.03	pounds/surface area		LEH-001
EFC 2	10/28/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 23	10/22/1998	Standing crop estimates	0	pounds/surface area		LEH-001
Sta 24	10/22/1998	Standing crop estimates	73.07	pounds/surface area		LEH-001
Sta 1	10/23/1998	Standing crop estimates	71.14	pounds/surface area		LEH-001
Mtn-1	10/21/1998	Standing crop estimates	61.96	pounds/surface area		LEH-001

Notes:

Informaton obtained from database source code LEH-001 within the project database. The original source was from Leviathan Mine Natural Resources Damage Assessment, Phase I Fisheries Assessment, by Stafford K. Lehr, CDFG. Lehr (2000).

OPERATION AND MONITORING OF BIOREACTORS AT THE LEVIATHAN MINE

(Miller, 2001)

Surface Water Results from the Project Database
Miller (2001)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
OS	3/12/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	3/27/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	4/16/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	4/24/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	5/8/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	6/21/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	6/25/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	6/28/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	7/6/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	7/12/2001	Alkalinity (Total)	0	mg/L	Total	MIL-001
OS	7/16/2001	Alkalinity	0	mg/L	Total	MIL-001
OS	4/16/2001	Ni	0.04	mg/L	Dis	MIL-001
OS	4/24/2001	Ni	0.06	mg/L	Dis	MIL-001
OS	5/8/2001	Ni	0.06	mg/L	Dis	MIL-001
OS	6/25/2001	Ni	0.09	mg/L	Dis	MIL-001
OS	2/6/2001	Ni	0.11	mg/L	Dis	MIL-001
OS	3/12/2001	Ni	0.11	mg/L	Dis	MIL-001
OS	3/27/2001	Ni	0.11	mg/L	Dis	MIL-001
OS	6/28/2001	Ni	0.11	mg/L	Dis	MIL-001
OS	7/6/2001	Ni	0.11	mg/L	Dis	MIL-001
OS	2/26/2001	Ni	0.12	mg/L	Dis	MIL-001
OS	6/21/2001	Ni	0.12	mg/L	Dis	MIL-001
OS	1/5/2001	Ni	0.13	mg/L	Dis	MIL-001
OS	6/14/2001	Ni	0.13	mg/L	Dis	MIL-001
OS	7/12/2001	Ni	0.13	mg/L	Dis	MIL-001
OS	7/16/2001	Ni	0.13	mg/L	Dis	MIL-001
OS	4/24/2001	Cu	0.13	mg/L	Dis	MIL-001
OS	3/27/2001	Cu	0.14	mg/L	Dis	MIL-001
OS	4/16/2001	Cu	0.14	mg/L	Dis	MIL-001
OS	2/6/2001	Cu	0.16	mg/L	Dis	MIL-001
OS	3/12/2001	Cu	0.16	mg/L	Dis	MIL-001
OS	2/26/2001	Cu	0.17	mg/L	Dis	MIL-001
OS	1/5/2001	Cu	0.2	mg/L	Dis	MIL-001
OS	5/8/2001	Cu	0.22	mg/L	Dis	MIL-001
OS	6/14/2001	Cu	0.22	mg/L	Dis	MIL-001
OS	6/25/2001	Cu	0.22	mg/L	Dis	MIL-001
OS	7/12/2001	Cu	0.22	mg/L	Dis	MIL-001
OS	6/21/2001	Cu	0.23	mg/L	Dis	MIL-001
OS	6/28/2001	Cu	0.23	mg/L	Dis	MIL-001

Surface Water Results from the Project Database
Miller (2001)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
OS	7/6/2001	Cu	0.23	mg/L	Dis	MIL-001
OS	7/16/2001	Cu	0.23	mg/L	Dis	MIL-001
OS	4/24/2001	Zn	0.94	mg/L	Dis	MIL-001
OS	3/27/2001	Zn	1.02	mg/L	Dis	MIL-001
OS	4/16/2001	Zn	1.03	mg/L	Dis	MIL-001
OS	6/25/2001	Zn	1.05	mg/L	Dis	MIL-001
OS	6/28/2001	Zn	1.07	mg/L	Dis	MIL-001
OS	7/6/2001	Zn	1.1	mg/L	Dis	MIL-001
OS	6/21/2001	Zn	1.13	mg/L	Dis	MIL-001
OS	3/12/2001	Zn	1.15	mg/L	Dis	MIL-001
OS	2/6/2001	Zn	1.18	mg/L	Dis	MIL-001
OS	1/5/2001	Zn	1.21	mg/L	Dis	MIL-001
OS	6/14/2001	Zn	1.22	mg/L	Dis	MIL-001
OS	2/26/2001	Zn	1.23	mg/L	Dis	MIL-001
OS	7/16/2001	Zn	1.55	mg/L	Dis	MIL-001
OS	7/12/2001	Zn	1.64	mg/L	Dis	MIL-001
OS	6/25/2001	pH	3	su	Field	MIL-001
OS	6/21/2001	pH	3.04	su	Field	MIL-001
OS	6/14/2001	pH	3.1	su	Field	MIL-001
OS	5/8/2001	pH	3.23	su	Field	MIL-001
OS	7/6/2001	pH	3.23	su	Field	MIL-001
OS	4/16/2001	pH	3.27	su	Field	MIL-001
OS	7/12/2001	pH	3.27	su	Field	MIL-001
OS	6/28/2001	pH	3.32	su	Field	MIL-001
OS	7/16/2001	pH	3.32	su	Field	MIL-001
OS	3/27/2001	pH	3.34	su	Field	MIL-001
OS	4/24/2001	pH	3.35	su	Field	MIL-001
OS	2/26/2001	pH	3.37	su	Field	MIL-001
OS	2/6/2001	pH	3.46	su	Field	MIL-001
OS	1/5/2001	pH	3.61	su	Field	MIL-001
OS	3/12/2001	pH	3.68	su	Field	MIL-001
OS	3/12/2001	Mn	17	mg/L	Dis	MIL-001
OS	3/27/2001	Mn	17	mg/L	Dis	MIL-001
OS	4/16/2001	Mn	17	mg/L	Dis	MIL-001
OS	4/24/2001	Mn	17	mg/L	Dis	MIL-001
OS	2/26/2001	Mn	17.3	mg/L	Dis	MIL-001
OS	2/6/2001	Mn	17.5	mg/L	Dis	MIL-001
OS	6/14/2001	Mn	18	mg/L	Dis	MIL-001
OS	6/21/2001	Mn	19	mg/L	Dis	MIL-001
OS	6/25/2001	Mn	19	mg/L	Dis	MIL-001
OS	6/28/2001	Mn	19	mg/L	Dis	MIL-001
OS	7/12/2001	Mn	19	mg/L	Dis	MIL-001
OS	7/16/2001	Mn	19	mg/L	Dis	MIL-001
OS	1/5/2001	Mn	19.5	mg/L	Dis	MIL-001
OS	7/6/2001	Mn	20	mg/L	Dis	MIL-001

Surface Water Results from the Project Database
Miller (2001)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
OS	6/21/2001	Al	25	mg/L	Dis	MIL-001
OS	6/25/2001	Al	26	mg/L	Dis	MIL-001
OS	6/28/2001	Al	27	mg/L	Dis	MIL-001
OS	6/14/2001	Al	28	mg/L	Dis	MIL-001
OS	7/16/2001	Al	29	mg/L	Dis	MIL-001
OS	7/6/2001	Al	30	mg/L	Dis	MIL-001
OS	7/12/2001	Al	30	mg/L	Dis	MIL-001
OS	7/6/2001	Fe	79	mg/L	Dis	MIL-001
OS	5/8/2001	Fe	83	mg/L	Dis	MIL-001
OS	6/28/2001	Fe	84	mg/L	Dis	MIL-001
OS	4/24/2001	Fe	90	mg/L	Dis	MIL-001
OS	3/27/2001	Fe	94	mg/L	Dis	MIL-001
OS	4/16/2001	Fe	95	mg/L	Dis	MIL-001
OS	6/25/2001	Fe	96	mg/L	Dis	MIL-001
OS	3/12/2001	Fe	103	mg/L	Dis	MIL-001
OS	2/6/2001	Fe	105	mg/L	Dis	MIL-001
OS	6/21/2001	Fe	107	mg/L	Dis	MIL-001
OS	2/26/2001	Fe	108	mg/L	Dis	MIL-001
OS	7/16/2001	Fe	109	mg/L	Dis	MIL-001
OS	7/12/2001	Fe	111	mg/L	Dis	MIL-001
OS	1/5/2001	Fe	112	mg/L	Dis	MIL-001
OS	6/14/2001	Fe	116	mg/L	Dis	MIL-001
OS	4/16/2001	SO4	1408	mg/L	Dis	MIL-001
OS	4/24/2001	SO4	1413	mg/L	Dis	MIL-001
OS	5/8/2001	SO4	1425	mg/L	Dis	MIL-001
OS	2/26/2001	SO4	1426	mg/L	Dis	MIL-001
OS	3/12/2001	SO4	1436	mg/L	Dis	MIL-001
OS	7/16/2001	SO4	1492	mg/L	Dis	MIL-001
OS	2/6/2001	SO4	1500	mg/L	Dis	MIL-001
OS	3/27/2001	SO4	1514	mg/L	Dis	MIL-001
OS	6/28/2001	SO4	1519	mg/L	Dis	MIL-001
OS	7/12/2001	SO4	1525	mg/L	Dis	MIL-001
OS	7/6/2001	SO4	1548	mg/L	Dis	MIL-001
OS	6/21/2001	SO4	1562	mg/L	Dis	MIL-001
OS	2/6/2001	TDS	2268	mg/L	Dis	MIL-001
OS	4/24/2001	TDS	2268	mg/L	Dis	MIL-001
OS	2/26/2001	TDS	2280	mg/L	Dis	MIL-001
OS	4/16/2001	TDS	2292	mg/L	Dis	MIL-001
OS	3/27/2001	TDS	2315	mg/L	Dis	MIL-001
OS	7/12/2001	TDS	2316	mg/L	Dis	MIL-001
OS	3/12/2001	TDS	2336	mg/L	Dis	MIL-001
OS	5/8/2001	TDS	2348	mg/L	Dis	MIL-001

Surface Water Results from the Project Database
Miller (2001)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
OS	7/16/2001	TDS	2348	mg/L	Dis	MIL-001
OS	6/21/2001	TDS	2360	mg/L	Dis	MIL-001
OS	6/25/2001	TDS	2360	mg/L	Dis	MIL-001
OS	6/28/2001	TDS	2428	mg/L	Dis	MIL-001
OS	7/6/2001	TDS	2492	mg/L	Dis	MIL-001

Notes:

Informaton obtained from database source code MIL-001 within the project database. The original source was from *Operation and Monitoring of Bioreactors at the Leviathan Mine*. Miller (2001)

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, Dis = dissolved, SpC = specific conductivity, uS/cm = microseimens per centimeter, ppm = parts per million, su = standard units, mg/L = milligrams per liter

PRELIMINARY ASSESSMENT OF FISH COMMUNITY DYNAMICS AND TRACE-ELEMENT EXPOSURES TO AQUATIC INVERTEBRATES AND SALMONIDS, LOWER BRYANT CREEK AND EAST FORK CARSON RIVER, DOUGLAS COUNTY, NEVADA 2001

(Higgins, 2001)

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
BRY	10/19/2001	Al	161	ppm	HIG-006
BRY	10/19/2001	Al	37.1	ppm	HIG-006
BRY	10/19/2001	Al	501	ppm	HIG-006
BRY	10/19/2001	Al	560	ppm	HIG-006
BRY	10/19/2001	As	0.1575	ppm	HIG-006
BRY	10/19/2001	As	1.5	ppm	HIG-006
BRY	10/19/2001	As	2.83	ppm	HIG-006
BRY	10/19/2001	As	3.06	ppm	HIG-006
BRY	10/19/2001	B	1.02	ppm	HIG-006
BRY	10/19/2001	B	1.05	ppm	HIG-006
BRY	10/19/2001	B	1.11	ppm	HIG-006
BRY	10/19/2001	Ba	14.2	ppm	HIG-006
BRY	10/19/2001	Ba	2.52	ppm	HIG-006
BRY	10/19/2001	Ba	20	ppm	HIG-006
BRY	10/19/2001	Ba	3.11	ppm	HIG-006
BRY	10/19/2001	Be	0.0509	ppm	HIG-006
BRY	10/19/2001	Be	0.0525	ppm	HIG-006
BRY	10/19/2001	Be	0.0829	ppm	HIG-006
BRY	10/19/2001	Be	0.0877	ppm	HIG-006
BRY	10/19/2001	Ca	12600	ppm	HIG-006
BRY	10/19/2001	Ca	4500	ppm	HIG-006
BRY	10/19/2001	Ca	4650	ppm	HIG-006
BRY	10/19/2001	Ca	5790	ppm	HIG-006
BRY	10/19/2001	Cd	0.0493	ppm	HIG-006
BRY	10/19/2001	Cd	0.066	ppm	HIG-006
BRY	10/19/2001	Cd	0.169	ppm	HIG-006
BRY	10/19/2001	Cd	0.18	ppm	HIG-006
BRY	10/19/2001	Co	0.591	ppm	HIG-006
BRY	10/19/2001	Co	0.914	ppm	HIG-006
BRY	10/19/2001	Co	5.46	ppm	HIG-006
BRY	10/19/2001	Co	8.1	ppm	HIG-006
BRY	10/19/2001	Cr	0.509	ppm	HIG-006
BRY	10/19/2001	Cr	0.594	ppm	HIG-006
BRY	10/19/2001	Cr	1.11	ppm	HIG-006
BRY	10/19/2001	Cr	1.19	ppm	HIG-006
BRY	10/19/2001	Cu	27.4	ppm	HIG-006
BRY	10/19/2001	Cu	28.2	ppm	HIG-006
BRY	10/19/2001	Cu	3.67	ppm	HIG-006
BRY	10/19/2001	Cu	4.15	ppm	HIG-006
BRY	10/19/2001	Fe	148	ppm	HIG-006
BRY	10/19/2001	Fe	204	ppm	HIG-006
BRY	10/19/2001	Fe	758	ppm	HIG-006
BRY	10/19/2001	Fe	870	ppm	HIG-006
BRY	10/19/2001	Hg	0.162	ppm	HIG-006
BRY	10/19/2001	Hg	0.202	ppm	HIG-006
BRY	10/19/2001	Hg	0.23	ppm	HIG-006
BRY	10/19/2001	Hg	0.557	ppm	HIG-006
BRY	10/19/2001	K	10600	ppm	HIG-006
BRY	10/19/2001	K	11800	ppm	HIG-006
BRY	10/19/2001	K	6830	ppm	HIG-006
BRY	10/19/2001	K	7770	ppm	HIG-006
BRY	10/19/2001	Mg	1030	ppm	HIG-006
BRY	10/19/2001	Mg	1560	ppm	HIG-006
BRY	10/19/2001	Mg	1620	ppm	HIG-006
BRY	10/19/2001	Mg	958	ppm	HIG-006
BRY	10/19/2001	Mn	17.7	ppm	HIG-006
BRY	10/19/2001	Mn	251	ppm	HIG-006
BRY	10/19/2001	Mn	40.8	ppm	HIG-006
BRY	10/19/2001	Mn	435	ppm	HIG-006
BRY	10/19/2001	Mo	1.02	ppm	HIG-006
BRY	10/19/2001	Mo	1.05	ppm	HIG-006
BRY	10/19/2001	Mo	1.11	ppm	HIG-006
BRY	10/19/2001	Na	2110	ppm	HIG-006
BRY	10/19/2001	Na	3080	ppm	HIG-006
BRY	10/19/2001	Na	3120	ppm	HIG-006

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
BRY	10/19/2001	Na	3530	ppm	HIG-006
BRY	10/19/2001	Ni	0.746	ppm	HIG-006
BRY	10/19/2001	Ni	1	ppm	HIG-006
BRY	10/19/2001	Ni	11.5	ppm	HIG-006
BRY	10/19/2001	Ni	9.47	ppm	HIG-006
BRY	10/19/2001	P	11200	ppm	HIG-006
BRY	10/19/2001	P	14600	ppm	HIG-006
BRY	10/19/2001	P	9940	ppm	HIG-006
BRY	10/19/2001	P	9960	ppm	HIG-006
BRY	10/19/2001	Pb	0.128	ppm	HIG-006
BRY	10/19/2001	Pb	0.137	ppm	HIG-006
BRY	10/19/2001	Pb	0.196	ppm	HIG-006
BRY	10/19/2001	Pb	0.4	ppm	HIG-006
BRY	10/19/2001	S	5510	ppm	HIG-006
BRY	10/19/2001	S	5540	ppm	HIG-006
BRY	10/19/2001	S	6940	ppm	HIG-006
BRY	10/19/2001	S	7030	ppm	HIG-006
BRY	10/19/2001	Se	1.44	ppm	HIG-006
BRY	10/19/2001	Se	2.25	ppm	HIG-006
BRY	10/19/2001	Se	2.37	ppm	HIG-006
BRY	10/19/2001	Se	2.5	ppm	HIG-006
BRY	10/19/2001	Si	144	ppm	HIG-006
BRY	10/19/2001	Si	259	ppm	HIG-006
BRY	10/19/2001	Si	285	ppm	HIG-006
BRY	10/19/2001	Si	90.7	ppm	HIG-006
BRY	10/19/2001	Sr	18.6	ppm	HIG-006
BRY	10/19/2001	Sr	26.6	ppm	HIG-006
BRY	10/19/2001	Sr	27.5	ppm	HIG-006
BRY	10/19/2001	Sr	31.2	ppm	HIG-006
BRY	10/19/2001	Ti	1.32	ppm	HIG-006
BRY	10/19/2001	Ti	12.9	ppm	HIG-006
BRY	10/19/2001	Ti	13.2	ppm	HIG-006
BRY	10/19/2001	Ti	24.2	ppm	HIG-006
BRY	10/19/2001	V	1.02	ppm	HIG-006
BRY	10/19/2001	V	1.28	ppm	HIG-006
BRY	10/19/2001	V	1.67	ppm	HIG-006
BRY	10/19/2001	V	1.98	ppm	HIG-006
BRY	10/19/2001	Zn	231	ppm	HIG-006
BRY	10/19/2001	Zn	301	ppm	HIG-006
BRY	10/19/2001	Zn	68.9	ppm	HIG-006
BRY	10/19/2001	Zn	79.5	ppm	HIG-006
EFC 1	10/19/2001	Al	13.8	ppm	HIG-006
EFC 1	10/19/2001	Al	1380	ppm	HIG-006
EFC 1	10/19/2001	Al	1440	ppm	HIG-006
EFC 1	10/19/2001	Al	15.5	ppm	HIG-006
EFC 1	10/19/2001	Al	25.2	ppm	HIG-006
EFC 1	10/19/2001	Al	4.16	ppm	HIG-006
EFC 1	10/19/2001	Al	49.6	ppm	HIG-006
EFC 1	10/19/2001	Al	51	ppm	HIG-006
EFC 1	10/19/2001	Al	59.8	ppm	HIG-006
EFC 1	10/19/2001	Al	7.64	ppm	HIG-006
EFC 1	10/19/2001	Al	81.9	ppm	HIG-006
EFC 1	10/19/2001	Al	974	ppm	HIG-006
EFC 1	10/19/2001	As	0.1555	ppm	HIG-006
EFC 1	10/19/2001	As	0.25	ppm	HIG-006
EFC 1	10/19/2001	As	0.295	ppm	HIG-006
EFC 1	10/19/2001	As	0.305	ppm	HIG-006
EFC 1	10/19/2001	As	1.19	ppm	HIG-006
EFC 1	10/19/2001	As	1.23	ppm	HIG-006
EFC 1	10/19/2001	As	1.63	ppm	HIG-006
EFC 1	10/19/2001	As	1.65	ppm	HIG-006
EFC 1	10/19/2001	As	2.27	ppm	HIG-006
EFC 1	10/19/2001	As	6.18	ppm	HIG-006
EFC 1	10/19/2001	As	7.77	ppm	HIG-006
EFC 1	10/19/2001	As	9.84	ppm	HIG-006

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 1	10/19/2001	B	0.833	ppm	HIG-006
EFC 1	10/19/2001	B	0.982	ppm	HIG-006
EFC 1	10/19/2001	B	1.01	ppm	HIG-006
EFC 1	10/19/2001	B	1.02	ppm	HIG-006
EFC 1	10/19/2001	B	1.03	ppm	HIG-006
EFC 1	10/19/2001	B	1.04	ppm	HIG-006
EFC 1	10/19/2001	B	1.07	ppm	HIG-006
EFC 1	10/19/2001	B	11.1	ppm	HIG-006
EFC 1	10/19/2001	B	6.48	ppm	HIG-006
EFC 1	10/19/2001	B	9.38	ppm	HIG-006
EFC 1	10/19/2001	Ba	0.188	ppm	HIG-006
EFC 1	10/19/2001	Ba	0.224	ppm	HIG-006
EFC 1	10/19/2001	Ba	0.591	ppm	HIG-006
EFC 1	10/19/2001	Ba	0.707	ppm	HIG-006
EFC 1	10/19/2001	Ba	1.19	ppm	HIG-006
EFC 1	10/19/2001	Ba	1.95	ppm	HIG-006
EFC 1	10/19/2001	Ba	18.6	ppm	HIG-006
EFC 1	10/19/2001	Ba	3.08	ppm	HIG-006
EFC 1	10/19/2001	Ba	32.5	ppm	HIG-006
EFC 1	10/19/2001	Ba	33.7	ppm	HIG-006
EFC 1	10/19/2001	Ba	35.3	ppm	HIG-006
EFC 1	10/19/2001	Ba	5.23	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0416	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0491	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0507	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0508	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0515	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0518	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0522	ppm	HIG-006
EFC 1	10/19/2001	Be	0.0533	ppm	HIG-006
EFC 1	10/19/2001	Be	0.104	ppm	HIG-006
EFC 1	10/19/2001	Be	0.117	ppm	HIG-006
EFC 1	10/19/2001	Be	0.121	ppm	HIG-006
EFC 1	10/19/2001	Ca	10900	ppm	HIG-006
EFC 1	10/19/2001	Ca	16800	ppm	HIG-006
EFC 1	10/19/2001	Ca	19300	ppm	HIG-006
EFC 1	10/19/2001	Ca	2450	ppm	HIG-006
EFC 1	10/19/2001	Ca	2570	ppm	HIG-006
EFC 1	10/19/2001	Ca	268	ppm	HIG-006
EFC 1	10/19/2001	Ca	2800	ppm	HIG-006
EFC 1	10/19/2001	Ca	2830	ppm	HIG-006
EFC 1	10/19/2001	Ca	40100	ppm	HIG-006
EFC 1	10/19/2001	Ca	4240	ppm	HIG-006
EFC 1	10/19/2001	Ca	896	ppm	HIG-006
EFC 1	10/19/2001	Ca	9500	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0347	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0383	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.043	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0433	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0447	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0453	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0479	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.0916	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.105	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.107	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.11	ppm	HIG-006
EFC 1	10/19/2001	Cd	0.165	ppm	HIG-006
EFC 1	10/19/2001	Co	0.416	ppm	HIG-006
EFC 1	10/19/2001	Co	0.491	ppm	HIG-006
EFC 1	10/19/2001	Co	0.507	ppm	HIG-006
EFC 1	10/19/2001	Co	0.508	ppm	HIG-006
EFC 1	10/19/2001	Co	0.515	ppm	HIG-006
EFC 1	10/19/2001	Co	0.518	ppm	HIG-006
EFC 1	10/19/2001	Co	0.522	ppm	HIG-006
EFC 1	10/19/2001	Co	0.533	ppm	HIG-006

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 1	10/19/2001	Co	4.13	ppm	HIG-006
EFC 1	10/19/2001	Co	4.62	ppm	HIG-006
EFC 1	10/19/2001	Co	4.76	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.416	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.508	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.557	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.598	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.624	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.638	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.671	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.68	ppm	HIG-006
EFC 1	10/19/2001	Cr	0.683	ppm	HIG-006
EFC 1	10/19/2001	Cr	1.38	ppm	HIG-006
EFC 1	10/19/2001	Cr	1.42	ppm	HIG-006
EFC 1	10/19/2001	Cr	11.5	ppm	HIG-006
EFC 1	10/19/2001	Cu	1.26	ppm	HIG-006
EFC 1	10/19/2001	Cu	1.59	ppm	HIG-006
EFC 1	10/19/2001	Cu	1.61	ppm	HIG-006
EFC 1	10/19/2001	Cu	1.73	ppm	HIG-006
EFC 1	10/19/2001	Cu	119	ppm	HIG-006
EFC 1	10/19/2001	Cu	27	ppm	HIG-006
EFC 1	10/19/2001	Cu	27.5	ppm	HIG-006
EFC 1	10/19/2001	Cu	28.3	ppm	HIG-006
EFC 1	10/19/2001	Cu	6.07	ppm	HIG-006
EFC 1	10/19/2001	Cu	6.14	ppm	HIG-006
EFC 1	10/19/2001	Cu	6.51	ppm	HIG-006
EFC 1	10/19/2001	Cu	8.66	ppm	HIG-006
EFC 1	10/19/2001	Fe	1600	ppm	HIG-006
EFC 1	10/19/2001	Fe	21.9	ppm	HIG-006
EFC 1	10/19/2001	Fe	244	ppm	HIG-006
EFC 1	10/19/2001	Fe	2730	ppm	HIG-006
EFC 1	10/19/2001	Fe	2750	ppm	HIG-006
EFC 1	10/19/2001	Fe	32.8	ppm	HIG-006
EFC 1	10/19/2001	Fe	36.4	ppm	HIG-006
EFC 1	10/19/2001	Fe	49.3	ppm	HIG-006
EFC 1	10/19/2001	Fe	62.3	ppm	HIG-006
EFC 1	10/19/2001	Fe	72.5	ppm	HIG-006
EFC 1	10/19/2001	Fe	78.7	ppm	HIG-006
EFC 1	10/19/2001	Fe	930	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.278	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.294	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.336	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.571	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.753	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.89	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.915	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.925	ppm	HIG-006
EFC 1	10/19/2001	Hg	0.984	ppm	HIG-006
EFC 1	10/19/2001	Hg	1.23	ppm	HIG-006
EFC 1	10/19/2001	Hg	1.24	ppm	HIG-006
EFC 1	10/19/2001	Hg	1.39	ppm	HIG-006
EFC 1	10/19/2001	K	10400	ppm	HIG-006
EFC 1	10/19/2001	K	10500	ppm	HIG-006
EFC 1	10/19/2001	K	11400	ppm	HIG-006
EFC 1	10/19/2001	K	12200	ppm	HIG-006
EFC 1	10/19/2001	K	12500	ppm	HIG-006
EFC 1	10/19/2001	K	16000	ppm	HIG-006
EFC 1	10/19/2001	K	16400	ppm	HIG-006
EFC 1	10/19/2001	K	17200	ppm	HIG-006
EFC 1	10/19/2001	K	6270	ppm	HIG-006
EFC 1	10/19/2001	K	6380	ppm	HIG-006
EFC 1	10/19/2001	K	6530	ppm	HIG-006
EFC 1	10/19/2001	K	6970	ppm	HIG-006
EFC 1	10/19/2001	Mg	1000	ppm	HIG-006
EFC 1	10/19/2001	Mg	1150	ppm	HIG-006

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 1	10/19/2001	Mg	1210	ppm	HIG-006
EFC 1	10/19/2001	Mg	1230	ppm	HIG-006
EFC 1	10/19/2001	Mg	1280	ppm	HIG-006
EFC 1	10/19/2001	Mg	1350	ppm	HIG-006
EFC 1	10/19/2001	Mg	1510	ppm	HIG-006
EFC 1	10/19/2001	Mg	1630	ppm	HIG-006
EFC 1	10/19/2001	Mg	1640	ppm	HIG-006
EFC 1	10/19/2001	Mg	771	ppm	HIG-006
EFC 1	10/19/2001	Mg	820	ppm	HIG-006
EFC 1	10/19/2001	Mg	954	ppm	HIG-006
EFC 1	10/19/2001	Mn	0.935	ppm	HIG-006
EFC 1	10/19/2001	Mn	11.3	ppm	HIG-006
EFC 1	10/19/2001	Mn	14.1	ppm	HIG-006
EFC 1	10/19/2001	Mn	17.6	ppm	HIG-006
EFC 1	10/19/2001	Mn	2.84	ppm	HIG-006
EFC 1	10/19/2001	Mn	23.7	ppm	HIG-006
EFC 1	10/19/2001	Mn	3.34	ppm	HIG-006
EFC 1	10/19/2001	Mn	35.9	ppm	HIG-006
EFC 1	10/19/2001	Mn	468	ppm	HIG-006
EFC 1	10/19/2001	Mn	549	ppm	HIG-006
EFC 1	10/19/2001	Mn	581	ppm	HIG-006
EFC 1	10/19/2001	Mn	6.35	ppm	HIG-006
EFC 1	10/19/2001	Mo	0.833	ppm	HIG-006
EFC 1	10/19/2001	Mo	0.982	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.01	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.02	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.03	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.04	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.07	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.08	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.11	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.25	ppm	HIG-006
EFC 1	10/19/2001	Mo	1.54	ppm	HIG-006
EFC 1	10/19/2001	Na	1170	ppm	HIG-006
EFC 1	10/19/2001	Na	2250	ppm	HIG-006
EFC 1	10/19/2001	Na	2490	ppm	HIG-006
EFC 1	10/19/2001	Na	2620	ppm	HIG-006
EFC 1	10/19/2001	Na	2800	ppm	HIG-006
EFC 1	10/19/2001	Na	3570	ppm	HIG-006
EFC 1	10/19/2001	Na	3760	ppm	HIG-006
EFC 1	10/19/2001	Na	4220	ppm	HIG-006
EFC 1	10/19/2001	Na	4500	ppm	HIG-006
EFC 1	10/19/2001	Na	6150	ppm	HIG-006
EFC 1	10/19/2001	Na	854	ppm	HIG-006
EFC 1	10/19/2001	Na	965	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.507	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.508	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.515	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.518	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.522	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.533	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.62	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.651	ppm	HIG-006
EFC 1	10/19/2001	Ni	0.806	ppm	HIG-006
EFC 1	10/19/2001	Ni	2.63	ppm	HIG-006
EFC 1	10/19/2001	Ni	3.21	ppm	HIG-006
EFC 1	10/19/2001	Ni	3.71	ppm	HIG-006
EFC 1	10/19/2001	P	11000	ppm	HIG-006
EFC 1	10/19/2001	P	12000	ppm	HIG-006
EFC 1	10/19/2001	P	12700	ppm	HIG-006
EFC 1	10/19/2001	P	13500	ppm	HIG-006
EFC 1	10/19/2001	P	13600	ppm	HIG-006
EFC 1	10/19/2001	P	15200	ppm	HIG-006
EFC 1	10/19/2001	P	16200	ppm	HIG-006
EFC 1	10/19/2001	P	17900	ppm	HIG-006

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BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 1	10/19/2001	P	26600	ppm	HIG-006
EFC 1	10/19/2001	P	7510	ppm	HIG-006
EFC 1	10/19/2001	P	7530	ppm	HIG-006
EFC 1	10/19/2001	P	7570	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.0907	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.0959	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.107	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.116	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.12	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.121	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.152	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.165	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.207	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.564	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.709	ppm	HIG-006
EFC 1	10/19/2001	Pb	0.782	ppm	HIG-006
EFC 1	10/19/2001	S	5080	ppm	HIG-006
EFC 1	10/19/2001	S	5180	ppm	HIG-006
EFC 1	10/19/2001	S	5350	ppm	HIG-006
EFC 1	10/19/2001	S	6290	ppm	HIG-006
EFC 1	10/19/2001	S	6670	ppm	HIG-006
EFC 1	10/19/2001	S	6860	ppm	HIG-006
EFC 1	10/19/2001	S	6950	ppm	HIG-006
EFC 1	10/19/2001	S	7160	ppm	HIG-006
EFC 1	10/19/2001	S	7400	ppm	HIG-006
EFC 1	10/19/2001	S	7590	ppm	HIG-006
EFC 1	10/19/2001	S	8390	ppm	HIG-006
EFC 1	10/19/2001	S	9260	ppm	HIG-006
EFC 1	10/19/2001	Se	0.547	ppm	HIG-006
EFC 1	10/19/2001	Se	0.563	ppm	HIG-006
EFC 1	10/19/2001	Se	0.564	ppm	HIG-006
EFC 1	10/19/2001	Se	0.628	ppm	HIG-006
EFC 1	10/19/2001	Se	0.641	ppm	HIG-006
EFC 1	10/19/2001	Se	0.653	ppm	HIG-006
EFC 1	10/19/2001	Se	0.862	ppm	HIG-006
EFC 1	10/19/2001	Se	0.887	ppm	HIG-006
EFC 1	10/19/2001	Se	0.925	ppm	HIG-006
EFC 1	10/19/2001	Se	1.07	ppm	HIG-006
EFC 1	10/19/2001	Se	1.45	ppm	HIG-006
EFC 1	10/19/2001	Se	4.5	ppm	HIG-006
EFC 1	10/19/2001	Si	106	ppm	HIG-006
EFC 1	10/19/2001	Si	117	ppm	HIG-006
EFC 1	10/19/2001	Si	118	ppm	HIG-006
EFC 1	10/19/2001	Si	205	ppm	HIG-006
EFC 1	10/19/2001	Si	248	ppm	HIG-006
EFC 1	10/19/2001	Si	30.5	ppm	HIG-006
EFC 1	10/19/2001	Si	462	ppm	HIG-006
EFC 1	10/19/2001	Si	47.2	ppm	HIG-006
EFC 1	10/19/2001	Si	58.4	ppm	HIG-006
EFC 1	10/19/2001	Si	70.9	ppm	HIG-006
EFC 1	10/19/2001	Si	78.7	ppm	HIG-006
EFC 1	10/19/2001	Si	8.3	ppm	HIG-006
EFC 1	10/19/2001	Sr	0.921	ppm	HIG-006
EFC 1	10/19/2001	Sr	11.9	ppm	HIG-006
EFC 1	10/19/2001	Sr	147	ppm	HIG-006
EFC 1	10/19/2001	Sr	2.11	ppm	HIG-006
EFC 1	10/19/2001	Sr	28.8	ppm	HIG-006
EFC 1	10/19/2001	Sr	30.4	ppm	HIG-006
EFC 1	10/19/2001	Sr	33.2	ppm	HIG-006
EFC 1	10/19/2001	Sr	34.6	ppm	HIG-006
EFC 1	10/19/2001	Sr	39.6	ppm	HIG-006
EFC 1	10/19/2001	Sr	54.5	ppm	HIG-006
EFC 1	10/19/2001	Sr	65.2	ppm	HIG-006
EFC 1	10/19/2001	Sr	7.5	ppm	HIG-006
EFC 1	10/19/2001	Ti	0.416	ppm	HIG-006

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EFC 1	10/19/2001	Ti	0.508	ppm	HIG-006
EFC 1	10/19/2001	Ti	0.522	ppm	HIG-006
EFC 1	10/19/2001	Ti	1.23	ppm	HIG-006
EFC 1	10/19/2001	Ti	1.25	ppm	HIG-006
EFC 1	10/19/2001	Ti	111	ppm	HIG-006
EFC 1	10/19/2001	Ti	2.52	ppm	HIG-006
EFC 1	10/19/2001	Ti	3.8	ppm	HIG-006
EFC 1	10/19/2001	Ti	4.54	ppm	HIG-006
EFC 1	10/19/2001	Ti	4.65	ppm	HIG-006
EFC 1	10/19/2001	Ti	50.1	ppm	HIG-006
EFC 1	10/19/2001	Ti	76.2	ppm	HIG-006
EFC 1	10/19/2001	V	0.833	ppm	HIG-006
EFC 1	10/19/2001	V	0.982	ppm	HIG-006
EFC 1	10/19/2001	V	1.01	ppm	HIG-006
EFC 1	10/19/2001	V	1.02	ppm	HIG-006
EFC 1	10/19/2001	V	1.03	ppm	HIG-006
EFC 1	10/19/2001	V	1.04	ppm	HIG-006
EFC 1	10/19/2001	V	1.07	ppm	HIG-006
EFC 1	10/19/2001	V	4.83	ppm	HIG-006
EFC 1	10/19/2001	V	4.97	ppm	HIG-006
EFC 1	10/19/2001	V	8.66	ppm	HIG-006
EFC 1	10/19/2001	Zn	12.8	ppm	HIG-006
EFC 1	10/19/2001	Zn	125	ppm	HIG-006
EFC 1	10/19/2001	Zn	145	ppm	HIG-006
EFC 1	10/19/2001	Zn	155	ppm	HIG-006
EFC 1	10/19/2001	Zn	16	ppm	HIG-006
EFC 1	10/19/2001	Zn	17.3	ppm	HIG-006
EFC 1	10/19/2001	Zn	197	ppm	HIG-006
EFC 1	10/19/2001	Zn	202	ppm	HIG-006
EFC 1	10/19/2001	Zn	223	ppm	HIG-006
EFC 1	10/19/2001	Zn	225	ppm	HIG-006
EFC 1	10/19/2001	Zn	88.3	ppm	HIG-006
EFC 1	10/19/2001	Zn	91.9	ppm	HIG-006
EFC 2	10/19/2001	Al	169	ppm	HIG-006
EFC 2	10/19/2001	Al	17.5	ppm	HIG-006
EFC 2	10/19/2001	Al	22.2	ppm	HIG-006
EFC 2	10/19/2001	Al	312	ppm	HIG-006
EFC 2	10/19/2001	Al	353	ppm	HIG-006
EFC 2	10/19/2001	Al	392	ppm	HIG-006
EFC 2	10/19/2001	Al	43.4	ppm	HIG-006
EFC 2	10/19/2001	Al	5.2	ppm	HIG-006
EFC 2	10/19/2001	Al	50.5	ppm	HIG-006
EFC 2	10/19/2001	Al	6.31	ppm	HIG-006
EFC 2	10/19/2001	Al	6.34	ppm	HIG-006
EFC 2	10/19/2001	Al	7.17	ppm	HIG-006
EFC 2	10/19/2001	Al	7.38	ppm	HIG-006
EFC 2	10/19/2001	Al	733	ppm	HIG-006
EFC 2	10/19/2001	Al	8.7	ppm	HIG-006
EFC 2	10/19/2001	As	0	ppm	HIG-006
EFC 2	10/19/2001	As	0.156	ppm	HIG-006
EFC 2	10/19/2001	As	0.312	ppm	HIG-006
EFC 2	10/19/2001	As	0.315	ppm	HIG-006
EFC 2	10/19/2001	As	0.323	ppm	HIG-006
EFC 2	10/19/2001	As	0.327	ppm	HIG-006
EFC 2	10/19/2001	As	0.328	ppm	HIG-006
EFC 2	10/19/2001	As	1.14	ppm	HIG-006
EFC 2	10/19/2001	As	1.3	ppm	HIG-006
EFC 2	10/19/2001	As	1.81	ppm	HIG-006
EFC 2	10/19/2001	As	14.4	ppm	HIG-006
EFC 2	10/19/2001	As	2.58	ppm	HIG-006
EFC 2	10/19/2001	As	3.15	ppm	HIG-006
EFC 2	10/19/2001	As	6.84	ppm	HIG-006
EFC 2	10/19/2001	As	7.91	ppm	HIG-006
EFC 2	10/19/2001	B	0.991	ppm	HIG-006
EFC 2	10/19/2001	B	1.00	ppm	HIG-006

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BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 2	10/19/2001	B	1.03	ppm	HIG-006
EFC 2	10/19/2001	B	1.04	ppm	HIG-006
EFC 2	10/19/2001	B	1.05	ppm	HIG-006
EFC 2	10/19/2001	B	1.07	ppm	HIG-006
EFC 2	10/19/2001	B	1.08	ppm	HIG-006
EFC 2	10/19/2001	B	1.09	ppm	HIG-006
EFC 2	10/19/2001	B	4.06	ppm	HIG-006
EFC 2	10/19/2001	B	4.25	ppm	HIG-006
EFC 2	10/19/2001	B	5.78	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.108	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.109	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.131	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.208	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.277	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.294	ppm	HIG-006
EFC 2	10/19/2001	Ba	0.614	ppm	HIG-006
EFC 2	10/19/2001	Ba	1.66	ppm	HIG-006
EFC 2	10/19/2001	Ba	15.4	ppm	HIG-006
EFC 2	10/19/2001	Ba	16.2	ppm	HIG-006
EFC 2	10/19/2001	Ba	17.7	ppm	HIG-006
EFC 2	10/19/2001	Ba	2.18	ppm	HIG-006
EFC 2	10/19/2001	Ba	3.18	ppm	HIG-006
EFC 2	10/19/2001	Ba	3.88	ppm	HIG-006
EFC 2	10/19/2001	Ba	5.46	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0496	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0502	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0515	ppm	HIG-006
EFC 2	10/19/2001	Be	0.052	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0521	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0525	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0526	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0533	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0538	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0539	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0545	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0546	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0548	ppm	HIG-006
EFC 2	10/19/2001	Be	0.0847	ppm	HIG-006
EFC 2	10/19/2001	Ca	14500	ppm	HIG-006
EFC 2	10/19/2001	Ca	18100	ppm	HIG-006
EFC 2	10/19/2001	Ca	2210	ppm	HIG-006
EFC 2	10/19/2001	Ca	2310	ppm	HIG-006
EFC 2	10/19/2001	Ca	292	ppm	HIG-006
EFC 2	10/19/2001	Ca	3000	ppm	HIG-006
EFC 2	10/19/2001	Ca	33300	ppm	HIG-006
EFC 2	10/19/2001	Ca	3390	ppm	HIG-006
EFC 2	10/19/2001	Ca	46700	ppm	HIG-006
EFC 2	10/19/2001	Ca	5540	ppm	HIG-006
EFC 2	10/19/2001	Ca	5660	ppm	HIG-006
EFC 2	10/19/2001	Ca	582	ppm	HIG-006
EFC 2	10/19/2001	Ca	808	ppm	HIG-006
EFC 2	10/19/2001	Ca	918	ppm	HIG-006
EFC 2	10/19/2001	Ca	967	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0344	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0365	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0393	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0432	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0437	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0463	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0487	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0501	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0513	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.0545	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.18	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.296	ppm	HIG-006

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EFC 2	10/19/2001	Cd	0.427	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.452	ppm	HIG-006
EFC 2	10/19/2001	Cd	0.468	ppm	HIG-006
EFC 2	10/19/2001	Co	0.52	ppm	HIG-006
EFC 2	10/19/2001	Co	0.525	ppm	HIG-006
EFC 2	10/19/2001	Co	0.533	ppm	HIG-006
EFC 2	10/19/2001	Co	0.539	ppm	HIG-006
EFC 2	10/19/2001	Co	0.545	ppm	HIG-006
EFC 2	10/19/2001	Co	0.925	ppm	HIG-006
EFC 2	10/19/2001	Co	0.926	ppm	HIG-006
EFC 2	10/19/2001	Co	0.939	ppm	HIG-006
EFC 2	10/19/2001	Co	1.11	ppm	HIG-006
EFC 2	10/19/2001	Co	1.42	ppm	HIG-006
EFC 2	10/19/2001	Co	1.52	ppm	HIG-006
EFC 2	10/19/2001	Co	14.1	ppm	HIG-006
EFC 2	10/19/2001	Co	14.8	ppm	HIG-006
EFC 2	10/19/2001	Co	15	ppm	HIG-006
EFC 2	10/19/2001	Co	2.53	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.52	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.525	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.526	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.533	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.535	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.538	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.539	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.545	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.546	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.548	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.623	ppm	HIG-006
EFC 2	10/19/2001	Cr	0.66	ppm	HIG-006
EFC 2	10/19/2001	Cr	11.1	ppm	HIG-006
EFC 2	10/19/2001	Cr	3.07	ppm	HIG-006
EFC 2	10/19/2001	Cr	5.61	ppm	HIG-006
EFC 2	10/19/2001	Cu	1.39	ppm	HIG-006
EFC 2	10/19/2001	Cu	1.45	ppm	HIG-006
EFC 2	10/19/2001	Cu	1.98	ppm	HIG-006
EFC 2	10/19/2001	Cu	19.8	ppm	HIG-006
EFC 2	10/19/2001	Cu	2.01	ppm	HIG-006
EFC 2	10/19/2001	Cu	2.15	ppm	HIG-006
EFC 2	10/19/2001	Cu	2.25	ppm	HIG-006
EFC 2	10/19/2001	Cu	25.8	ppm	HIG-006
EFC 2	10/19/2001	Cu	28.2	ppm	HIG-006
EFC 2	10/19/2001	Cu	29	ppm	HIG-006
EFC 2	10/19/2001	Cu	4.15	ppm	HIG-006
EFC 2	10/19/2001	Cu	5.51	ppm	HIG-006
EFC 2	10/19/2001	Cu	554	ppm	HIG-006
EFC 2	10/19/2001	Cu	6.95	ppm	HIG-006
EFC 2	10/19/2001	Cu	9.36	ppm	HIG-006
EFC 2	10/19/2001	Fe	116	ppm	HIG-006
EFC 2	10/19/2001	Fe	16.6	ppm	HIG-006
EFC 2	10/19/2001	Fe	17.1	ppm	HIG-006
EFC 2	10/19/2001	Fe	18.3	ppm	HIG-006
EFC 2	10/19/2001	Fe	1840	ppm	HIG-006
EFC 2	10/19/2001	Fe	197	ppm	HIG-006
EFC 2	10/19/2001	Fe	22.3	ppm	HIG-006
EFC 2	10/19/2001	Fe	313	ppm	HIG-006
EFC 2	10/19/2001	Fe	46.5	ppm	HIG-006
EFC 2	10/19/2001	Fe	481	ppm	HIG-006
EFC 2	10/19/2001	Fe	521	ppm	HIG-006
EFC 2	10/19/2001	Fe	718	ppm	HIG-006
EFC 2	10/19/2001	Fe	804	ppm	HIG-006
EFC 2	10/19/2001	Fe	82.1	ppm	HIG-006
EFC 2	10/19/2001	Fe	95.5	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.359	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.416	ppm	HIG-006

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BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC 2	10/19/2001	Hg	0.439	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.545	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.679	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.724	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.773	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.801	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.802	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.814	ppm	HIG-006
EFC 2	10/19/2001	Hg	0.83	ppm	HIG-006
EFC 2	10/19/2001	Hg	1.01	ppm	HIG-006
EFC 2	10/19/2001	Hg	1.27	ppm	HIG-006
EFC 2	10/19/2001	Hg	1.29	ppm	HIG-006
EFC 2	10/19/2001	Hg	1.39	ppm	HIG-006
EFC 2	10/19/2001	K	10700	ppm	HIG-006
EFC 2	10/19/2001	K	10800	ppm	HIG-006
EFC 2	10/19/2001	K	11100	ppm	HIG-006
EFC 2	10/19/2001	K	12500	ppm	HIG-006
EFC 2	10/19/2001	K	13100	ppm	HIG-006
EFC 2	10/19/2001	K	17800	ppm	HIG-006
EFC 2	10/19/2001	K	18200	ppm	HIG-006
EFC 2	10/19/2001	K	18400	ppm	HIG-006
EFC 2	10/19/2001	K	18500	ppm	HIG-006
EFC 2	10/19/2001	K	6430	ppm	HIG-006
EFC 2	10/19/2001	K	6680	ppm	HIG-006
EFC 2	10/19/2001	K	7080	ppm	HIG-006
EFC 2	10/19/2001	K	7710	ppm	HIG-006
EFC 2	10/19/2001	Mg	1050	ppm	HIG-006
EFC 2	10/19/2001	Mg	1120	ppm	HIG-006
EFC 2	10/19/2001	Mg	1140	ppm	HIG-006
EFC 2	10/19/2001	Mg	1150	ppm	HIG-006
EFC 2	10/19/2001	Mg	1240	ppm	HIG-006
EFC 2	10/19/2001	Mg	1260	ppm	HIG-006
EFC 2	10/19/2001	Mg	1270	ppm	HIG-006
EFC 2	10/19/2001	Mg	1430	ppm	HIG-006
EFC 2	10/19/2001	Mg	754	ppm	HIG-006
EFC 2	10/19/2001	Mg	811	ppm	HIG-006
EFC 2	10/19/2001	Mg	815	ppm	HIG-006
EFC 2	10/19/2001	Mn	0.69	ppm	HIG-006
EFC 2	10/19/2001	Mn	0.981	ppm	HIG-006
EFC 2	10/19/2001	Mn	1.39	ppm	HIG-006
EFC 2	10/19/2001	Mn	1.42	ppm	HIG-006
EFC 2	10/19/2001	Mn	1.45	ppm	HIG-006
EFC 2	10/19/2001	Mn	11	ppm	HIG-006
EFC 2	10/19/2001	Mn	167	ppm	HIG-006
EFC 2	10/19/2001	Mn	18.4	ppm	HIG-006
EFC 2	10/19/2001	Mn	189	ppm	HIG-006
EFC 2	10/19/2001	Mn	191	ppm	HIG-006
EFC 2	10/19/2001	Mn	2.94	ppm	HIG-006
EFC 2	10/19/2001	Mn	21.4	ppm	HIG-006
EFC 2	10/19/2001	Mn	39	ppm	HIG-006
EFC 2	10/19/2001	Mn	6.63	ppm	HIG-006
EFC 2	10/19/2001	Mn	6.92	ppm	HIG-006
EFC 2	10/19/2001	Mo	0.991	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.00	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.03	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.04	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.05	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.07	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.08	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.09	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.1	ppm	HIG-006
EFC 2	10/19/2001	Mo	1.15	ppm	HIG-006
EFC 2	10/19/2001	Na	1040	ppm	HIG-006
EFC 2	10/19/2001	Na	1070	ppm	HIG-006
EFC 2	10/19/2001	Na	1170	ppm	HIG-006

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EFC 2	10/19/2001	Na	1180	ppm	HIG-006
EFC 2	10/19/2001	Na	1220	ppm	HIG-006
EFC 2	10/19/2001	Na	2410	ppm	HIG-006
EFC 2	10/19/2001	Na	2570	ppm	HIG-006
EFC 2	10/19/2001	Na	2910	ppm	HIG-006
EFC 2	10/19/2001	Na	3010	ppm	HIG-006
EFC 2	10/19/2001	Na	3020	ppm	HIG-006
EFC 2	10/19/2001	Na	3560	ppm	HIG-006
EFC 2	10/19/2001	Na	3580	ppm	HIG-006
EFC 2	10/19/2001	Na	3650	ppm	HIG-006
EFC 2	10/19/2001	Na	4680	ppm	HIG-006
EFC 2	10/19/2001	Na	6840	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.515	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.519	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.524	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.525	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.531	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.539	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.545	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.546	ppm	HIG-006
EFC 2	10/19/2001	Ni	0.61	ppm	HIG-006
EFC 2	10/19/2001	Ni	1.03	ppm	HIG-006
EFC 2	10/19/2001	Ni	2.06	ppm	HIG-006
EFC 2	10/19/2001	Ni	3.42	ppm	HIG-006
EFC 2	10/19/2001	Ni	4.09	ppm	HIG-006
EFC 2	10/19/2001	Ni	4.81	ppm	HIG-006
EFC 2	10/19/2001	Ni	6.92	ppm	HIG-006
EFC 2	10/19/2001	P	10700	ppm	HIG-006
EFC 2	10/19/2001	P	11300	ppm	HIG-006
EFC 2	10/19/2001	P	11400	ppm	HIG-006
EFC 2	10/19/2001	P	11500	ppm	HIG-006
EFC 2	10/19/2001	P	11700	ppm	HIG-006
EFC 2	10/19/2001	P	12400	ppm	HIG-006
EFC 2	10/19/2001	P	15100	ppm	HIG-006
EFC 2	10/19/2001	P	15200	ppm	HIG-006
EFC 2	10/19/2001	P	16400	ppm	HIG-006
EFC 2	10/19/2001	P	24000	ppm	HIG-006
EFC 2	10/19/2001	P	30800	ppm	HIG-006
EFC 2	10/19/2001	P	7920	ppm	HIG-006
EFC 2	10/19/2001	P	8000	ppm	HIG-006
EFC 2	10/19/2001	P	8220	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.0688	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.0787	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.0926	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.0942	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.117	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.142	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.157	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.163	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.164	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.166	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.239	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.286	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.453	ppm	HIG-006
EFC 2	10/19/2001	Pb	0.468	ppm	HIG-006
EFC 2	10/19/2001	Pb	1.96	ppm	HIG-006
EFC 2	10/19/2001	S	5370	ppm	HIG-006
EFC 2	10/19/2001	S	5540	ppm	HIG-006
EFC 2	10/19/2001	S	5550	ppm	HIG-006
EFC 2	10/19/2001	S	6630	ppm	HIG-006
EFC 2	10/19/2001	S	6840	ppm	HIG-006
EFC 2	10/19/2001	S	7180	ppm	HIG-006
EFC 2	10/19/2001	S	7540	ppm	HIG-006
EFC 2	10/19/2001	S	7840	ppm	HIG-006
EFC 2	10/19/2001	S	8150	ppm	HIG-006

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EFC 2	10/19/2001	S	8460	ppm	HIG-006
EFC 2	10/19/2001	S	9100	ppm	HIG-006
EFC 2	10/19/2001	S	9240	ppm	HIG-006
EFC 2	10/19/2001	S	9440	ppm	HIG-006
EFC 2	10/19/2001	S	9670	ppm	HIG-006
EFC 2	10/19/2001	Se	0.429	ppm	HIG-006
EFC 2	10/19/2001	Se	0.521	ppm	HIG-006
EFC 2	10/19/2001	Se	0.541	ppm	HIG-006
EFC 2	10/19/2001	Se	0.59	ppm	HIG-006
EFC 2	10/19/2001	Se	0.622	ppm	HIG-006
EFC 2	10/19/2001	Se	0.699	ppm	HIG-006
EFC 2	10/19/2001	Se	0.713	ppm	HIG-006
EFC 2	10/19/2001	Se	0.716	ppm	HIG-006
EFC 2	10/19/2001	Se	0.724	ppm	HIG-006
EFC 2	10/19/2001	Se	0.807	ppm	HIG-006
EFC 2	10/19/2001	Se	0.838	ppm	HIG-006
EFC 2	10/19/2001	Se	0.84	ppm	HIG-006
EFC 2	10/19/2001	Se	0.905	ppm	HIG-006
EFC 2	10/19/2001	Se	1.35	ppm	HIG-006
EFC 2	10/19/2001	Se	4.75	ppm	HIG-006
EFC 2	10/19/2001	Si	100	ppm	HIG-006
EFC 2	10/19/2001	Si	106	ppm	HIG-006
EFC 2	10/19/2001	Si	126	ppm	HIG-006
EFC 2	10/19/2001	Si	156	ppm	HIG-006
EFC 2	10/19/2001	Si	207	ppm	HIG-006
EFC 2	10/19/2001	Si	238	ppm	HIG-006
EFC 2	10/19/2001	Si	246	ppm	HIG-006
EFC 2	10/19/2001	Si	27.5	ppm	HIG-006
EFC 2	10/19/2001	Si	30.4	ppm	HIG-006
EFC 2	10/19/2001	Si	31.3	ppm	HIG-006
EFC 2	10/19/2001	Si	33.7	ppm	HIG-006
EFC 2	10/19/2001	Si	36.5	ppm	HIG-006
EFC 2	10/19/2001	Si	54	ppm	HIG-006
EFC 2	10/19/2001	Si	54.2	ppm	HIG-006
EFC 2	10/19/2001	Sr	0.972	ppm	HIG-006
EFC 2	10/19/2001	Sr	1.41	ppm	HIG-006
EFC 2	10/19/2001	Sr	10.2	ppm	HIG-006
EFC 2	10/19/2001	Sr	139	ppm	HIG-006
EFC 2	10/19/2001	Sr	153	ppm	HIG-006
EFC 2	10/19/2001	Sr	18.9	ppm	HIG-006
EFC 2	10/19/2001	Sr	2.42	ppm	HIG-006
EFC 2	10/19/2001	Sr	2.67	ppm	HIG-006
EFC 2	10/19/2001	Sr	2.73	ppm	HIG-006
EFC 2	10/19/2001	Sr	21.1	ppm	HIG-006
EFC 2	10/19/2001	Sr	24.8	ppm	HIG-006
EFC 2	10/19/2001	Sr	25.1	ppm	HIG-006
EFC 2	10/19/2001	Sr	36.9	ppm	HIG-006
EFC 2	10/19/2001	Sr	51.4	ppm	HIG-006
EFC 2	10/19/2001	Sr	61.7	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.52	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.521	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.539	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.545	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.546	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.745	ppm	HIG-006
EFC 2	10/19/2001	Ti	0.845	ppm	HIG-006
EFC 2	10/19/2001	Ti	1.97	ppm	HIG-006
EFC 2	10/19/2001	Ti	10.7	ppm	HIG-006
EFC 2	10/19/2001	Ti	12.6	ppm	HIG-006
EFC 2	10/19/2001	Ti	2.28	ppm	HIG-006
EFC 2	10/19/2001	Ti	2.71	ppm	HIG-006
EFC 2	10/19/2001	Ti	25	ppm	HIG-006
EFC 2	10/19/2001	Ti	7.7	ppm	HIG-006
EFC 2	10/19/2001	Ti	8.95	ppm	HIG-006
EFC 2	10/19/2001	V	0.991	ppm	HIG-006

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EFC 2	10/19/2001	V	1.00	ppm	HIG-006
EFC 2	10/19/2001	V	1.03	ppm	HIG-006
EFC 2	10/19/2001	V	1.04	ppm	HIG-006
EFC 2	10/19/2001	V	1.05	ppm	HIG-006
EFC 2	10/19/2001	V	1.07	ppm	HIG-006
EFC 2	10/19/2001	V	1.08	ppm	HIG-006
EFC 2	10/19/2001	V	1.09	ppm	HIG-006
EFC 2	10/19/2001	V	1.12	ppm	HIG-006
EFC 2	10/19/2001	V	1.41	ppm	HIG-006
EFC 2	10/19/2001	V	2.6	ppm	HIG-006
EFC 2	10/19/2001	Zn	113	ppm	HIG-006
EFC 2	10/19/2001	Zn	115	ppm	HIG-006
EFC 2	10/19/2001	Zn	124	ppm	HIG-006
EFC 2	10/19/2001	Zn	147	ppm	HIG-006
EFC 2	10/19/2001	Zn	15.7	ppm	HIG-006
EFC 2	10/19/2001	Zn	15.8	ppm	HIG-006
EFC 2	10/19/2001	Zn	17.2	ppm	HIG-006
EFC 2	10/19/2001	Zn	17.4	ppm	HIG-006
EFC 2	10/19/2001	Zn	177	ppm	HIG-006
EFC 2	10/19/2001	Zn	196	ppm	HIG-006
EFC 2	10/19/2001	Zn	230	ppm	HIG-006
EFC 2	10/19/2001	Zn	25.1	ppm	HIG-006
EFC 2	10/19/2001	Zn	252	ppm	HIG-006
EFC 2	10/19/2001	Zn	292	ppm	HIG-006
EFC 2	10/19/2001	Zn	447	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	12.2	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	1440	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	21.3	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	46.2	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	634	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	679	ppm	HIG-006
EFC-Ruhen	10/19/2001	Al	9.16	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	0.298	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	0.300	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	0.306	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	0.324	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	2.52	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	2.84	ppm	HIG-006
EFC-Ruhen	10/19/2001	As	6.39	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	0.994	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	1.00	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	1.02	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	3.06	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	3.17	ppm	HIG-006
EFC-Ruhen	10/19/2001	B	9.53	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	0.93	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	1.04	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	1.65	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	1.69	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	11.4	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	12.2	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ba	23.4	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.0497	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.0500	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.0510	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.0541	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.0552	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.056	ppm	HIG-006
EFC-Ruhen	10/19/2001	Be	0.103	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	12600	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	1430	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	1580	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	1880	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	26300	ppm	HIG-006

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EFC-Ruhen	10/19/2001	Ca	8860	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ca	9540	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.0390	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.0506	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.0511	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.256	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.279	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cd	0.285	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	0.497	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	0.500	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	0.510	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	0.541	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	3.62	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	3.93	ppm	HIG-006
EFC-Ruhen	10/19/2001	Co	4.01	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	0.712	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	0.821	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	1.13	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	1.31	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	2.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cr	3.68	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	11.1	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	27.3	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	30.7	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	5.98	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	9.39	ppm	HIG-006
EFC-Ruhen	10/19/2001	Cu	9.43	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	1100	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	2680	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	38.5	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	54.1	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	570	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	91.2	ppm	HIG-006
EFC-Ruhen	10/19/2001	Fe	93.8	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	0.286	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	0.29	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	0.352	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	0.845	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	0.997	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	1.11	ppm	HIG-006
EFC-Ruhen	10/19/2001	Hg	1.17	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	11900	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	12100	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	12200	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	12400	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	6010	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	6340	ppm	HIG-006
EFC-Ruhen	10/19/2001	K	7380	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	1000	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	1100	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	1290	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	1420	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	1620	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	896	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mg	947	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	190	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	199	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	322	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	4.67	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	5.87	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	7.01	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mn	8.2	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mo	0.994	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mo	1.00	ppm	HIG-006

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EFC-Ruhen	10/19/2001	Mo	1.02	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mo	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mo	1.1	ppm	HIG-006
EFC-Ruhen	10/19/2001	Mo	1.12	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	2730	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	3020	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	3220	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	3250	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	3290	ppm	HIG-006
EFC-Ruhen	10/19/2001	Na	4010	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	0.5	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	0.51	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	0.541	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	2.05	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	2.9	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ni	4.44	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	12700	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	14100	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	14300	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	21400	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	7130	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	7280	ppm	HIG-006
EFC-Ruhen	10/19/2001	P	7490	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.0780	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.101	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.102	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.284	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.307	ppm	HIG-006
EFC-Ruhen	10/19/2001	Pb	0.647	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	5300	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	5330	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	5420	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	7220	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	7520	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	8020	ppm	HIG-006
EFC-Ruhen	10/19/2001	S	8230	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	0.404	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	0.425	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	0.474	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	0.687	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	0.727	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	1.01	ppm	HIG-006
EFC-Ruhen	10/19/2001	Se	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	111	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	218	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	266	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	307	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	33.6	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	37.7	ppm	HIG-006
EFC-Ruhen	10/19/2001	Si	42.6	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	14	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	16.5	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	19.7	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	29.9	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	30	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	44.7	ppm	HIG-006
EFC-Ruhen	10/19/2001	Sr	89.1	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	0.709	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	0.897	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	1.04	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	2.56	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	22.8	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	33.8	ppm	HIG-006
EFC-Ruhen	10/19/2001	Ti	62.8	ppm	HIG-006

Bioassessment Results from the Project Database
Higgins (2001)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	SourceCode
EFC-Ruhen	10/19/2001	V	0.994	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	1.00	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	1.02	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	1.08	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	2.33	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	2.69	ppm	HIG-006
EFC-Ruhen	10/19/2001	V	4.92	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	122	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	135	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	148	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	161	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	200	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	241	ppm	HIG-006
EFC-Ruhen	10/19/2001	Zn	243	ppm	HIG-006

Notes:

The original source for these data were from *Preliminary Assessment of Fish Community Dynamics and Trace-element Exposures to Aquatic Invertebrates and Salmonids, Lower Bryant Creek and East Fork Carson River, Douglas County, Nevada* . By Higgins (2001).

Al = Aluminum, As = Arsenic, B = Boron, Ba = Barium, Be = Beryllium, Ca = Calcium, Cd = Cadmium, Co = Cobalt, Cr = Chromium, Cu = Copper, Hg = Mercury, K = Potassium, Fe = Iron, Mg = Magnesium, Mn = Manganese, Mo = Molybdenum, Na = Sodium, Ni = Nickel, P = Phosphorus, Pb = Lead, S = Sulfer, Se = Sellenium, Si = Silicon, Sr = Strontium, Ti = Titanium, V = Vanadium, Z = Zinc, ppm = parts per million

GEOTECHNICAL INVESTIGATION REPORT, PHASE I PRELIMINARY SLOPE STABILITY EVALUATION, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA

(Kleinfelder, 2001)

GEOTECHNICAL INVESTIGATION REPORT
PHASE I PRELIMINARY SLOPE EVALUATION
LEVIATHAN MINE DELTA AREA WASTE PILE
ALPINE COUNTY, CALIFORNIA

KLEINFELDER

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An employee owned company

March 16, 2001
File: 30-2867-01.001

California Regional Water Quality Control Board – Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Attention: Ms. Laurie A. Scribe, Environmental Specialist

SUBJECT: Geotechnical Investigation Report
Phase I Preliminary Slope Stability Evaluation
Leviathan Mine Delta Area Waste Pile
Alpine County, California

Dear Ms. Scribe:

The attached report presents the results of our Phase I preliminary slope stability evaluation of the Delta Area waste pile at the Leviathan Mine in Alpine County, California. Our work consisted of a literature search, a field reconnaissance, limited laboratory testing, a preliminary slope stability analysis, installation of slope monitors, and preparation of this report. Phase II investigations, when the site is more accessible, are recommended for development of final recommendations.

Based on our work completed to date, we have drawn the following general conclusions:

- Mine waste material was deposited into the Leviathan Creek valley to depths ranging up to 65 feet. Leviathan Creek was rerouted around the waste pile.
- Field and aerial photo reconnaissance indicates that a landslide has occurred on the northwest limits of the Delta Area waste pile. A well defined but erosion-modified scarp, several feet in height, is present near the top of the slope with evidence of toe bulging and movement at the toe of the slope. At the time of our reconnaissance, the limits of the landslide appeared to involve mainly the northwestern-facing slope, north of MW-12. Based on reviews of aerial photographs, the landslide was present in 1975 but the size of the landslide appears to have increased between 1975 and 1999. The lower limit of the landslide, adjacent to Leviathan Creek, appears at a similar location in 1975 and 1999, but by 1999 a new upper scarp of the landslide was located uphill approximately 100 feet.
- We could not detect evidence of failure on the waste pile south of the Delta Area slope, in the area of Pond 4 nor in the channelized area of Leviathan Creek.
- Surface soils in the Delta Area waste pile consist of clayey or silty sands with moderate to low strength parameters based on testing performed by Kleinfelder. The permeability of the waste material is low (10^{-6} cm/sec) based on testing by SRK (1998). Native soils below the waste material consist of organic-rich silty clay.

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- Groundwater is present in the slope as evidenced by springs near the base of the slope and water levels in the monitor well at the top of the slope (MW-12) (SRK 1998). The groundwater level appears to be within the lower ten feet of the waste material and may be one of the primary causes of landslide movement.
- There is evidence of past slope instability in waste material on the high slope east and south of the Delta Area, but signs of recent movement or involvement with the Delta Area landslide could not be detected.
- A slope monitoring system, consisting of 12 survey points, has been installed on the Delta Area slope and is being monitored on a monthly basis (weather permitting).
- The results of the preliminary slope stability analysis, based on assumed subsurface profiles and strength parameters, indicate the Delta Area slope is marginally stable. Fluctuation of water levels within the slide mass may be causing periodic movement.
- Measures which could be implemented this spring to increase stability include grading and drainage improvements on and near the top of the slope to channel snowmelt around the slide mass. Preliminary concepts for long-term stabilization include installation of drainage and regrading or buttressing the slope. These methods will require additional study to finalize design recommendations.
- Additional Phase II investigations including field exploration drilling, installation of monitoring equipment, and further analyses will be required to better define the mechanism and limits of movement and to define final options for stabilization.

These and other conclusions and recommendations, along with restrictions and limitations on these conclusions, are discussed in the attached report.

We appreciate this opportunity to be of service to you, and look forward to continued involvement in this interesting project. If you have any questions regarding this report or need additional information or services, please feel free to call one of the undersigned in our Reno office.

Sincerely,

KLEINFELDER, INC.

REGISTERED PROFESSIONAL ENGINEER
ALAN N. STILLEY
No. GE002233
Exp. 12-31-03
GEOTECHNICAL
STATE OF CALIFORNIA

REGISTERED CERTIFIED ENGINEERING GEOLOGIST
DAVID J. HERZOG
No. 1[illegible]
Exp. 4/01
STATE OF CALIFORNIA

Al Stilley, P.E., G.E.
Regional Senior Engineer

David Herzog, CEG
Engineering Geologist

Stephen Korbay, CEG
Chief Engineering Geologist

Christine Welch, P.E.
Vice President, Regional Manager

Enclosures: Report (5 Bound/1 Unbound)

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GEOTECHNICAL INVESTIGATION REPORT
PHASE I PRELIMINARY SLOPE STABILITY EVALUATION
LEVIATHAN MINE DELTA AREA WASTE PILE
ALPINE COUNTY, CALIFORNIA

1.0 INTRODUCTION AND SCOPE OF WORK

1.1 Project Description and History

This report presents the results of our Preliminary Phase I slope stability evaluation of the Delta Area waste pile at the Leviathan Mine. The Leviathan Mine is an inactive sulfur mine located in the eastern Sierra Nevada, in Alpine County, California. It is about thirty miles south and west of Carson City, Nevada. The mine is located in steeply sloping terrain at an elevation of about 7,000 feet and receives annual precipitation of about 15 inches, mainly in the form of snowfall. Access to the mine is normally restricted between about December and April, due to snowfall.

A landslide has occurred in a portion of the Delta Area waste pile. The area of instability is roughly 250 feet in length by about 150 feet in maximum width and is about 80 feet in height. It is located on the steep, northwest limit of the waste pile, adjacent to Leviathan Creek, referenced as the Delta Area. Access near the toe of the study slope is restricted due to the steep terrain. Vicinity maps are shown on Plates A1 and A2, and photographs of the slide are shown on Plates A8 and A9, in Appendix A.

The mine was originally developed in the 1800's as an underground mine. Numerous underground adits and workings were active through the early 1950's when the mine was acquired by the Anaconda Company, and open pit mining methods were employed. The open pit mine was last actively operated in the early 1960's when it was shutdown and purchased by another owner. It is currently owned by the State of California, who is in the process of collecting and treating acid mine drainage, and performing other mitigation for eventual mine closure.

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Environmental mitigation was undertaken beginning in the early 1980's. The State Water Resources Control Board (SWRCB) performed geologic mapping of the site and the U.S. Geological Survey (USGS) drilled numerous piezometers. A portion of the SWRCB Geologic Map is presented as Plate A3 in Appendix A. An Environmental Impact Report (Brown and Caldwell, April 1983) was prepared in 1983, and mitigation was conducted in 1984 and 1985. Mitigation has consisted of filling in and recontouring the open pit and other areas, revegetation, construction of water holding ponds, and enclosing and channeling portions of Leviathan Creek, which flows through the site. Additionally, construction and operation of an acid water treatment system was completed in 1999. In 1998, SRK Consulting prepared a work plan to further evaluate the mine site and subsequently installed monitor wells and excavated test pits. A detailed history and discussion of the background of the mine is presented in the Environmental Impact Report.

1.2 Purpose and Scope of Work

The purpose of our investigation was to evaluate the stability of the Delta Area waste pile slope, shown on Plate A4 in Appendix A. A detailed scope of services was outlined in our proposal dated December 11, 2000. In discussions with your personnel, we understand the following items are of concern with the slope.

- There is a concern that the slope may be on the verge of an imminent failure. There are plans to eventually install water-monitoring equipment near the toe of the slope, which would require personnel and equipment to access the toe area. There is also concern that slope instability could affect water treatment ponds and equipment, which are located several hundred feet south of the slope crest. Evaluation of the slope, and recommendations for short-term measures to stabilize the slope are required.

- If stability of the slope is a concern, a long-term solution to improve the stability that will be compatible with the overall reclamation plan will be required.

Since access to the site is limited during the winter, a phased approach to the project was suggested. Phase I of the investigation was started as soon as we were authorized to proceed in early January, 2001. Phase I consisted of a site reconnaissance and preliminary field and laboratory work. Phase II will be undertaken in the spring or summer when the site is more accessible. The scope of the Phase I investigations are summarized below:

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- Reference and Literature Search – Collect background data on the site history, geology and other pertinent information;
- Field Reconnaissance and Mapping – Perform a field reconnaissance of the site to map significant features and collect surface soil samples;
- Limited Laboratory Testing – Perform limited laboratory testing for physical and engineering properties of the site soils;
- Field Monitoring Program, - Install baseline field survey monitor points on the slope to collect future measurements and allow evaluation of horizontal and vertical movement of the slope;
- Preliminary Slope Stability Analysis – Perform a preliminary slope stability analysis of the affected slope; and
- Report of Findings with Preliminary Recommendations – Prepare a report of the Phase I investigations with findings and preliminary recommendations for slope stabilization.

Details regarding the Phase I investigations are provided in Section 2.0 of this report.

1.3 Authorization

Authorization to proceed with our work on this project was provided by the California Regional Water Quality Control Board (RWQCB), Mr. Harold Singer, in the form of a written Notice to Proceed with Phase I, dated January 9, 2001.

1.4 References

The following information was reviewed by Kleinfelder in the course of this study:

- *Leviathan Mine Pollution Abatement Project, Design Report and Draft Environmental Impact Report,* Brown and Caldwell Consulting Engineers, April 1983.
- *Summary of U.S. Geological Survey Drilling Exploration*, (Appendix B1 to Brown and Caldwell Report) 1982.

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- *Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, California 1981-1983,* U.S. Geological Survey, Open-File Report 85-160
- *Earthquake Occurrence in Reno-Carson City Urban Corridor, Seismological Research Letters,* Vol. 68, No. 3, May/June, pp 401-412 ,dePolo, D.M., and Price, J.G.,1997
- *Monitor Well Logs, Test Pit Logs, Groundwater Well Levels, and Laboratory Testing Results, Geotechnical Investigation,* SRK Consulting, 1998
- *Landslide Investigation, Leviathan Mine, Alpine County,* (Appendix Charlene Herbst), State Water Resources Control Board, Division of Technical Resources, July 6, 1982.
- *Aerial Photographs, Leviathan Mine, 1946 and 1963,* Regional Water Quality Control Board, South Lake Tahoe, California.
- *Aerial Photographs, Leviathan Mine, 1975 and 1999,* United States Forest Service, Carson City, Nevada.
- *Pre-Mine Topographic Map, Leviathan Mine,* Regional Water Quality Control Board, South Lake Tahoe, California.
- *1998 Topographic Map (10 foot contours), Leviathan Mine,* Summit Engineering, provided by Regional Water Quality Control Board, South Lake Tahoe, California.
- *Geology of the Leviathan Sulfur Mine and Vicinity,* Charlene Herbst, State Water Resources Control Board, Division of Technical Services, March 1983.
- Clark W., *Mines and Mineral Resources of Alpine County, California.* California Division of Mines and Geology, County Report No. 8., 1977.
- Herbst, C., 1983, *Survey of Leviathan Creek and Proposed Aspen Creek realignment, Leviathan Sulfer Mine,* Memo from State Water Resources Control Board to Lahontan, RWQCB.

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2.0 METHODS OF STUDY

2.1 Reference and Literature Search

A search of geotechnical and geologic references in the area was conducted. References reviewed during this study are listed in Section 1.4. Information on the project was obtained from conversations with your personnel, site visits on December 6, 2000 and January 4, 2001, and from the April 1983 Environmental Impact Report (Brown and Caldwell). The USGS and the SWRCB conducted studies in the early 1980's including preparation of a geologic map (Herbst, 1983) of the mine area. We also received information from 1998 investigations consisting of monitor well logs, test pit logs, laboratory testing, and topographic mapping.

Aerial photographs from 1946, 1963, 1975, and 1999 were reviewed using stereoscopic pairs. The 1946 and 1963 photographs were provided by the RWQCB. The 1975 and 1999 photographs were provided by the U.S. Forest Service. Topographic contours of the mine site prior to large-scale mining in 1941 were provided by RWQCB and were scanned. Topographic contours of the mine site from 1998 were provided electronically by the RWQCB. The pre-mine contours and the 1998 contours were overlain and are presented on Plate A4 in Appendix A.

The U.S. Geological Survey (USGS) drilled several boreholes and installed several piezometers in the Delta Area south of the current landslide investigation area in 1982, prior to construction of Pond 4. These include DH-9A through –9C, DH-10A through –10C, DH-11A through –11C, and DH-18A through –18C. These locations are shown in Plate A2, Mine Vicinity Map.

SRK Consulting drilled five monitoring wells (MW-9, MW-10s and –10d, MW-11, and MW-12) in the Delta area in August and September 1998 (Plate A2), after installation of Pond 4. Well MW-12 is located immediately above and south of the landslide scarp that is the subject of this investigation (Plate A4). SRK also excavated two test pits in the Delta area (Test Pits LPT-1 and LPT-2) and performed laboratory testing of soils obtained from LPT-1. Laboratory testing included Atterberg limits, grain size, compaction, and permeability. Test pit locations are shown in Plates A2 and A4.

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2.2 Field Reconnaissance/Mapping

A field reconnaissance was conducted by our senior geologists and engineer on January 4, 2001. During this reconnaissance, information from the previous studies was confirmed. The limits of the landslide were approximately mapped, mine waste piles in the area were mapped, and the area was visually examined for evidence of slope movement. During the field reconnaissance, tentative slope monitoring points were established and bulk samples of the near surface soil were obtained.

2.3 Laboratory Testing

Soil samples were obtained by hand in the field at five of the slope monitor point locations, as shown in Appendix D. These samples were transported to our laboratory where laboratory tests were conducted to determine physical and engineering properties. The purpose of the laboratory tests was to characterize the surface soils and to evaluate strength parameters for the slope stability analysis. Laboratory tests that were conducted included grain size analysis, Atterberg limits, moisture content, and direct shear tests. Samples for direct shear testing were remolded to a dry density of approximately 81 pounds per cubic feet. Laboratory test results from this investigation are presented in Appendix B.

2.4 Field Monitoring

A slope movement monitoring system was installed on the slope of the slide on January 5, 2001. This system consists of 12 survey benchmarks established in a grid pattern over the slope. Benchmarks consist of steel pins driven several feet into the slope. The benchmarks will be surveyed on about a monthly basis (weather permitting) for accurate measurements of changes in horizontal and vertical location. Surveying was provided by Western Engineering and Surveying Services from Carson City, Nevada. Information on the slope monitoring system is summarized in Appendix D.

2.5 Preliminary Slope Stability Analysis

A preliminary section through the slope was developed, (Plate A7, Appendix A) using field observations, pre-mine, and 1998 topographic mapping, and information from previous studies.

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A preliminary slope stability analysis was conducted using the laboratory data for strength parameters obtained from surface soil samples and information from the previous reports. Slope stability analyses were conducted with computerized programs and by hand analysis. The methodology and results of the slope stability analyses are presented and discussed in Section 3.5.

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3.0 DISCUSSION

3.1 Site Conditions

The slope and area of concern is designated as the Delta Area, located adjacent to Leviathan Creek along the western edge of the property (Plates A2 and A4). Plate A4 contains topographic contours of the pre-mine conditions (in magenta) and 1998 conditions (in black). Photographs of the slide area are shown on Plates A8 and A9 in Appendix A. The slope in question is composed of mine waste material, faces northwest, and is approximately 80 feet in height. The area of instability is approximately 250 feet in length in a north-south direction, and a maximum of about 150 feet wide in an east-west direction. Leviathan Creek flows along the western side of the slope. Evaluation of pre-mine topography (see Plates A4 and A7) indicates that up to 65 feet of mine waste material was placed into the drainage of Leviathan Creek during mining operations and Leviathan Creek was reportedly displaced around the waste pile.

Aerial photographs from 1946, 1963, 1975, and 1999 were reviewed. The 1975 and 1999 aerial photographs have been enlarged and are presented as Plates A5 and A6, respectively. Field and aerial photo reconnaissance indicates that a landslide has occurred in the northwest facing slope of the Delta Area waste pile (Plate A4). The first indication of the landslide appears on the 1975 aerial photograph. The landslide appears to consist of an upper rotational slide and a lower debris flow or planar slide. A well defined but erosion-modified scarp, several feet in height, has formed near the top of the slope with evidence of toe bulging and movement at the toe of the slope. This primary scarp extends for over 200 feet along the top of the slope. A second smaller scarp is present above the primary scarp. Evidence of previous slope movement has been reported with areas near the crest of the slope exhibiting several feet of subsidence. Photographs of the slide area, including the scarp and toe, are shown on Plates A8 and A9 in Appendix A.

A lower less-defined scarp is present at the base of the rotational portion of the landslide. The lower debris flow or planar portion of the landslide is below this lower scarp and exhibits evidence of saturation, springs, and more moisture than the upper rotational portion of the slide. Small trees on the lower slope face also show signs of creep-type movement in their curved trunks. At the time of our reconnaissance, the limits of the landslide appeared to involve mainly

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the northwestern facing slope, northeast of monitoring well MW-12. The slope immediately below (north of) well MW-12 did not exhibit evidence of movement, based on our site reconnaissance and aerial photograph review. However, the 1999 aerial photograph indicated that a lineament extended down the face of the slope north of MW-12. This lineament may represent a tension crack delineating the western edge of the landslide.

Based on the aerial photographs, the waste pile was not present in 1946. Although the waste pile was present in 1963, there was no indication of slide movement. In 1975, the waste pile had developed a landslide extending approximately 150 feet in a northwesterly direction. Also, a defined scarp was present and an eroded drainage channel directed water into the southwestern corner of the landslide. The landslide location is referred to as the "waterfall" in Herbst (1998) and described as "the lower steep channel of the waterfall area resulting from downcutting of the creek through the artificial fill".

Between 1975 and 1999, the landslide had enlarged with a new head scarp located uphill approximately 100 feet and westward approximately 80 feet. The toe of the landslide did not appear to have moved downhill more than 20 feet between 1975 and 1999. The presence of Leviathan Creek along the toe of the landslide appears to constrain the movement of the landslide toe. As toe movement occurs, Leviathan Creek may transport the slide material downstream.

Groundwater is present within the slope as shown by active springs, which flow year round from the northwestern and western portions of the toe area. Ice was observed in these areas during our site reconnaissance. Groundwater was also present in monitor well MW-12, located above the top of the Delta Area slope, at a depth of approximately 42 feet below ground surface (bgs). The boring log from MW-12 indicates that the contact between the overlying mine waste and the native soils was encountered at a depth of 52 feet bgs. This places the groundwater level within the lower ten feet of the waste pile. This may be one of the primary driving forces behind landslide movement.

An unpaved road provides access to the site from the north and continues south to the treatment ponds and the mining area. A road from the access road extends onto the Delta Area mine waste material. A culvert underlies the access road near this junction and also collects surface water from the unlined drainage ditch along the eastern side of the access road. The downslope outlet of the culvert directs surface water into the toe of the waste pile slope and has caused erosion along the edge of the waste material and the landslide.

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3.2 Areal Geology

This description of the areal geology is excerpted from the references listed in Section 1.4. Geologic conditions in the mine area are complex, consisting of both sedimentary and volcanic sequences. A portion of the SWRCB Geologic Map is presented as Plate A3. Geologic units in the vicinity of the Delta Area consist of Quaternary age artificial fill (Qaf), composed of mine tailings; landslide deposits (Qls); debris flows (Qdf); and talus (Qt). Tertiary age basalt (Trb) forms the cliffs northeast of the site with Tertiary age sandstone (Trcs) present immediately to the north and west. Tertiary age andesite (Ta) outcrops are present to the northwest. Most likely, the mine waste material at the site is underlain by Tertiary age sandstone (Trcs).

During the 1982 and 1983 geologic mapping, several large landslides were mapped in the mine area, primarily in areas of mine tailings or waste rock. The geologic description of the landslides indicated the plane of slippage was generally in the mine tailings for most of the slides, and not in the underlying native materials. One large landslide was mapped extending from near the top of the ridge at elevation 7,130 feet msl to immediately above Leviathan Creek at an elevation of 6,880 feet msl, a distance of 950 feet (Plate A3). The toe of this landslide is mapped to the top of the slope above the Delta Area slope and is mapped entirely within mine waste material. This landslide was mapped prior to extensive grading operations that created Pond 4 and the lower access road. Field and aerial photo reconnaissance and evaluation of the pre-mine and 1998 topographic contours indicates that large quantities (up to 70 feet deep) of waste material were placed in a ravine area that may have been an historic landslide area. A scarp was formed within the waste material with landslide debris extending downslope approximately 500 feet to within 200 feet of the main access road. No evidence of recent landslide movement was seen. A drainage ditch used to convey water from the open pit to the access road north of the mine was not offset between 1975 and 1999. Additionally, no side scarps were identified. The extensive grading operations resulted in a large quantity of fill material placed in the area of the mapped toe of this landslide. This may have acted as a buttress for the slide, restraining additional movement.

3.3 Site Geology and Subsurface Conditions

Visual observations indicate that the exposed waste pile slope consists mainly of fine-grained clayey or silty soils, although there are areas of gravel and large rock. Surface soils encountered

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in the Delta Area landslide and sampled during the Phase I investigation consist of clayey or silty sands of high plasticity with moderate to low strength parameters. Remolded direct shear tests performed by Kleinfelder indicated friction angles ranged from 16 to 28 degrees with high cohesion values. Previous geotechnical investigations by others indicated that subsurface mine waste material extends to depths of 52 feet bgs and consists of sandy silt or silty clay with high plasticity. The permeability of the waste material in the upper six feet was low and ranged from 3.0×10^{-6} cm/sec to 7.2×10^{-6} cm/sec, according to tests by others (SRK, 1998). Native soils below the waste material consist of organic-rich silty clay.

Cross section A-A' was constructed through the Delta Area Landslide and is presented as Plate A7 in Appendix A. The location of the section is shown in Plate A4. The maximum thickness of mine waste material along this section is 55 feet. This section also shows the groundwater level within the mine waste at a depth of 42 feet bgs and the location of the springs at the toe of the slide.

Groundwater in the area of Pond 4 (MW-10) is present at shallow depths, ranging from 5 to 16 feet bgs. Prior to construction of Pond 4, groundwater levels were at or above ground surface in this area (USGS Piezometers 9, 10, 11, and 18).

3.4 Seismic Conditions

The Leviathan mine site is in a region traditionally characterized by moderate to high seismic activity. The site is subject to ground motion from large earthquakes in western Nevada and eastern California. The site is not located within the boundaries of an Alquist-Priolo Earthquake Fault Zone (APEFZ), and no active (Holocene-age) faults are known to cross the site. Most of the past seismic activity is centered along the Genoa Fault Zone and Double Spring Flat Fault Zone/Antelope Valley Fault Zones, both of which are in an APEFZ. These faults are the closest known active faults and are located approximately 9.8 miles west and 5.4 miles east of the site, respectively (dePolo, 1997). The maximum credible earthquakes for the Genoa and Double Spring Flat/Antelope Valley Fault Zones are predicted to have magnitudes of 7.4 and 6.7, respectively (dePolo, 1997). A major seismic event on these faults could cause strong to moderately strong ground shaking at the site.

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3.5 Preliminary Slope Stability Analysis

3.5.1 Methodology

A preliminary slope stability analysis was conducted to estimate the stability of the existing landslide. Limit equilibrium methods were generally used. Several methods of evaluating the stability were conducted. These methods included the Bishop method of slices, an infinite slope analysis, and a sliding block method of analysis. Both computer analyses and hand calculations were used. It is necessary to define or assume the following items to properly evaluate the stability of a landslide.

- Slope Geometry – It is necessary to have a relatively accurate surface profile of the slope with the head and toe of the slide defined. For our analysis, the 1998 topography, together with the surveying for the slope monitor points were used. The accuracy of this information is considered to be good.
- Soil Strength Parameters along failure plane – Stability analysis requires testing the angle of internal friction and cohesion for soils in the failure zone. Typically, this requires locating the plane of movement, obtaining soil samples from the actual failure plane, and performing laboratory strength tests. For this phase of our analysis, surface samples of soils were collected and tested in the laboratory. Strength parameters from previous investigations were also reviewed. The accuracy of this information is considered to be only fair and should be further evaluated by future sampling. In our preliminary analyses, friction angles between about 15 and 22 degrees and cohesion values between about 200 and 500 pounds per square foot were used.
- Location of Failure Plane – Accurate location of the plane of movement is required for analysis, and is often the most difficult characteristic of the slide to determine. In this instance, the head of the slide is defined at ground surface by the scarp, and the toe of the slide is evident at ground surface, but between these two locations, it has not been located. Usually, test borings or instrumentation installed down a drill hole is used to determine the location of movement. In this case, several locations for the plane of movement were assumed and stability evaluated for each. The most probable plane of movement is discussed below. The accuracy of this information is considered to be only fair, and should be further evaluated by future exploration sampling and testing.

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- Location of Groundwater – Groundwater levels, throughout the slide mass, can have a significant impact on stability. In this case, Monitor Well 12 provides an accurate location of the water table near the head of the slope. The groundwater springs near the toe also give an indication at that location. For our analysis, several different levels were assumed as discussed below. The accuracy of this information is considered to be only fair, and should be further evaluated by future exploration sampling and testing.
- Seismicity – A seismic event can have a significant impact on stability of the landslide. Ground shaking can create additional forces, tending to initiate movement. Seismicity of the area was evaluated in general terms by review of geologic references and fault maps of the area. Seismic coefficients of about 0.1 were used in the pseudostatic method of analysis. Stability was generally evaluated for both static and dynamic conditions as discussed below. The accuracy of this information is considered to be good.

A general description of each of the stability methods, and specific assumptions used for each are discussed below.

- *Bishop Method of Slices*

With this method, circular failure planes are assumed. Each circular failure surface is divided into a number of slices and the forces tending to cause failure (gravity, hydrostatic pressure and seismic forces) are calculated. The forces tending to resist movement (friction and cohesion) are also calculated. A factor of safety is then calculated for the circular failure surface as the ratio of the forces resisting movement, divided by the forces tending to cause movement. Theoretically, when this factor of safety is less than one, movement will occur. A trial and error method is used to locate a number of failure surfaces and evaluate the factor of safety for each. Locations where the factor of safety is less than one should indicate where slope instability will occur. In our analysis, strength parameters from the laboratory tests were used, and failure surfaces were limited to the waste pile material (not allowed to extend into natural soil below the waste pile). Preliminary results of our analysis are presented in section 3.5.1.

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- *Infinite Slope Analysis*

With this method, a layer of earth parallel to the existing slope is evaluated. Again, forces tending to cause and resist movement are determined and a factor of safety is calculated. In our analysis, several different surface layer thickness', as well as water table locations, were evaluated.

- *Sliding Block Method of Analysis*

With this method, the slide mass is broken into discrete blocks by linear plane surfaces. Again the forces tending to cause and resist movement on each block are calculated and an overall factor of safety against movement is calculated. The visual geometry of the slide is usually used in establishing the location of the sliding blocks. In this instance, the slide was modeled assuming a plane of movement extended downward from the upper scarp at a steep angle to near the contact between the waste pile and the original ground surface. From this point, it was assumed the plane of movement was located along the original ground surface until it daylighted near the toe.

3.5.2 Results of Stability Analysis

Since much of the specific information required for slope stability analyses was not available, it was necessary to assume values or items, such as the location of planes of movement, strength parameters, and water levels. For these reasons, the factors of safety discussed below are approximate and should be considered preliminary. Factors of safety could change when final information is obtained. The results of our analyses are briefly summarized below.

- **Circular Method of Slices Analysis** – Factors of safety for this method, under static conditions, generally ranged from about 1.2 to about 1.4, while factors of safety for the seismic case were in the range of 1.0 to 1.2. In our analysis, failure surfaces were restricted to locations in the waste pile.

- **Sliding Block Analysis** – Factors of safety for the static case were in the range of 1.0 to 1.2, while factors of safety for the seismic case may range from less than 1.0 to about 1.1. In our analysis the major plane of movement was assumed to be along the original contact between the ground and the waste pile. The stability of the slope is sensitive to water levels. The slope was evaluated assuming the water level measured in MW-12 extended to the elevation of the springs at the toe of the slope. If water

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levels are significantly above this level, the stability is lower and if water levels are lower, the stability increases.

- **Infinite Slope Analysis** – Factors of safety for this method of analysis were generally high as long as water does not saturate the ground surface. If water is allowed to saturate the entire slope and flow downhill, factors of safety are low.

3.6 Methods of Stabilization

Evaluation of the history and the stability of the Delta Area landslide indicates that if measures are not taken to stabilize the slide, enlargement might be expected to occur over a period of time. If periods of low precipitation occur, and groundwater is not transmitted into the slide mass, low rates of movement could be expected. If high precipitation occurs, groundwater levels increase in the slide mass, or if seismic events occur, movement could be initiated and the slide mass could expand up slope. The permeability of the slide mass and natural materials is apparently low. Groundwater conditions may therefore lag precipitation trends. It may require long periods of time, after wet or dry periods, for the effects on the slide to become apparent. Without providing some method of stabilization, enlargement of the slide can probably be eventually expected. Methods of stabilization generally fall into long-term solutions, which will require more study and detailed design, and short-term solutions which could be implemented in the near term.

3.6.1 Long Term Stabilization

Stabilization of a landslide mass generally requires either reducing the forces tending to cause movement, increasing the forces resisting movement, or a combination of both. Stabilization by grading at the toe of the slope would require construction of access roads and disturbance to areas at the toe. Alternatives were considered for stabilization as discussed below:

- **Drainage** – Long-term stabilization of the Delta Area landslide will probably require control of the groundwater within the slide mass. The overall stability of the mass will be improved if water is removed and the groundwater level lowered below the base of the slide. If groundwater is not controlled, movement and slope creep, particularly near the toe where the springs are located, will probably continue to occur. Several methods are possible. Horizontal drains could be installed near the toe of the slide, which could drain by gravity. Since the permeability of the slide

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material is low, horizontal drains would require close spacing and would probably have to extend horizontally beyond the slide head scarp (200 feet ±) to intercept and lower the water level below the slide. Design of the horizontal drain system will require exploration borings to investigate the subsurface conditions at the slide, especially the groundwater levels.

Another option would be to try to cut off the groundwater up gradient of the landslide, before it reaches the slide. It might be possible to accomplish this with a buried cutoff drain or barrier to the south of the slide, possibly between Pond 4 and the head of the slide. The disadvantage to this method is that the depth of installation of a buried cutoff drain is limited by construction methods. There is also uncertainty as to the source of the water, and location of a cutoff drain may not intercept all water. Considerable additional exploration would be required to evaluate the feasibility of this alternative.

- **Regrading** – The geometry of the slope and landslide can be changed to reduce the gravity forces causing movement. Several methods may be applicable to the Delta Area slide. It may be possible to flatten the slope where the landslide is occurring, or portions of this slope. Generally, the toe of the slope is inclined at about 1.5 (horizontal) to 1 (vertical). The upper portions of the slide are near 2 H:1V or flatter. By flattening the slope, the weight of earth tending to cause movement is reduced, thereby improving slide stability. This option would require drainage measures near the toe of the slide where the springs occur. Extremely flat slopes would be required where slopes are saturated. This option would also require disposal of excavated material at some other location, preferably where the slide would not be impacted by the added weight of the fill.

- **Buttressing** – Another variation of the regrading alternative would be to construct a buttress or berm near the toe of the slope. The buttress could be designed to provide stability to the landslide, but would probably have to be combined with drainage at the toe of the slide. A system of blanket drains with filter fabric would have to be constructed between the toe of the landslide and the buttress. The buttress could be constructed of material removed near the head of the slide by slope flattening, thus unloading that area. The buttress would be compacted in accordance with our design recommendations. This option would probably require disturbance of an area at the toe of the slide and potentially to Leviathan Creek on the western side of the slide.

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There also appear to be quantities of rock in the mine area that could be used to construct a toe buttress. The use of a rock buttress could reduce the quantity of material that would be required, and also reduce grading disturbance near the toe of the slope.

With the information currently available, it is difficult to select the best alternative for long term stabilization. Additional study of the existing slide needs to be conducted to better define a specific alternative, and to evaluate costs and impacts of each. At this time, a preferred alternative might consist of a combination of providing horizontal drains installed at the toe of the slide with construction of a toe buttress.

3.6.2 Short Term Stabilization

Short-term stabilization methods should consist mainly of grading and drainage provisions to try to keep moisture from entering the slope, particularly above the slide. This could consist of grading to slope the ground surface away from the slide, ditches to direct snowmelt and runoff away from the slide area, and extending the culvert under the road to the bed of Leviathan Creek.

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4.0 CONCLUSIONS

- Mine waste material was deposited into the Leviathan Creek Valley to depths ranging up to 65 feet. Leviathan Creek was rerouted around the waste pile.
- Field and aerial photo reconnaissance indicates that a landslide has occurred on the northwest limits of the Delta Area waste pile. A well defined but erosion-modified scarp, several feet in height, is present near the top of the slope with evidence of toe bulging and movement at the toe of the slope. At the time of our reconnaissance, the limits of the landslide appeared to involve mainly the northwestern-facing slope, northeast of MW-12. Based on reviews of aerial photographs, the landslide was present in 1975 but the size of the landslide appears to have increased between 1975 and 1999. The lower limit of the landslide, adjacent to Leviathan Creek, appears at a similar location in 1975 and 1999, but by 1999 a new upper scarp of the landslide was located uphill approximately 100 feet.
- We could not detect evidence of failure on the waste pile south of the Delta Area slope, in the area of Pond 4 nor in the channelized area of Leviathan Creek.
- Surface soils in the Delta Area waste pile consist of clayey or silty sands with moderate to low strength parameters based on testing performed by Kleinfelder. The permeability of the waste material is low (10^{-6} cm/sec) based on testing by SRK (1998). Native soils below the waste material consist of organic-rich silty clay.
- Groundwater is present in the slope as evidenced by springs near the base of the slope and water levels in the monitor well at the top of the slope (MW-12) (SRK 1998). The groundwater level appears to be within the lower ten feet of the waste material and may be one of the primary causes of landslide movement.
- There is evidence of past slope instability in waste material on the high slope east and south of the Delta Area, but signs of recent movement or involvement with the Delta Area landslide could not be detected.
- A slope monitoring system, consisting of 12 survey points, has been installed on the Delta Area slope and is being monitored on a monthly basis (weather permitting).

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- The results of the preliminary slope stability analysis, based on assumed subsurface profiles and strength parameters, indicate the Delta Area slope is marginally stable. Fluctuation of water levels within the slide mass may be causing periodic movement.
- Immediate measures which could be implemented to increase stability include grading and drainage improvements on and near the top of the slope to channel snowmelt around the slide mass. Preliminary concepts for long-term stabilization include installation of drainage and regrading or buttressing the slope. These methods will require additional study to finalize design recommendations.
- Additional Phase II investigations including field exploration drilling, installation of monitoring equipment, and further analyses will be required to better define the mechanism and limits of movement and to define final options for stabilization.

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5.0 RECOMMENDATIONS

5.1 Short Term Recommendations

The following items could be implemented this spring to help prevent surface water from penetrating the slide mass.

- Grade the top and slopes of the slide to divert snowmelt and precipitation runoff away from the slide mass. Flat areas or depressions that pond or collect water should be graded to drain out of the slide area.
- Consider plowing snow off of the slide mass and away from the slope above the slide. Snow should be plowed into an area where it will melt and run off away from the slide as rapidly as possible.
- The existing culvert under the access road should be extended downslope to the bed of Leviathan Creek to reduce erosion and saturation of the toe of the mine waste material and the slide.

5.2 Recommendations for Phase II Investigations

Additional Phase II investigations should be performed to further characterize the slide, collect information for analysis, and finalize stabilization design. We recommend the following investigations.

- Perform Test Borings –Test borings should be performed to evaluate the actual subsurface profile and water level depths and obtain samples for laboratory testing.
- Install Slope Monitoring Equipment – Slope inclinometers should be installed in a number of the test borings to better define the areas of movement within the slide mass. Slope inclinometers should be monitored on a long-term basis.
- Laboratory Testing – Additional strength parameter tests should be run on soil samples obtained during the drilling program. It is important to establish strength parameters for soils within the plane of movement.

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- Analysis – Additional detailed analysis should be performed to further develop the best long-term alternative(s) for stabilization. Additional stability analysis will be required with the actual slide configuration, soil strength parameters, and water level information.

5.3 Ongoing Monitoring of Survey Points

As part of our Phase I study, we will continue to have Western Engineering and Surveying monitor the survey points that were established on the slide mass. This monthly monitoring will continue at least throughout the winter and spring, weather and snow permitting. Results of these surveys will be forwarded upon receipt.

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6.0 LIMITATIONS AND ADDITIONAL SERVICES

Discussion, conclusions and recommendations contained in this report are based on our field observations, review of previous studies, aerial photo analysis, laboratory testing of surficial soil samples, slope stability analysis, and our understanding of the project requirements. The study was performed using a mutually agreed upon scope of work. It is our opinion that this study was a cost-effective method to evaluate the subject site and evaluate some of the potential geotechnical concerns. More detailed, focused, and/or thorough investigations have been recommended. Further studies will tend to increase the level of assurance and better define alternatives. If the Client wishes to reduce the uncertainties beyond the level associated with this study, Kleinfelder should be contacted for additional consultation.

The soils data used in the preparation of this report were obtained from surface samples and past studies. It is possible that variations in soils exist between the points explored. The nature and extent of soil variations may not be evident until construction occurs.

This report has been prepared for planning purposes for specific application to the Delta Area landslide stabilization in accordance with the generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors including advances in man's understanding of applied science may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 36 months from its issue. Kleinfelder should be notified if the project is delayed by more than 24 months from the date of this report so that a review of site conditions can be made, and recommendations revised if appropriate.

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It is the CLIENT'S responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk. Any party other than the Client who wishes to use this report shall notify Kleinfelder of such intended use by executing the "Application for Authorization to Use" which follows this document as an appendix. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

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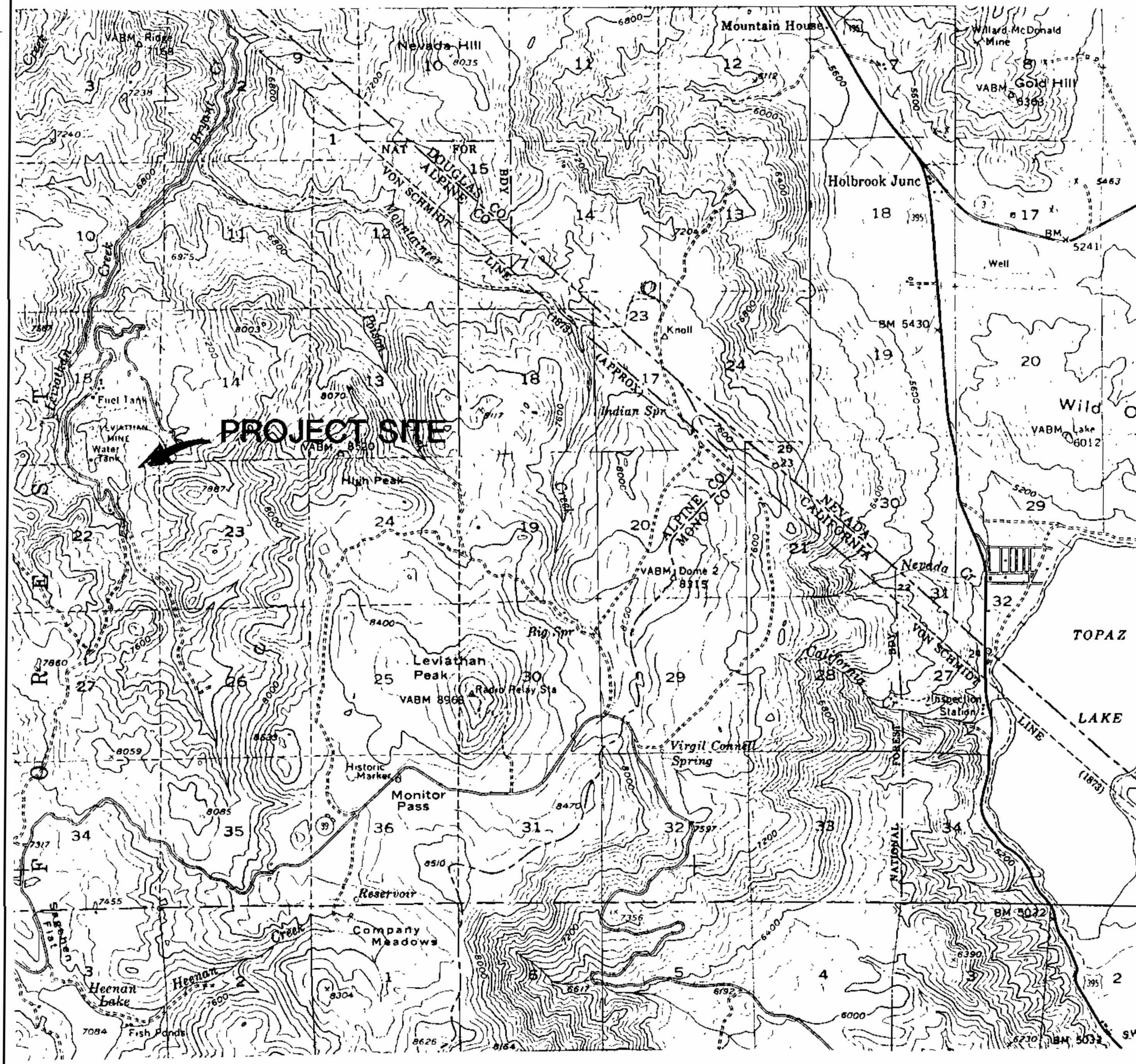
Appendix A

Plates and Photographs



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SCALE: 1" = 1 MILE

REFERENCE: TOPAZ LAKE QUADRANGLE, CALIFORNIA-NEVADA, 15 MINUTE SERIES

KLEINFELDER 4875 LONGLEY LANE, SUITE 100 RENO, NEVADA 89502 Tel. (702) 689-7800	**VICINITY MAP** LEVIATHAN MINE	PLATE **A-1**
PROJECT NO. 30-2867-01.001	ALPINE COUNTY, CALIFORNIA	

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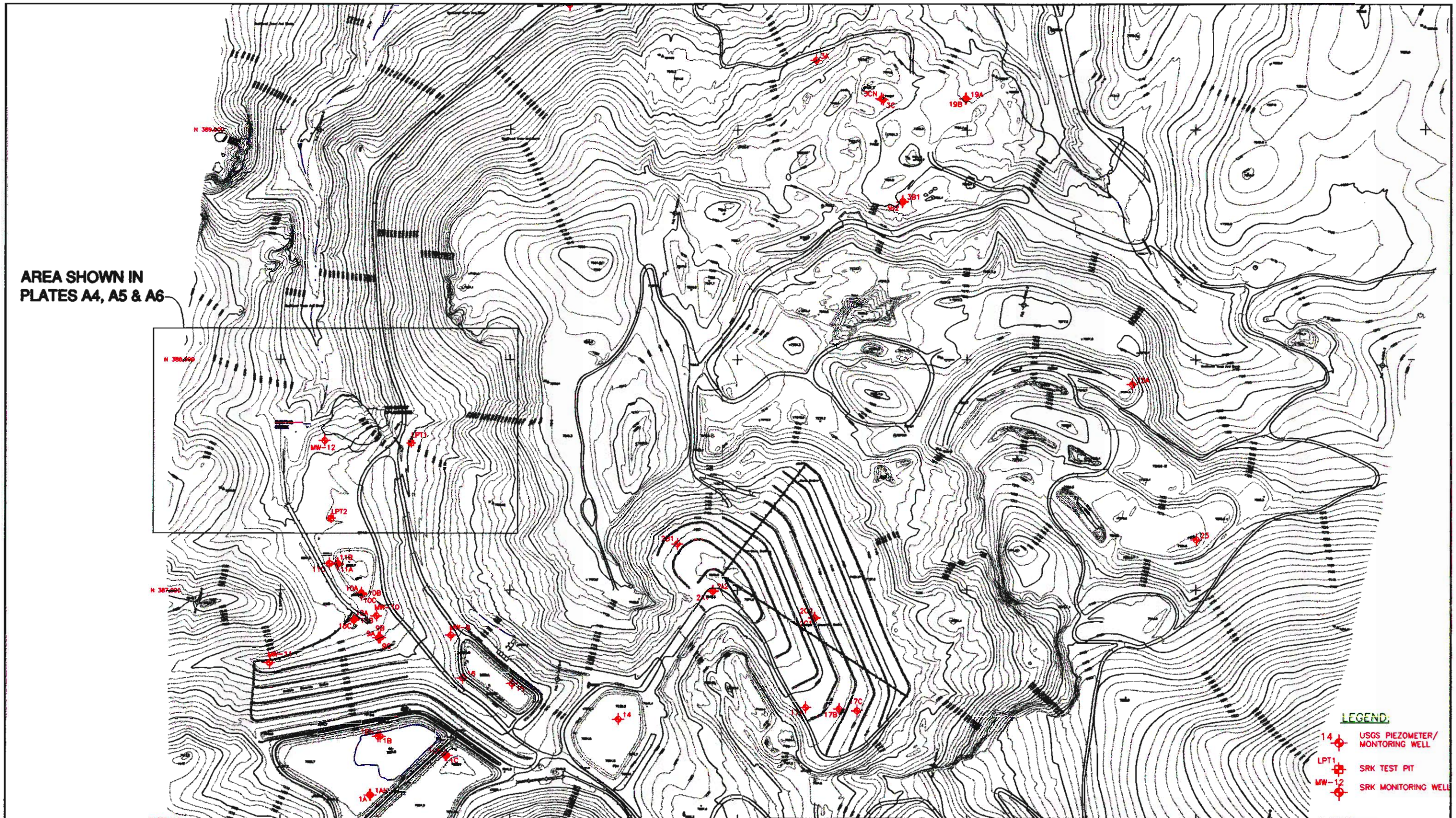

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REFERENCE: SUMMIT ENGINEERING, 1998

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MINE VICINITY MAP

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-2

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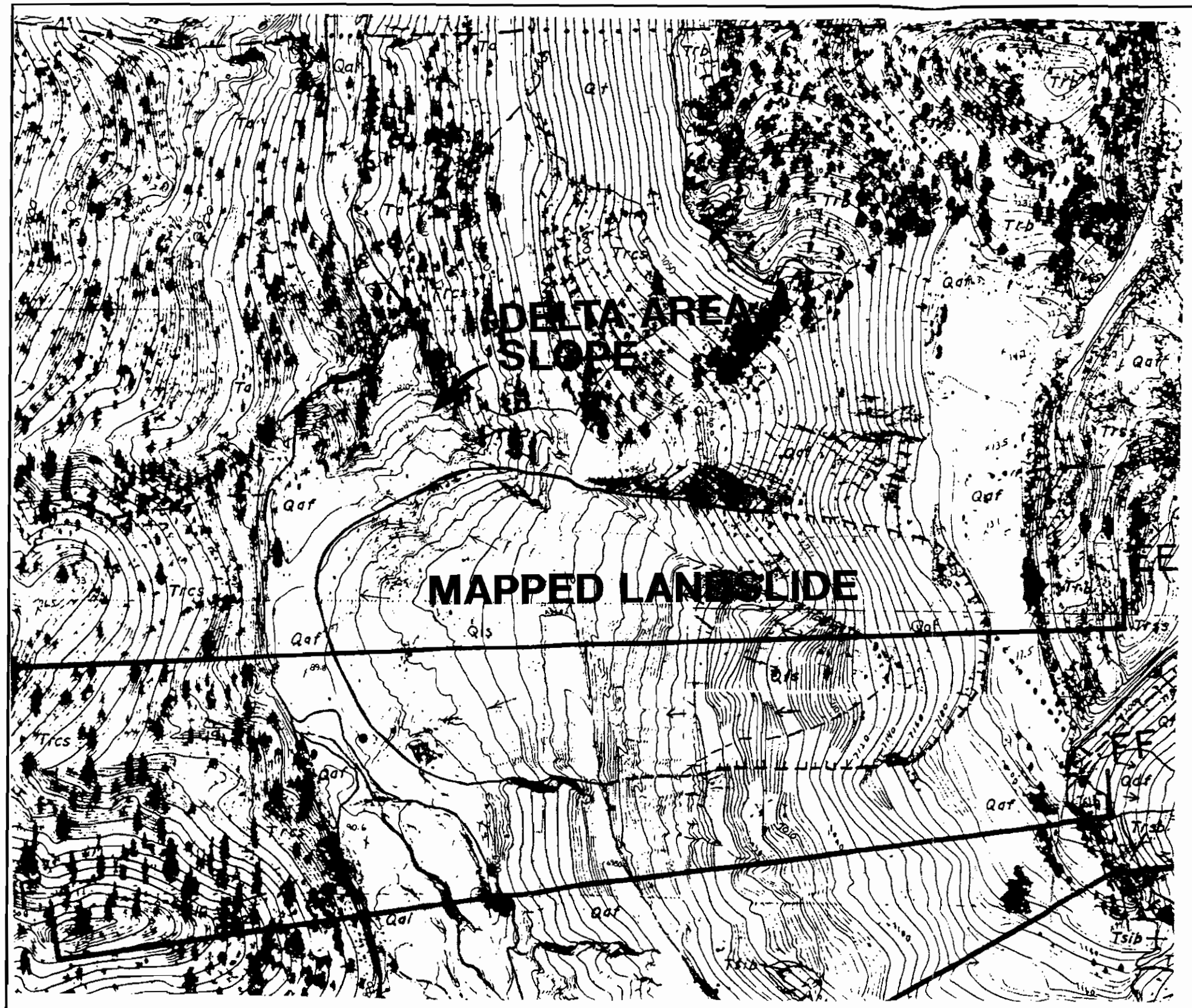

SYMBOLS

STRIKE AND DIP OF BEDDING

STRIKE AND DIP OF JOINT

CONTACT
dashed where approximatly located; dotted where projected beneath mapped units.

FAULT, SHOWING DIP
dashed where approximatly located; dotted where projected beneath mapped units; queried where uncertain.

LANDSLIDE SCARP (large)

LANDSLIDE SCARP (small)
less than 1.5meters (4 feet) vertical height.

GROUND SURFACE CRACKING
possible landslide dislocation.

SCALE
1 : 2400

ROCK UNITS

QUATERNARY

Qls	LANDSLIDE
Qdf	DEBRIS FLOW
Qal	ALLUVIUM
Qps	PONDED SEDIMENTS
Qaf	ARTIFICIAL FILL
Qt	TALUS
Qt_m	TALUS RESULTING FROM MINING

TERTIARY

Tsib	SILICIFIED IRON-STAINED BRECCIA
Tsb	SILICIFIED BRECCIA
Trs	UPPER SEDIMENTARY SEQUENCE
Trss	Sandstone
Trsl	Lahar
Trsa	Argillically Altered Sandstone
Trsb	Chloritized Breccia
Tso	Ore Rock
Tsob	Ore Rock with Relict Breccia Texture
$Trsa_b$	Argillically Altered Lahar
Trb	BASALT (Trba where autobrecciated)
Trc	LOWER SEDIMENTARY SEQUENCE
Trcs	Sandstone.
Trcl	Lahar
	INTRUSIVE UNITS
Tqlp	QUARTZ LATITE PORPHRY
Tlpa	LEVIATHAN PEAK ANDESITE
Tlpaa	Altered Leviathan Peak Andesite
Ta	BIOTITE PYROXENE HORNBLENDE ANDESITE
Tra	HORNBLENDE PYROXENE ANDESITE

REFERENCE: SWRCB, 1983

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GEOLOGIC MAP

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE
A-3

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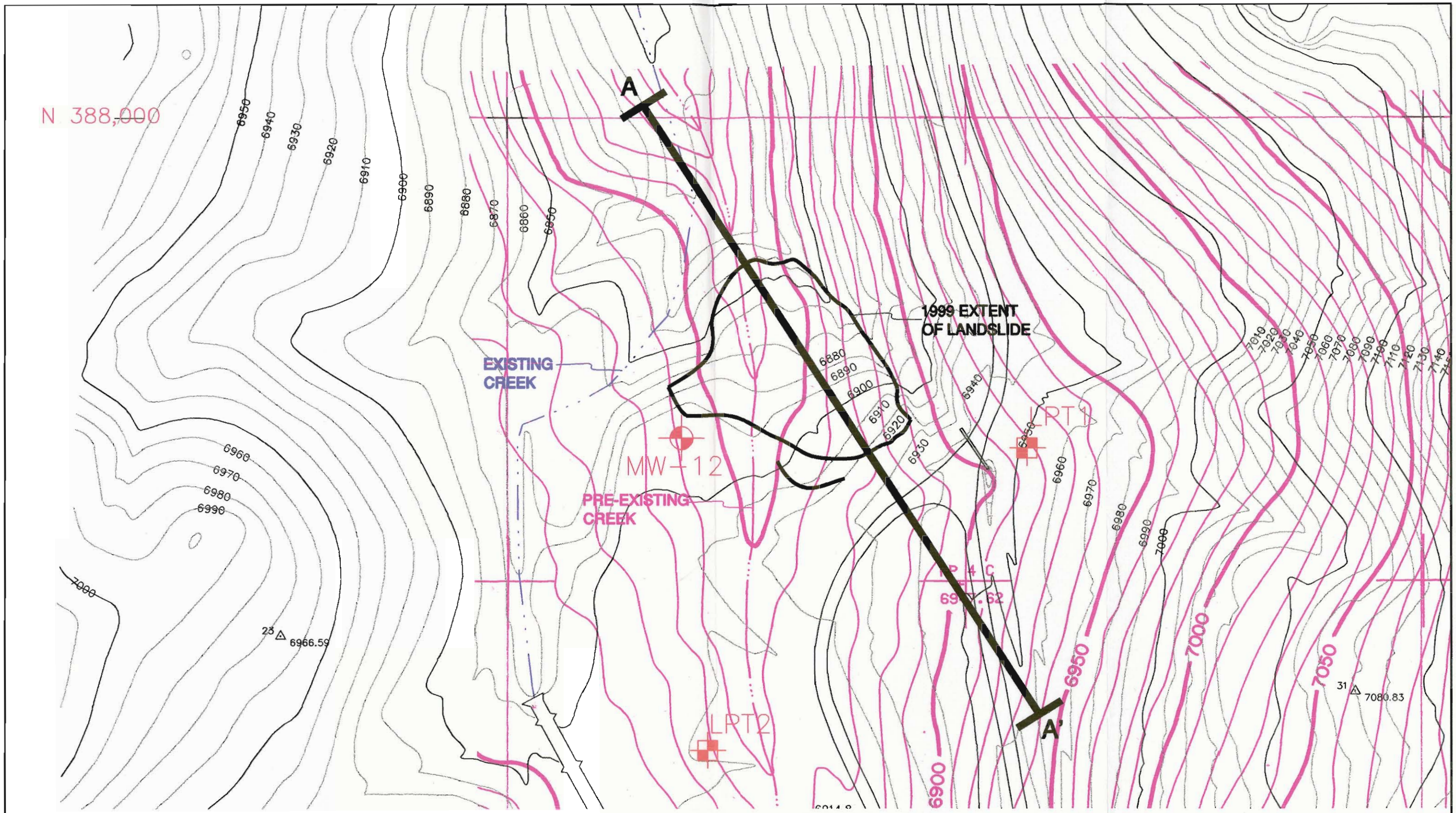

LEGEND: REFERENCE: SUMMIT ENGINEERING, 1998

14 USGS PIEZOMETER/ MONITORING WELL

LPT1 SRK TEST PIT

MW-12 SRK MONITORING WELL

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LEGEND

A—A' CROSS-SECTION LINE

TOPOGRAPHIC CONTOURS, PRE-MINE

1999 EXTENT OF LANDSLIDE (APPROXIMATE)

TOPOGRAPHIC CONTOURS, 1998

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DELTA AREA SLOPE SITE PLAN

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-4

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1999 AIR PHOTO OF DELTA AREA SLOPE

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-5

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1975 AIR PHOTO OF DELTA AREA SLOPE

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-6

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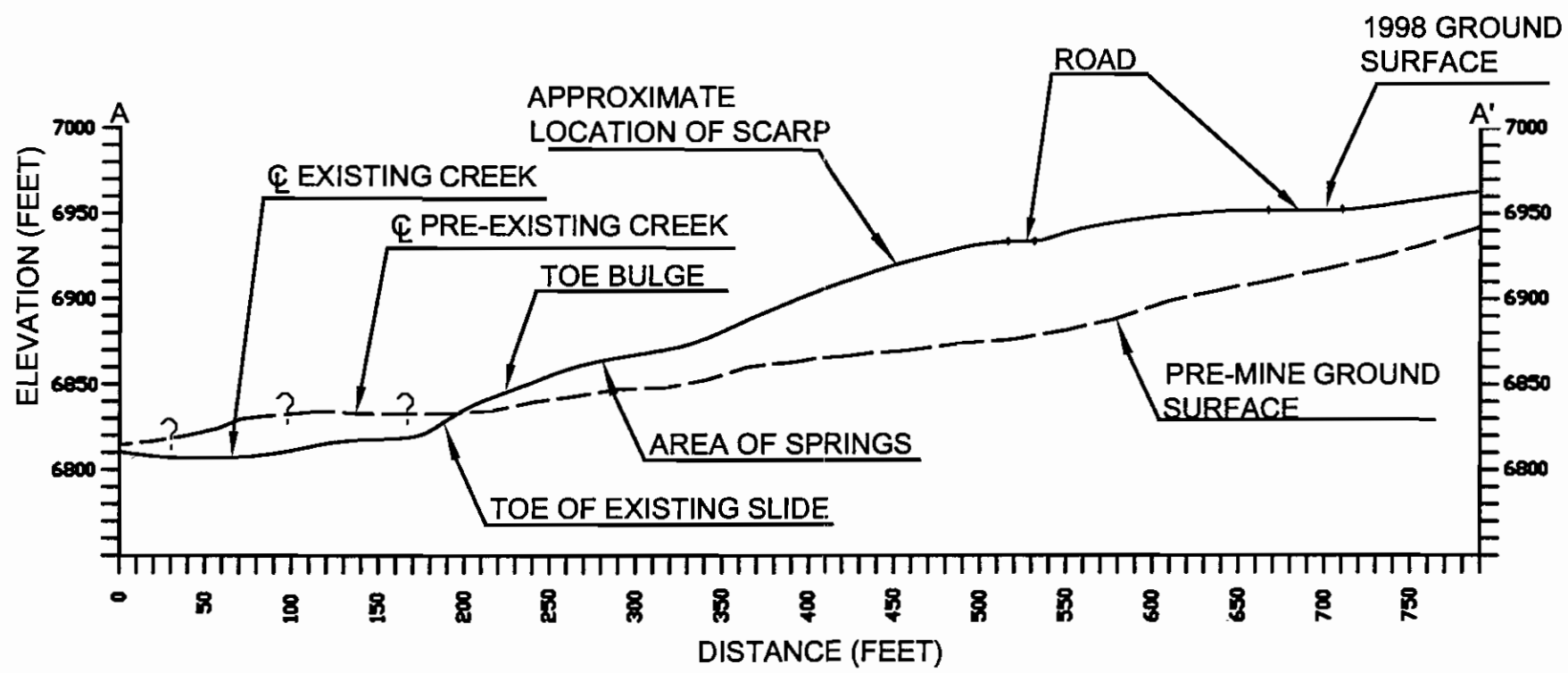

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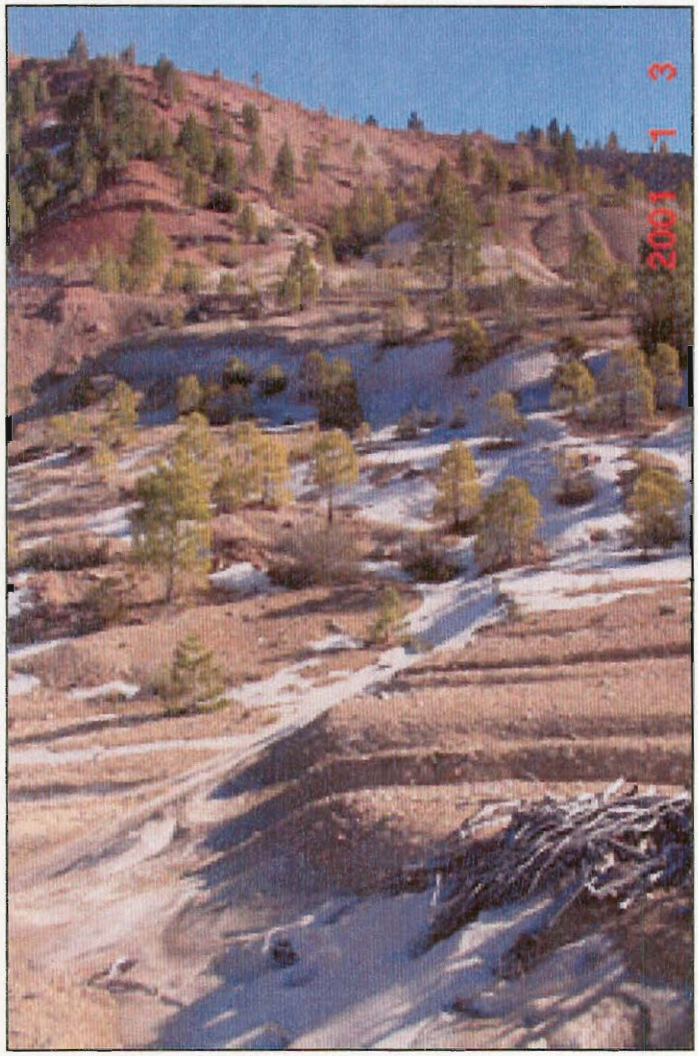
CROSS-SECTION A-A'

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE
A7



PHOTOGRAPH 1 -
LOOKING SOUTHEAST ALONG
SCARP AT TOP OF LANDSLIDE.

PHOTOGRAPH 2 -
LOOKING NORTHWEST
AT
LANDSLIDE. SCARP
IS
EVIDENT NEAR TOP
OF
SLOPE. WHITE POST
IS
LOCATION OF MW-12,
JUST ABOVE SCARP.

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PHOTOGRAPHS

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-8

PHOTOGRAPH 3 - LOOKING SOUTH AT TOE OF LANDSLIDE.

PHOTOGRAPH 4 - LOOKING NORTH AT TOE OF LANDSLIDE AND AREA BELOW LANDSLIDE.

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PHOTOGRAPHS

LEVIATHAN MINE

ALPINE COUNTY, CALIFORNIA

PLATE

A-9

Appendix B

Laboratory Test Data

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOIL More than 50% of the material is LARGER than the No. 200 sieve.	GRAVELS More than 50% of coarse part is LARGER than the No. 4 Sieve.	CLEAN GRAVELS Less than 5% finer than No. 200 Sieve. PI<4	GW	Well graded gravels, gravel - sand mixtures, little or no fines, Cu>4 & 1<Cc>3
			GP	Poorly graded gravels or gravel - sand mixtures, little or no fines Cu<4 or 1>Cc<3
		GRAVEL More than 12% finer than No. 200 Sieve.	GM	Silty gravels, gravel - sand - silt mixtures
			GC	Clayey gravels, gravel - sand - clay mixtures
	SANDS More than 50% of coarse part is SMALLER than the No. 4 Sieve.	CLEAN SANDS Less than 5% finer than No. 200 Sieve.	SW	Well graded sands, gravelly sands, little or no or no fines, Cu>6 & 1<Cc>3
			SP	Poorly graded sands or gravelly sands, little or no fines Cu<6 or 1>Cc<3
		SAND More than 12% finer than No. 200 Sieve. PI<4	SM	Silty sands, sand - silt mixtures
		PI>7	SC	Clayey sands, sand - clay mixtures
FINE GRAINED SOIL More than 50% of the material is SMALLER than the No. 200 sieve.	SILTS AND CLAYS Liquid limit LESS than 50	PI-Below A-Line	ML	Inorganic silts, rock flour, or clayey silts of low plasticity
		PI-Above A-Line	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts & organic clays of low plasticity
	SILTS AND CLAYS Liquid limit GREATER than 50	PI-Below A-Line	MH	Inorganic silts, clayey silts, or silts of high plasticity
		PI-Above A-Line	CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat & other highly organic soils

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

12" 3" 3/4" #4 #10 #40 #200 0.002 mm

DESCRIPTIVE TERMS USED WITH SOILS

CONSISTENCY & APPARENT DENSITY		
	SILTS & CLAYS	SANDS & GRAVELS
Strongest	Hard	Very Dense
	Very Stiff	Dense
	Stiff	Medium Dense
	Medium Stiff	Loose
Weakest	Soft	Very Loose
	Very Soft	

MOISTURE CONTENT	
Wettest	Wet
	Very Moist
	Moist
	Slightly Moist
Driest	Dry

▽ - Water Level Observed During Exploration

▼ - Water Level Observed After Exploration

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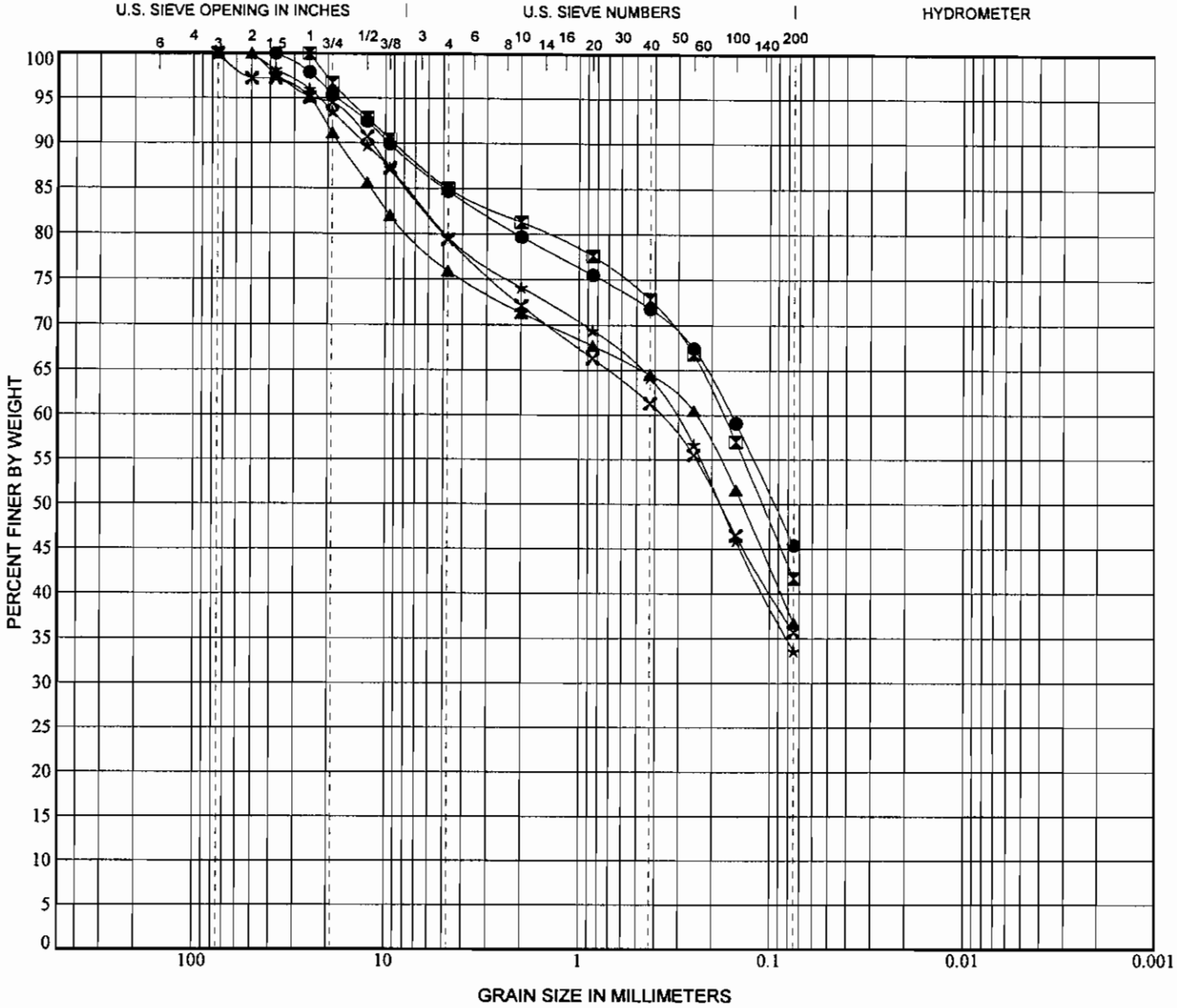
PROJECT NO. 30-2867-01.001

KEY TO SOIL CLASSIFICATION AND TERMS

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE
B-1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Depth (ft.)	Description - ASTM Classification	LL	PL	PI	Cc	Cu
●	SP-11	0.5	Light Brown Gravelly Clayey Sand (SC)	72	31	41		
⊠	SP-12	0.5	Light Brown Gravelly Clayey Sand (SC)	78	33	45		
▲	SP-3	0.5	Light Brown Gravelly Silty Sand (SM)	78	37	41		
★	SP-6	0.5	Light Brown Gravelly Clayey Sand (SC)	78	33	45		
✕	SP-8	0.5	Light Brown Gravelly Clayey Sand (SC)	75	33	42		

	Boring	Depth (ft.)	D100	D60	D30	D10	% Gravel	% Sand	% Silt	% Clay
●	SP-11	0.5	37.5	0.159			15.3	39.3	45.4	
⊠	SP-12	0.5	25	0.175			15.0	43.3	41.7	
▲	SP-3	0.5	75	0.243			24.1	39.2	36.7	
★	SP-6	0.5	50	0.316			20.4	46.0	33.6	
✕	SP-8	0.5	75	0.377			20.6	43.7	35.7	

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Leviathan Mine
Delta Area Phase I Preliminary Slope Stability Analysis

Alpine County, California

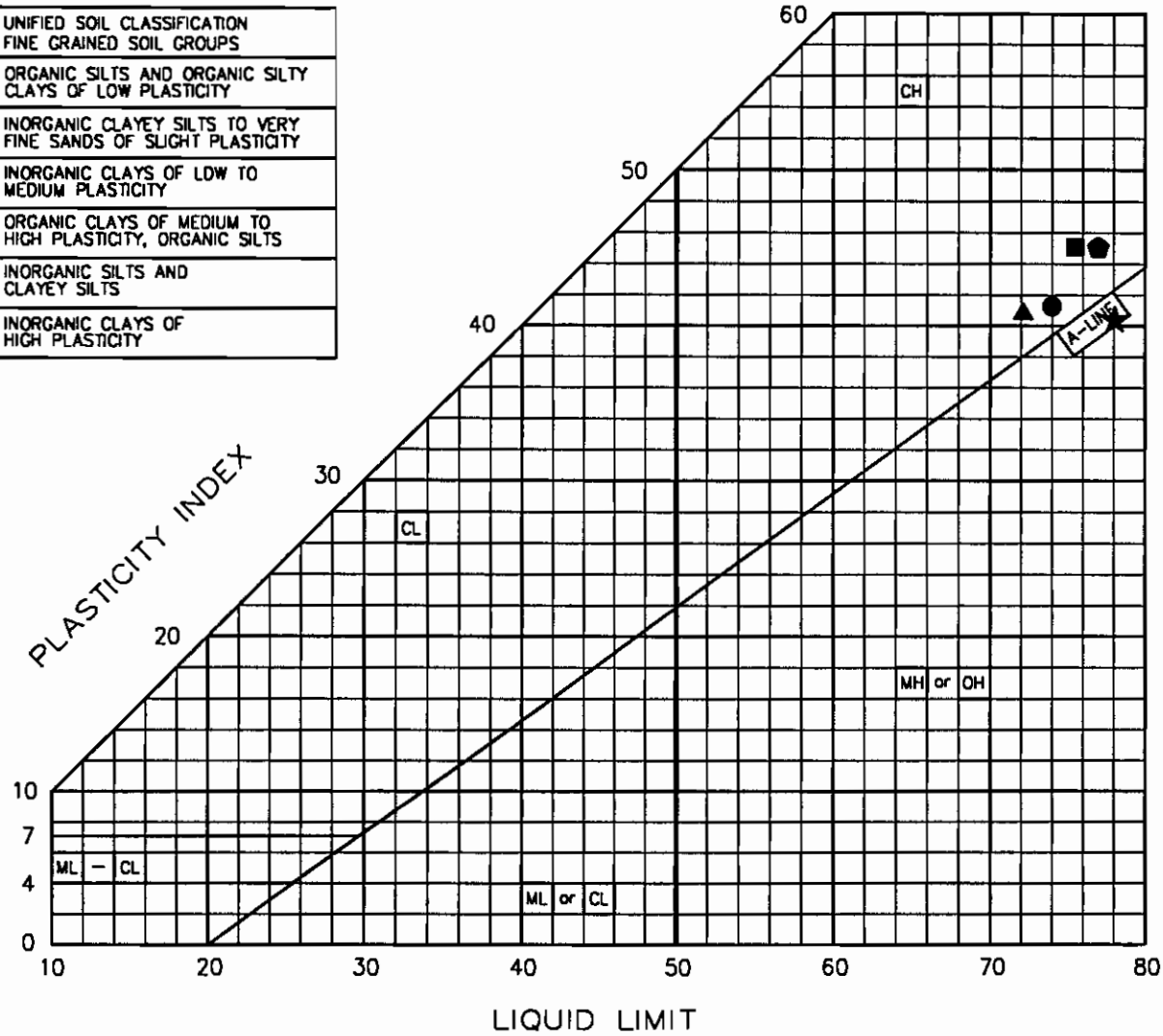
PLATE

B-2

PROJECT NUMBER: 30-2867-01.001

GRAIN SIZE ANALYSES

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML	INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH	INORGANIC SILTS AND CLAYEY SILTS
CH	INORGANIC CLAYS OF HIGH PLASTICITY



TEST SYMBOL	SAMPLE NO.	SAMPLE (DEPTH)	LIQUID LIMIT	PLASTICITY INDEX	CLASSIFICATION
★	SP-3	0-0.5'	78.4	40.9	Light Brown Gravelly Silty Sand (SM)
⬟	SP-6	0-0.5'	78.3	45.7	Light Brown Gravelly Clayey Sand (SC)
●	SP-8	0-0.5'	74.6	41.6	Light Brown Gravelly Clayey Sand (SC)
▲	SP-11	0-0.5'	72.0	41.1	Light Brown Gravelly Clayey Sand (SC)
■	SP-12	0-0.5'	77.7	45.0	Light Brown Gravelly Clayey Sand (SC)
⊠					
□					

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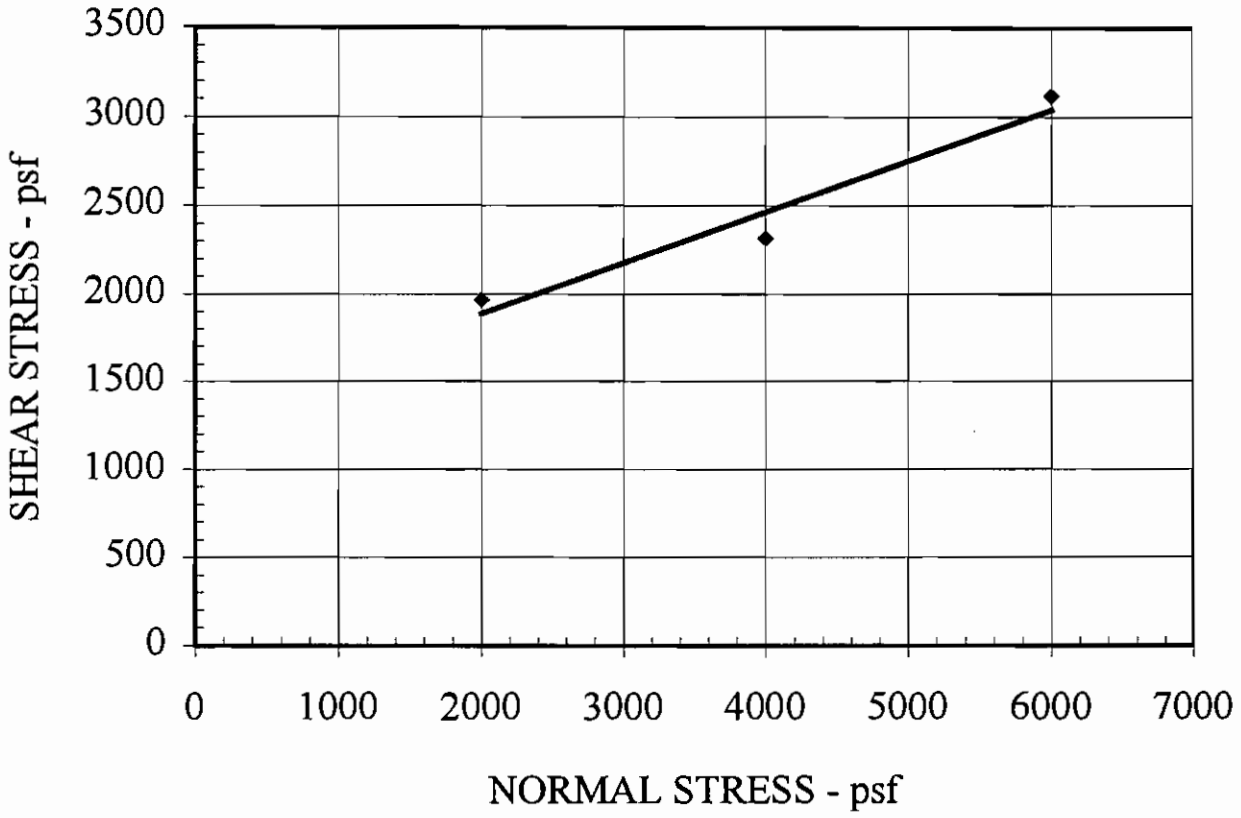
PLASTICITY INDEX

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE
B-3

CAD FILE: L:\2001\DRAWING\30286701\30286701-P4.pl.dwg

DIRECT SHEAR (AASHTO T236)



TEST TYPE:	CD/WET/REMOLDED/STAGED
BORING NO:	SP 3
DEPTH:	0-0.5 ft
SOIL DESCRIPTION:	Lt. Brown Gravelly Silty Sand (SM)
RATE OF SHEAR:	0.0010 in/min

FRICTION ANGLE, degrees:	16
COHESION, psf:	1315

INITIAL DRY DENSITY - pcf	81.1		
FINAL DRY DENSITY - pcf	85.2		
INITIAL WATER CONTENT - %	37.4		
FINAL WATER CONTENT - %	42.0		
MAXIMUM STRESS - psf	1967	2315	3119
NORMAL STRESS - psf	2000	4000	6000

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DIRECT SHEAR

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE

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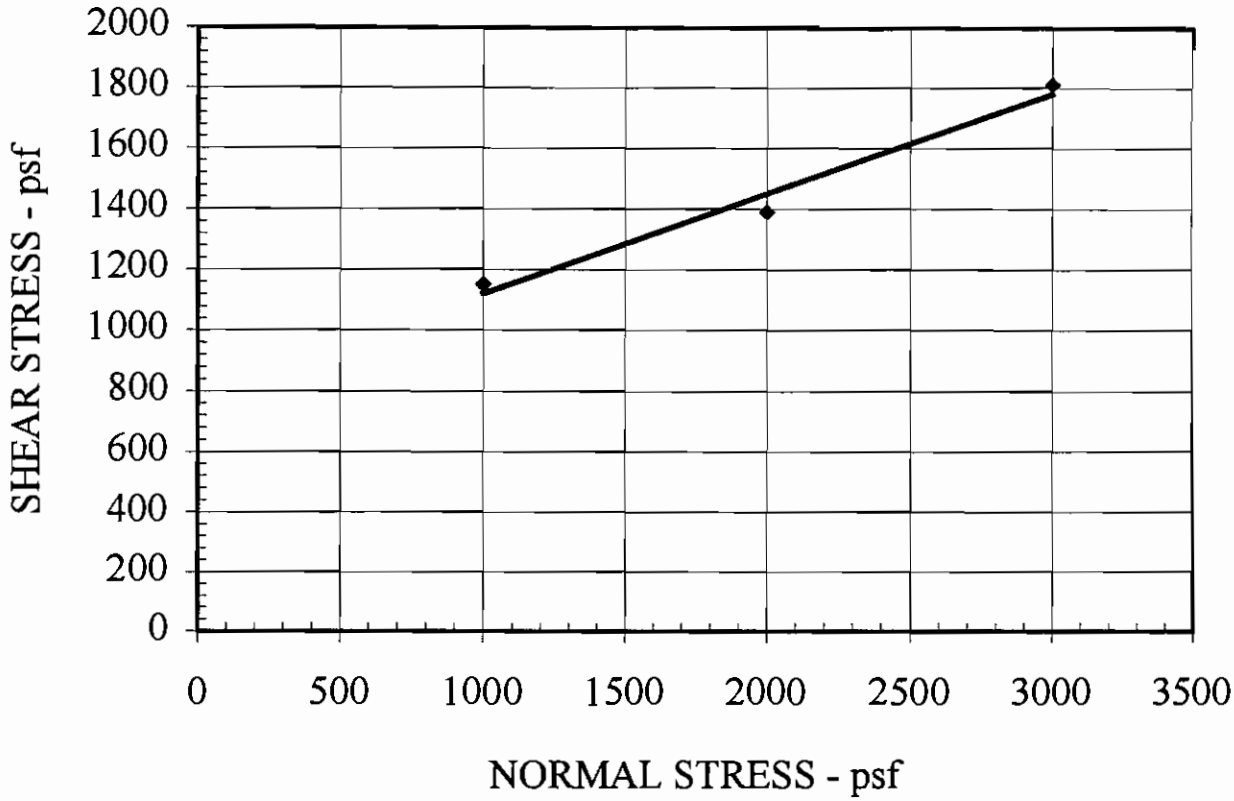
DIRECT SHEAR (AASHTO T236)



TEST TYPE:	CD/WET/REMOLDED/STAGED
BORING NO:	SP 6
DEPTH:	0-0.5 ft
SOIL DESCRIPTION:	Lt. Brown Gravelly Clayey Sand (SC)
RATE OF SHEAR:	0.0010 in/min

FRICTION ANGLE, degrees:	18
COHESION, psf:	792

INITIAL DRY DENSITY - pcf	80.8		
FINAL DRY DENSITY - pcf	83.5		
INITIAL WATER CONTENT - %	36.7		
FINAL WATER CONTENT - %	42.0		
MAXIMUM STRESS - psf	1152	1391	1811
NORMAL STRESS - psf	1000	2000	3000

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PROJECT NO. 30-2867-01.001

DIRECT SHEAR

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE
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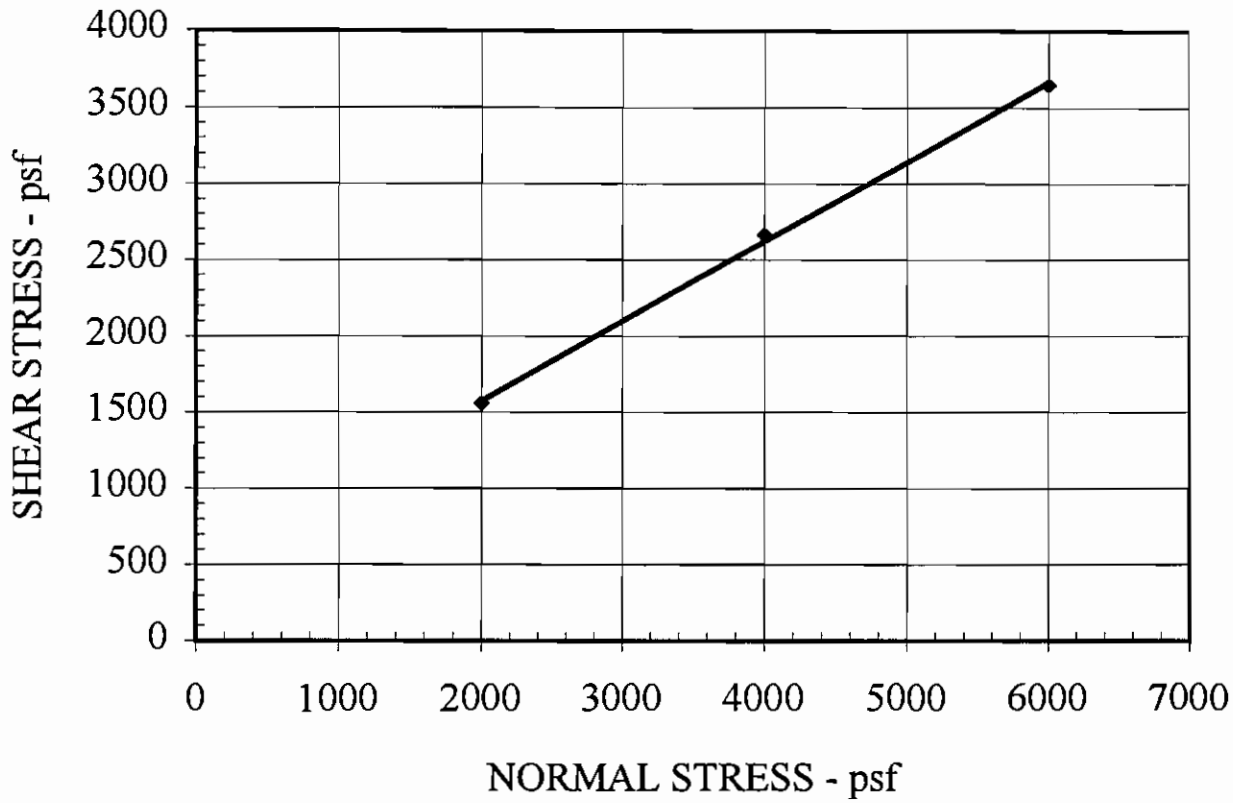
DIRECT SHEAR (AASHTO T236)



TEST TYPE:	CD/WET/REMOLDED/STAGED
BORING NO:	SP 8
DEPTH:	0-0.5 ft
SOIL DESCRIPTION:	Lt. Brown Gravelly Clayey Sand (SC)
RATE OF SHEAR:	0.0010 in/min

FRICTION ANGLE, degrees:	28
COHESION, psf:	535

INITIAL DRY DENSITY - pcf	81.1		
FINAL DRY DENSITY - pcf	86.2		
INITIAL WATER CONTENT - %	30.1		
FINAL WATER CONTENT - %	38.6		
MAXIMUM STRESS - psf	1559	2663	3647
NORMAL STRESS - psf	2000	4000	6000

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DIRECT SHEAR

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE
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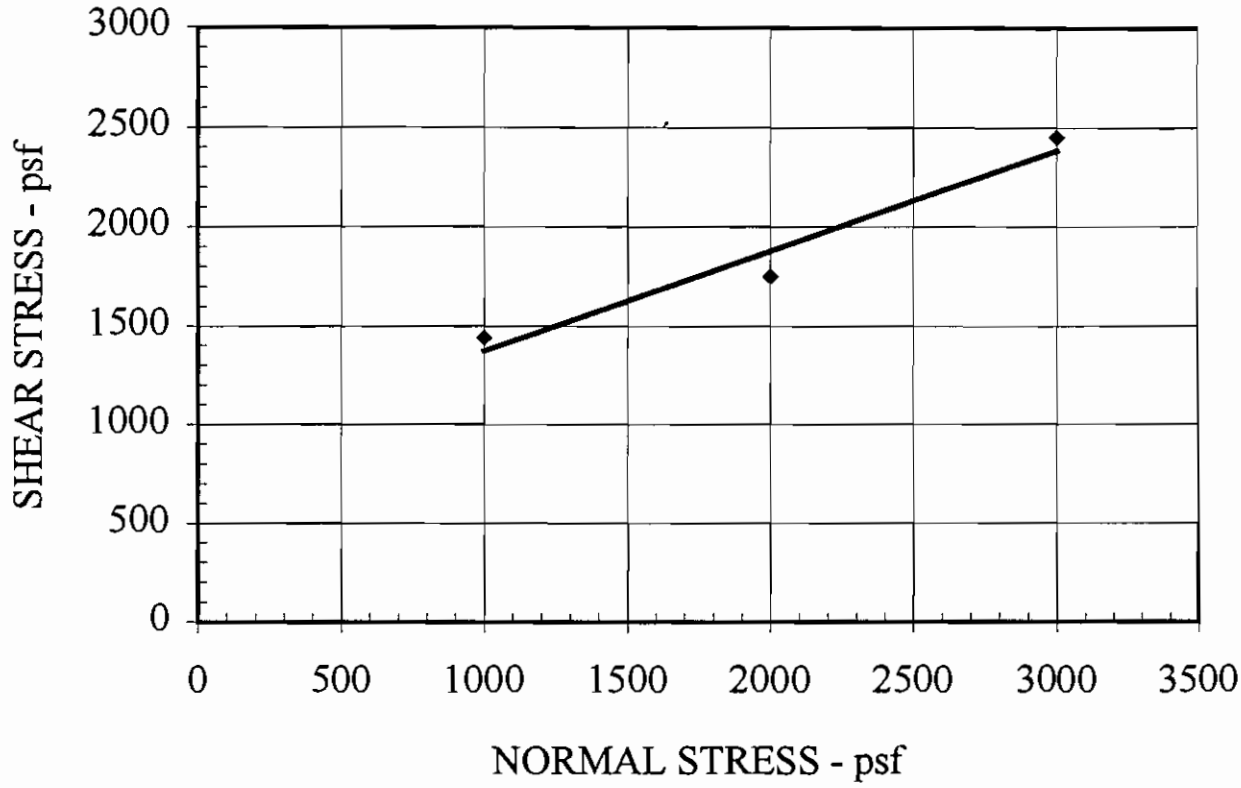
DIRECT SHEAR (AASHTO T236)



TEST TYPE:	CD/WET/REMOLDED/STAGED
BORING NO:	SP 11
DEPTH:	0-0.5 ft
SOIL DESCRIPTION:	Lt. Brown Gravelly Clayey Sand (SC)
RATE OF SHEAR:	0.0010 in/min

FRICTION ANGLE, degrees:	27
COHESION, psf:	869

INITIAL DRY DENSITY - pcf	81.8		
FINAL DRY DENSITY - pcf	85.7		
INITIAL WATER CONTENT - %	35.0		
FINAL WATER CONTENT - %	39.4		
MAXIMUM STRESS - psf	1439	1751	2450
NORMAL STRESS - psf	1000	2000	3000

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DIRECT SHEAR

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

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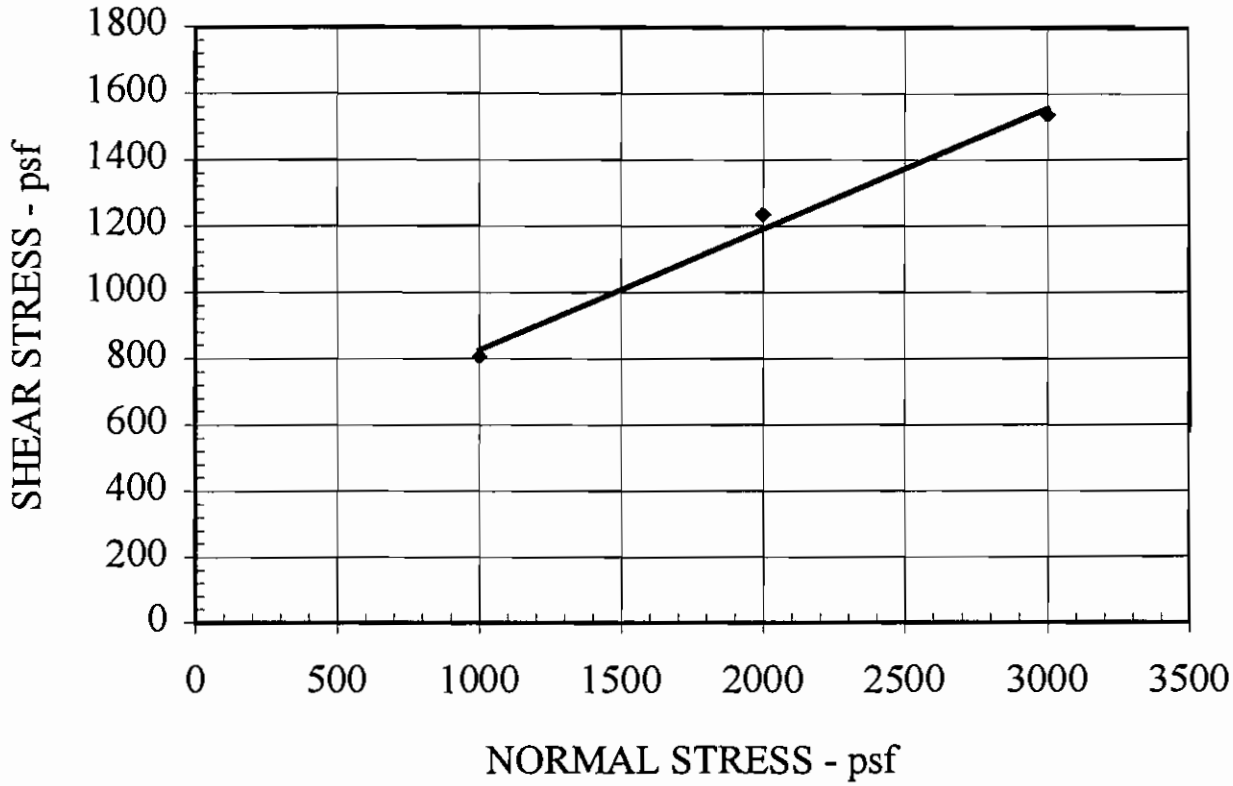
DIRECT SHEAR (AASHTO T236)



TEST TYPE:	CD/WET/REMOLDED/STAGED
BORING NO:	SP 12
DEPTH:	0-0.5 ft
SOIL DESCRIPTION:	Lt. Brown Gravelly Clayey Sand (SC)
RATE OF SHEAR:	0.0010 in/min

FRICTION ANGLE, degrees:	20
COHESION, psf:	462

INITIAL DRY DENSITY - pcf	80.0		
FINAL DRY DENSITY - pcf	83.8		
INITIAL WATER CONTENT - %	39.3		
FINAL WATER CONTENT - %	41.5		
MAXIMUM STRESS - psf	805	1235	1535
NORMAL STRESS - psf	1000	2000	3000

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DIRECT SHEAR

LEVIATHAN MINE
PRELIMINARY SLOPE STABILITY ANALYSIS
ALPINE COUNTY, CALIFORNIA

PLATE

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Appendix C

Information From Previous Investigations

TEST PIT LTP-1

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 6985 ft. MSL

SampNo	WD (pcf)	DD (pcf)	MC (%)
T1,T1A,B1	105.6	83.3	26.8
T3,T4			
T2,B2			

SAMPLES | GRAPHIC LOG

DESCRIPTION

0–2: SILTY TO CLAYEY SAND (SM/SC),
trace of fine gravel with more fine/coarse gravel float at surface, predominantely well graded, low plasticity, light brown, slightly moist, loose to very loose
note: angular gravel
note: no dessication observed at surface, dry to ~1" at depth

2–6: SILTY GRAVEL (GM),
trace/some clay, some sand, predominantely well graded, angular, low plasticity, red-orange, dense, moist

note: increase in gravel below 4'

Stopped backhoe at 6'
Tube samples (1.92" I.D.) taken at 0.5-1' and 5.5-6'
Bulk samples taken at 0.5'-1' and 5.5-6'
note: nuclear density gauge data indicated to left
note: groundwater not encountered
note: hand dug complimentary test pit 5' to east on 10/9/98 to collect additional tube samples (T3 & T4 (1-1.5'))

TEST PIT LTP-2

DATE EXCAVATED: 10/1/98
EXCAVATION METHOD: 310-E 4X4 DEERE Backhoe
LOGGED BY: KDW
SURFACE ELEVATION: 6915 ft. MSL

SampNo	WD (pcf)	DD (pcf)	MC (pcf)
T1,T1A,B1	105.6	78.3	34.9
T4			
T3			
T2,B2			

SAMPLES | GRAPHIC LOG

DESCRIPTION

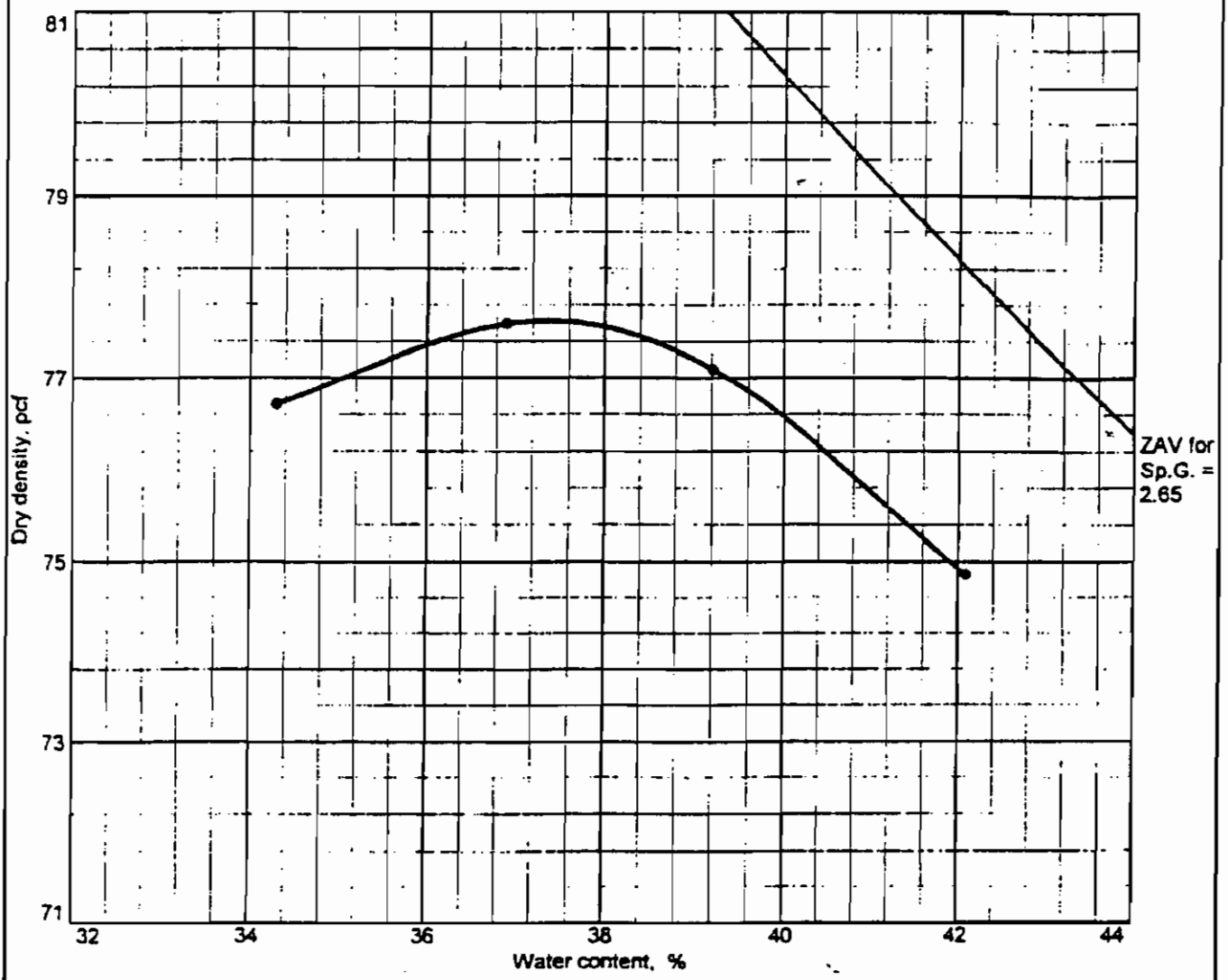
0–6: CLAYEY SAND (SC),
some fine gravel, trace coarse gravel, predominantely well graded, medium to high plasticity, brown with multi colored mottling (red/orange/yellow), moist, loose
note: upper 1-2" dry, no evident dessication at surface
note: becomes coarser with more gravel and some cobbles below 1'

increasing clay content and color change to gray with lower moisture content below 4'

Stopped backhoe at 6.5'
Tube samples (1.92 I.D.) taken at 0.5-1' and 6-6.5'
Bulk samples taken at 0.5-1' and 6-6.5'
note: nuclear density gauge data indicated to left
note: groundwater not encountered
note: excavated complimentary test pit 10' to east on 10/9/98 to collect additional tube samples (T3 (2-2.5') & T4 (0.9-1.4'))

SRK Consulting Engineers and Scientists 5250 Neil Road Suite 300 Reno, NV 89502	LOG OF TEST PITS LTP-1 AND LTP-2 Geotechnical Investigation Leviathan Mine, CA	TEST PIT REPORT

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure B Standard
Oversize correction applied to final results

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
0.0-0.5'	MH		43.5%	2.65	77	39	18.0	55.2

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 85.8 pcf	77.6 pcf	sandy elastic SILT w/gravel, mixed browns
Optimum moisture = 30.6 %	37.3 %	

Project No. 19333.1401 Client: ARCO
Project: Leviathan

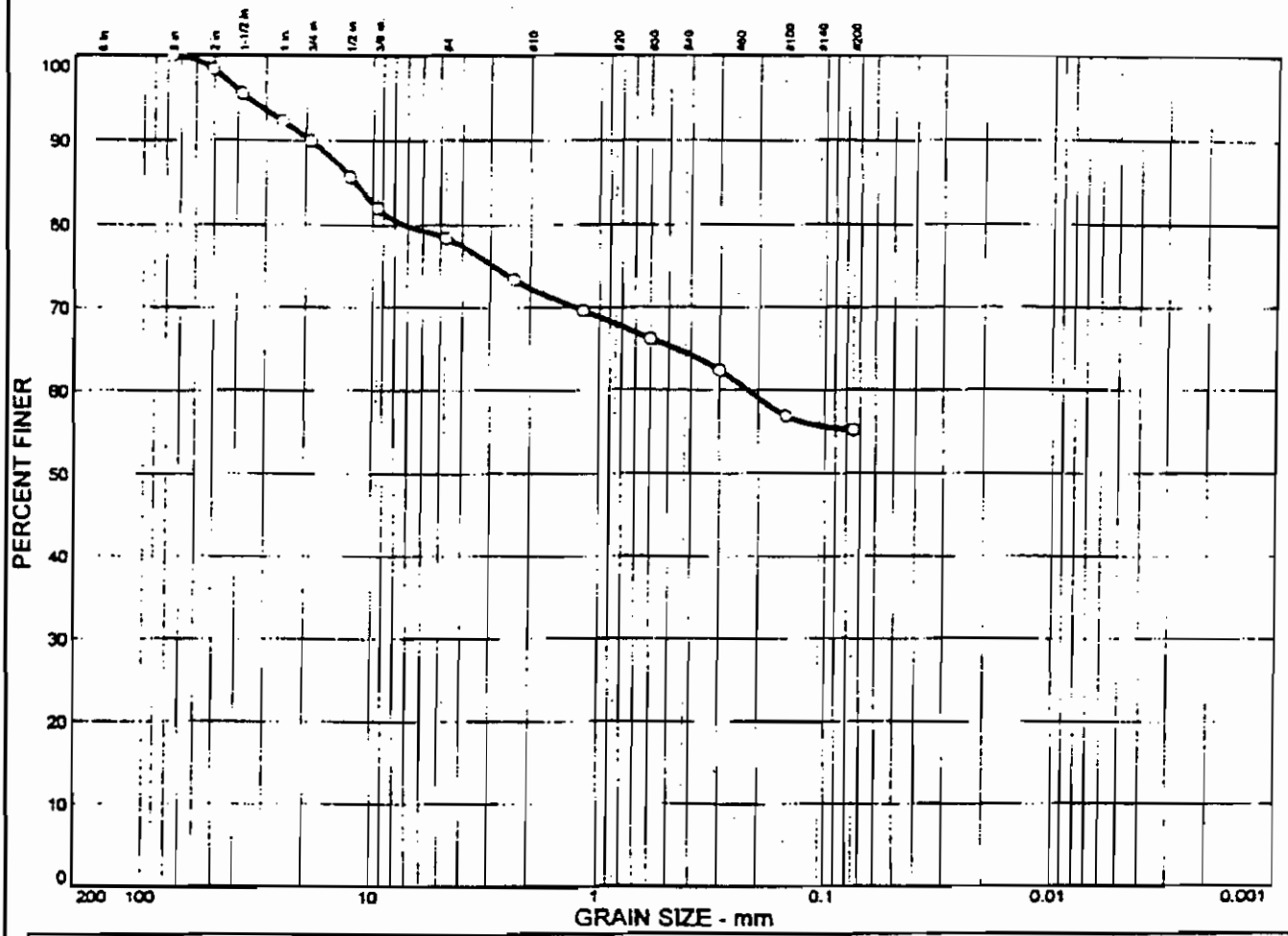
Source: LTP-1 Sample No.: TOP Elev./Depth: 0.0-0.5'

Remarks:

COMPACTION TEST REPORT

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	21.6	23.2	55.2	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
77	38	12.0	0.225						

MATERIAL DESCRIPTION	USCS	AASHTO
sandy elastic SILT w/gravel, mixed browns	MH	

Project No. 19333.1401 **Client:** ARCO

Project: Leviathan

Source: LTP-1 **Sample No.:** TOP **Elev./Depth:** 0.0-0.5'

Remarks:

Natural moisture - 43.5%

Particle Size Distribution Report

STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 5084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-1, T3	Tested By	SDD
Description	1.0-1.5'	Checked By	GM
Sample Type	California Liner	Date	10/14/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.91	Specific Gravity	2.65
Init. Ht. (cm)	10.10	Assumed?	Yes
Init. Vol (cm³)	191.57	Init. Void Ratio	1.582
Init. Sample Wet Wt. (g)	297.19	Initial Porosity	0.613
Init. Moisture Content	51.2%	Init. Dry Density (pcf)	64.0
		Initial Calculated Saturation	85.8%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm²)	18.83
Confining Pressure (psi)	2.0	Height Change (cm)	0.02
Volume Change (cc)	1.73	Final Ht. (cm)	10.08
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	511.85	Final Void Ratio	1.559
Final Dry Wt. + Pan (g)	389.01	Final Volume (cm³)	189.84
Pan Wt. Only (g)	192.47	Final Dry Density (pcf)	64.6
Final Moisture Content	62.5%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	1.00	Final Porsity	0.609

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	0.9	47.2				
20	3.0	45.2	1.9	114.55	1.63	7.3E-06
20	5.0	43.3	1.8	110.55	1.57	7.2E-06
20	6.9	41.4	1.7	106.70	1.52	7.2E-06
20	8.8	39.6	1.7	102.95	1.46	7.3E-06
					Average =	7.2E-06

REMARKS: Sample was homogenous.

10-15-98 04:58PM FROM SRK LABORATORY TO SRK TUCSON P02

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
FLEXIBLE WALL PERMEAMETER (ASTM D 6084 - 90)

Project	Leviathan	Project No.	19333
Sample No.	LTP-2, T4	Tested By	SDD
Description	0.9-1.4'	Checked By	GM
Sample Type	California Liner	Date	10/15/98

INITIAL SAMPLE DATA			
Sample Dia (cm)	4.81	Specific Gravity	2.65
Init. Ht. (cm)	10.25	Assumed?	Yes
Init. Vol (cm^3)	186.58	Init. Void Ratio	1.136
Init. Sample Wet Wt. (g)	320.86	Initial Porosity	0.532
Init. Moisture Content	38.6%	Init. Dry Density (pcf)	77.4
		Initial Calculated Saturation	90.2%
CONSOLIDATION DATA			
Back Pressure (psi)	40.0	Final Area (cm^2)	15.62
Confining Pressure (psi)	2.0	Height Change (cm)	0.04
Volume Change (cc)	27.03	Final Ht. (cm)	10.22
FINAL SAMPLE DATA			
Final Wet Wt. + Pan (g)	565.46	Final Void Ratio	0.826
Final Dry Wt. + Pan (g)	459.87	Final Volume (cm^3)	159.55
Pan Wt. Only (g)	228.43	Final Dry Density (pcf)	90.5
Final Moisture Content	45.6%	Final Calculated Saturation	100.0%
Burrette Calibration (cc/cm)	0.91		
Constant Pressure Head (psi)	2.00	Final Porsity	0.452

TEST DATA

Elapsed Time (min)	Head Burrette Reading (cm)	Tail Burrette Reading (cm)	Flow Q (cc)	Average Total Head (cm)	Average Total Head (psi)	Permeability k (cm/sec)
	12.9	25.3				
30	14.1	23.9	1.2	151.70	2.16	2.8E-06
30	15.3	22.5	1.2	149.10	2.12	2.9E-06
30	16.5	21.0	1.2	146.45	2.08	3.0E-06
30	17.7	19.5	1.2	143.75	2.04	3.1E-06
					Average =	3.0E-06

REMARKS: Sample was not homogenous. Clayey sand top w/scattered gravel lenses bottom.

10-15-98 04:58PM FROM SRK LABORATORY TO SRK TUCSON P03

Boring Log
(MW-9)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 85.4
Location: Pond 3 North end	Screen size/unit: 0.02,inches
Date drilled: 8/29/98	Screen Type: PVC Slotted
Date finished: 8/29/98	Drill method:
Surface elevation: 6990 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 40 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core					CL	Dark yellowish brown
					100			CL	Very dark gray, almost black andesit ore. Sandy gravelly clay with evident sulphur. Wet at 4.5 feet along gravels.
5.0					50			CL	Back into mixed waste rock which is predominantly
10.0					100			CL	Return to dary gray ore materaial containing abundant sulphur, and mineralized andesite.
15.0					100				
20.0					100			CL	8 inch cobbles at 18.5 feet. Orangish brown iron stained silica cap rock with cobbles. Adic leach tuff with iron staining.
					100				
					100				
25.0					100			GC	Iron stained gravels (cap or tuff) with some intermixed gray clay and gravels. Gray clay cobbles at 26 feet.
30.0					100			CL	Moderate brown, soft clay

SRK Consulting
5250 Neil Road, Suite 300, Reno, Washoe, NV, 89502

Company Log

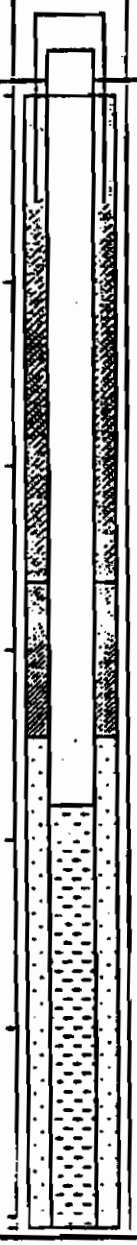
Nov. 9, 1998 | Drawn By: | Page:1 of 2

Boring Log
(MW-9)

Depth (feet)	Well	(PID) PPM	Samples: Number	Samples: Condition	Samples: Recovery	Samples: Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100				with gravel and sand. Orangish to brown material with some gray color.
					100			CL	
35.3									
					100				
40.0									

Boring Log
(MW-10S)

Project name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 13
Location: South of Pond 4	Screen size/unit: 0.02,inches
Date drilled: 9/10/98	Screen Type: PVC Slotted
Date finished: 9/10/98	Drill method:
Surface elevation: 6915 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 39 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0									
5.0									
10.0									
15.0									
20.0									
25.0									
30.0									

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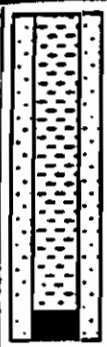
Company Log

Nov. 9, 1998 | Drawn By: | Page:1 of 2

Boring Log
(MW-10S)

Depth	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
30.3									
35.3									
39.0									

SRK Consulting
5250 Neil Road, Suite 300, Reno, Washoe, NV, 89502

Company Log

Nov. 9, 1998 | Drawn By: | Page:2 of 2

Boring Log
(MW-10D)

Site name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 16.5
Location: South of Pond 4,	Screen size/unit: 0.02,inches
Date drilled: 9/9/98	Screen Type: PVC Slotted
Date finished: 9/9/98	Drill method:
Surface elevation: 6915 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 75 feet	

Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core		100			CL	Sandy gravelly clay waste rock. Multicolored-brown, yellow, orange, gray/green.
5.0					100				
10.0					100			CL	Increase in acid leach cobbles and gravels. Color generally lighter. Sand is coarse to fine and angular. Gravels are rounded to subrounded.
15.0					100				
20.0					100			CL	Sandy gravelly clay. Predominately moderate brown. Decrease in clay. Increase in sand and gravas. Agglomearate.
25.0					80				
30.0					100			CL	Sandy gravelly clay agglomerate predominately moderate brown. Gray antular to subrounded tuff.
					100				

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Company Log

Nov. 9, 1998 | Drawn By: | Page: 1 of 3

Boring Log
(MW-10D)

Depth (Feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
30.3			Core						
					100			CL	
35.3									
					100				Agglomerate medium brown, sandy, gravelly clay. Some GC. Angular mineralized sulphur crystals. Mottles are yellow, orange, green, gray and brown.
40.3									
					100			CL	
45.3					100				
					0				
									Grayish brown grading towards gray clay with fine to coarse sand and gravel.
50.3									
					100			CL	
55.3					100				Very dark brown and medium to dark gray clay with organics including branches, and roots. Some cobbles sand and gravels. Agglomerate material. Not colormixed.
					100				
60.3								CL	
					100				
65.3									Laminated reddish to moderate brown lake deposit agglomerated sandy clay with some GC.
					100			CL	
67.9									

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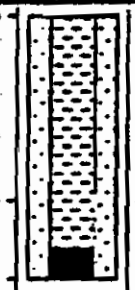
Company Log

Nov. 9, 1998 | Drawn By: | Page:2 of 3

Boring Log
(MW-10D)

Depth (Meas)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100				
					100				
								CL	
					90				
72.9									
75.0									

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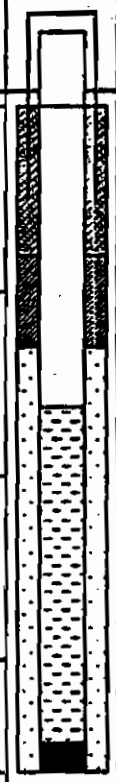
Company Log

Nov. 9, 1998 | Drawn By: | Page:3 of 3

Boring Log
(MW-11)

Name: Leviathan Mine	Project number:
Project name:	Depth to water at drilling time: 11.1
Location: Lower	Screen size/unit: 0.02,inches
Date drilled: 9/8/98	Screen Type: PVC Slotted
Date finished: 9/8/98	Drill method:
Surface elevation: 6925 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 18 feet	



Depth (feet)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core		80			CL	Compacted dark yellowish brown mixed waste rock. Large amount of roots between 2 to 2.5 feet. Greenish tuff sediments present at 4.5 feet.
5.0					100			GC	Dark brown almost black clayey subrounded alluvial gravels. Large amount of organic materaial including roots and branches.
10.0					80			CL	Greenish and brown clay in lenses.
15.0					100 100			GC	Laminated clay an cobbles/gravels. Andesite.
18.0									

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Company Log

Nov. 9, 1998 | Drawn By: | Page: 1 of 1

Boring Log
(MW-12)

Name: Leviathan Mine	Project number:
Client name:	Depth to water at drilling time: 42
Location: North end of	Screen size/unit: 0.02,inches
Date drilled: 9/10/98	Screen Type: PVC Slotted
Date finished: 9/11/98	Drill method:
Surface elevation: 6900 feet	Notes: Gerald Cain CA. C-57 #694686
Logged by: Chris tenBraak	Elev. ToC - 6898.74
Drilling Co.: Boart Longyear	
Driller: Gerald Cain CA. C-57 #694686	
Total depth of hole: 72 feet	

Depth (feet)	Well	(PID) ppm	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
0.0			Core						Moderate brown mottled clay waste dump with fine to coarse sand and gravel in clay matrix.
					90				
5.0					80				
10.0					33			CL	
15.0					41				
20.0					100				
								GC	Predominately orange to Iron stained sand and angular gravels. Predominately moderate brown clay. Some tuffacious sediments.
25.0					100				
					100			CL	
					100				
28.9					100				

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Company Log

Nov. 9, 1998 Drawn By:

Boring Log
(MW-12)

Depth (Feet)	Well	(PID) PPM	Samples Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
30.3			Core		100				
					100			CL	
35.3					100				
					100				Iron staining. Moderately brown clay with gravels and sands. 'Fresh' greenish andesite. Fewer gravels and cobbles.
40.3					100				
					83			CL	
45.3					100				
					100				
50.3					100				
					100				Large amount of dark organic material. Some gravels and cobbles. Grading toward dark brown silty clay with greenish gray lenses.
55.3					100			CL	
60.3					100				
65.3					100			CH	Organic material. Fat, silty clay. Some sand.
7.9									

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Company Log

Nov. 9, 1998 | Drawn By: | Page:2 of 3

Boring Log
(MW-12)

(ft)	Well	(PID) PPM	Samples: Number	Condition	Recovery	Blows	Graphic Log	USCS Symbol	Description
67.9			Core		100				
					100			CH	
72.0									

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Company Log

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TABLE 81.--Location, altitude, depth, and perforated interval for test holes drilled with CME-750 rig--Continued

Test-hole number	Location coordinates[1]		Altitude of top of casing[1] (feet above sea level)	Depth (feet below top of casing)	
	North	East		Total	Approximate perforated interval
17B	386484.686	2669441.493	7,102.84	70	54.5-64.5
17C	386477.488	2669547.423	7,128.42	95	80-90
26	--	--	[2]7,107	60	50-60
27	--	--	[2]7,097	73	Dry hole; no casing
		Between open pit and waste dump			
14	386440.360	2668472.652	7,037.77	91	71-91
15	386598.262	2668007.534	6,992.00	31.5	19-31.5
16	386621.402	2667792.160	6,990.76	62	42-62
		Delta area			
9A	386796.279	2667454.105	6,901.33	52	47-52
9B	386796.457	2667459.366	6,900.35	25	20-25
9C	386796.789	2667464.368	6,900.55	15	10-15
10A	386989.599	2667351.441	6,893.33	50	45-50
10B	386985.898	2667351.819	6,894.51	25	20-25
10C	386981.791	2667352.803	6,893.66	15	10-15
11A	387112.655	2667248.603	6,889.51	55	50-55
11B	387117.887	2667248.052	6,889.07	30	25-30
11C	387117.205	2667212.045	6,889.48	15	10-15
18A	386878.160	2667321.350	6,895.00	47	42-47
18B	386874.842	2667319.501	6,894.11	25	20-25
18C	386871.910	2667317.647	6,895.03	15	10-15
		Upper landslide area			
3A	389303.166	2669345.127	7,062.55	118.5	108.5-118.5
3B1	388691.265	2669720.916	7,105.11	82	72-82
3B2	388686.649	2669719.280	7,105.43	25	15-25
3C	389131.196	2669636.062	7,121.86	90	80-90
3CN	389135.967	2669628.699	7,119.98	51	Blank casing to 51

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
8	11-19-82	68.50	6.6	510	7.5	—	
	11-23-82	68.32	7.3	520	8.0	—	
	04-08-83	62.8	6.4	540	9.0	—	
8A	11-19-82	21.40	6.9	—	7.5	—	
	11-23-82	21.74	7.6	600	8.0	—	
	04-08-83	21.8	6.3	580	8.5	—	
9A	11-12-82	3.64	5.1	3,800	—	—	
	11-16-82	4.35	5.3	3,100	8.5	—	
	11-29-82	5.90	5.8	3,000	—	—	
9B	11-12-82	1.15	4.6	4,500	—	—	
	11-16-82	1.15	4.3	4,100	8.0	—	
	11-29-82	2.0	4.7	4,400	—	—	
9C	11-12-82	1.17	3.8	4,900	—	—	
	11-16-82	1.51	3.4	5,000	8.0	—	
10A	11-12-82	0.50	6.0	2,200	—	—	
	11-16-82	flowing	5.7	2,000	9.5	—	
	11-29-82	flowing	6.2	1,400	8.5	—	
10B	11-12-82	flowing	5.1	2,400	—	—	
	11-16-82	flowing	4.9	2,300	9.5	—	
10C	11-12-82	0.45	5.5	2,800	—	—	
	11-16-82	flowing	5.4	3,000	9.5	—	
11A	11-12-82	0.57	5.9	2,100	—	—	
	11-16-82	3.55	5.6	2,100	8.0	—	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
11B	11-12-82	0.23	4.9	5,500	--	--	
	11-16-82	2.29	4.7	6,100	7.0	--	
11C	11-12-82	1.84	4.9	4,800	--	--	
	11-16-82	1.13	4.8	4,800	8.0	--	
14	10-26-82	32.13	2.6	5,400	--	--	
	04-06-83	27.7	3.0	5,400	11.0	0.08	
15	11-17-82	17.54	4.0	3,900	8.0	--	
16	11-08-82	50.12	4.0	2,900	7.0	--	
	11-16-82	51.24	4.0	3,100	7.0	--	
	04-06-83	49.73	4.1	2,700	7.0	0.12	
17A	11-08-82	50.40	2.5	4,100	--	--	
	11-17-82	50.59	2.6	3,800	11.0	--	
17B	11-08-82	46.00	6.2	2,800	--	--	
	11-17-82	45.95	6.0	3,000	8.0	--	
17C	11-08-82	80.00	4.4	2,600	--	--	
	11-17-82	72.53	4.2	3,000	11.0	--	
18A	11-12-82	0.23	4.8	2,300	--	--	
	11-16-82	flowing	4.2	2,300	7.0	--	
	11-29-82	flowing	4.5	2,200	7.0	--	
18B	11-12-82	0.14	4.5	--	--	--	
	11-16-82	0.20	4.2	2,900	7.0	--	
	11-19-82	0.83	4.3	3,400	7.0	--	

TABLE 83.--Water-level and field water-quality data for test holes drilled with CME-750 rig--Continued

Test-hole number	Measurement date	Depth to water from top of casing (feet)	pH (units)	Specific conductance (umhos per centimeter)	Temperature (°C)	Dissolved oxygen (mg/L)	Remarks
18C	11-12-82	0.76	6.1	3,300	—	--	
	11-16-82	1.74	5.4	3,200	7.0	—	
	11-29-82	1.65	5.5	3,100	7.0	—	
19A	11-09-82	24.90	4.6	2,500	9.0	--	
	12-15-82	26.25	5.1	1,900	7.5	—	
19B	11-09-82	18.90	4.0	2,600	9.0	—	
	12-15-82	19.00	3.8	2,500	8.0	—	
20	11-12-82	2.91	6.6	1,700	—	--	
	12-10-82	2.80	6.6	1,400	5.0	0.9	
	04-08-83	2.40	6.7	1,400	7.5	—	
20A	11-12-82	45.31	6.7	660	—	--	
	12-10-82	45.00	6.9	480	7.5	0.9	
	04-08-83	40.6	6.5	680	8.5	—	
21	11-15-82	39.10	6.9	2,050	6.0	—	
	12-15-82	39.21	7.0	1,700	7.0	—	
	04-08-83	39.1	6.8	1,700	7.0	—	Blockage at 66.2 ft
22	11-08-82	67.57	7.3	610	6.0	--	
	04-06-83	66.5	6.7	890	—	0.05	
23A	11-15-82	50.49	6.2	1,600	5.0	--	
	12-17-82	50.92	6.3	1,000	5.5	--	
24	11-08-82	50.54	7.0	850	7.0	—	
	12-17-82	51.17	7.0	660	6.0	—	

USGS

Location LEVIATHAN MINE Date AUGUST 3, 1982 Local well number 9A

County ALPINE, CALIF Map HEENAN LAKE-CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA, WRD Project number 4732-09900 Altitude 6901 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

~~clay c cobbles cob sandy sdy~~
~~silt st boulders b fine f~~
~~sand s clayey cly medium m~~
~~gravel g silty sty coarse co.~~

Rge. 21E
Twsp. 10N
Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1.5 FT ABOVE LSD	Lithologic description (ENGINEERING)	Summary log (GEOLOGIC)
				CHATTER		GRAVEL, COARSE TO FINE, SAND AND CLAY. LIGHT BROWN TO DARK GRAY.	ALLUVIUM, GRAVEL, SAND AND CLAY LIGHT BROWN TO DARK GRAY. REWORKED MINING WASTE. SOME LARGE COBBLES
				-25 FT SMOOTH	▼ 2.37 FT AUG 10, 1982	SANDY CLAY, REDDISH BROWN MOIST, LOOSE	FILL, MINE WASTE, CLAY WITH OCCASIONAL COBBLES AND BOULDERS OF ANDESITE, TUFF SANDSTONE AND CLAYSTONE.
5							
				-8 CHATTER VIGOROUSLY		BOULDER GRAVEL AND CLAY, LOOSE.	
10				-10 SMOOTH AND EASY (LIGHT GRAY SOUPY MUD)	▽	FIRST WATER	
						CLAY, LIGHT GRAY, LOOSE, WET AND OCCASIONAL BOULDER.	
15							
20						SAME	
25						SAME	
30							
				-32.5 SLIGHTLY HARDER			
35							

Location LEVIATHAN MINE Date AUGUST 3 1982 Local well number 9A

County ALPINE, CALIF Map HEENAN LAKE CALNEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA, WRD Project number 473Z-09900 Altitude _____

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Rge. 21E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1.5FT ABOVE LSD	Lithologic description	Summary log
				37 EASIER 38+ CHATTER 39+ EASY		SAME	
40	10 4 7 5			CHATTERS VERY ROUGH		SAND CLAY, DARK BROWN, LAYERED, GRAVELLY 3-4 IN. LAYERS, EACH LAYER CONTAINS RUSTY ZONES, POSSIBLE SOIL. BOULDERS ?? WILL CORE	PROBABLE TOP OF ORIGINAL LAND SURFACE SOFT WEATHERED VOLCANI-CLASTIC BEDROCK ??
45		47 FT				47 FT BOTTOM OF AUGER FLIGHT RECOVERY FROM CORING RUN POOR. FIVE COBBLES	
50		52 FT				BOTTOM OF CORING RUN	
55						BOTTOM OF BORING INSTALLED 5 FT 40 SLOT PVC 44.5 FT SOLID PVC 49.5 FT TOTAL PVC CASING − 3.3 FT CUTOFF 46.2 FT TOTAL PVC CASING	

WOD 1½ ID SPOON NO INSERTS

Location LEVIATHAN MINE Date 8-4-82 Local well number 9B

County ALPINE, CALIF Map HEENAN LAKE Scale 1:24,000 Lat. _____ Long. _____

District NEVADA, WRD Project number 4732-09900 Altitude 6901 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GANTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Rge. 21 E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 0.5 FT ABOVE LSD	Lithologic description	Summary log
					▼ 0.66 FT AUG 10, 1982	SEE 9A FOR LOG	SEE 9A FOR LOG.
5					▽	FIRST WATER	
10							
15							
20							
25						BOTTOM OF HOLE INSTALLED 5 FT 40 SLOT PVC 20 FT SOLID PVC 25 FT TOTAL PVC CASING PACKED WITH 2, 5 GALLON BUCKETS OF MONTERREY SAND AND 1 GAL. OF BENTONITE.	

Location LEVIATHAN MINE Date AUGUST 4 1982 Local well number 9C

County ALPINE, CALIF Map HEENAN LAKE CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA, WRD Project number 4732-09900 Altitude _____

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING FT ABOVE LSD	Lithologic description	Summary log
						SEE BORING 9A FOR LOG.	SEE BORING 9A FOR LOG
5		NO SAMPLES			15 FT 40 SLOT PVC 10 FT SOLID PVC 12.5 GAL. BUCKETS MONTERREY SAND 1 GAL BENTONITE PELLETS		
10				1ST WATER		1ST WATER	
15						BOTTOM OF HOLE INSTALLED 5 FT 40 SLOT PVC 10 FT SOLID PVC 15 FT TOTAL PVC CASING PACKED WITH 2.5 GALLON BUCKETS MONTERREY SAND AND ONE GALLON BENTONITE PELLETS	

Location LEVIATHAN MINE Date AUG 4, 1982 Local well number 10A

County ALPINE, CALIF Map HEENAN LAKE, CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-09900 Altitude 6893 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GOUTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Rge. 21E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1.3 FT ABOVE LSD	Lithologic description	Summary log
						1530 START	
				PUSHED		GRAVEL AND SAND, SOFT LIGHT BROWN AND LIGHT GRAY	ALLUVIUM - WASHED MINE WASTE, GRAVEL AND SAND LIGHT BROWN AND LIGHT GRAY.
		P			▽ FIRST WATER	SANDY CLAY, SOFT, WET, LOOSE LIGHT BROWNISH GRAY.	
							MINE WASTE, SANDY CLAY,
5		P		PUSHED			
10				9 EASY SMOOTH		SAME, OCCASIONAL, COBBLES	
15				EASY SMOOTH			
20				EASY		WATER COMING UP OUTSIDE AUGER 4-5GPM FLOWING.	
25				EASY			
30				SLIGHTLY FIRMER		SANDY CLAY, MEDIUM GRAY, LOOSE, WET, SLIGHTLY FIRMER THAN ABOVE.	
35							

Location LEVIATHAN MINE Date AUGUST 4, 1982 Local well number 10A

County ALPINE, CALIF Map HEENAN LAKE, CALIF Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-09900 Altitude 6893 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action		Lithologic description	Summary log
	35					SAME	
				41.5 SLIGHT CAVITY (VERY SANDY MUD)			
40							
				42 STRONGER CAVITY			PROBABLE OLD LANDSURFACE
				VERY STRONG CAVITY			PROBABLE TOP OF BEDROCK(?) TUFFACEOUS SANDSTONE ??? (FORMATION OUTCROPS ABOUT 100 YARD WEST OF SITE AND STRIKES TOWARD SITE) SOFT FRIABLE.
45							
						FORMATION RUNS UP HOLE DIFFICULT TO CLEAN FOR SAMPLING OR CORING. ABOUT 10 GAL. PER MINUTE FLOW OUTSIDE AUGER FLIGHTS.	making water.
50						BOTTOM OF BORING. INSTALLED 5 FT OF 40 SLOT PVC; 42.7 FT OF SOLID PVC; 47.7 FT TOTAL PVC CASING	

Location LEVIATHAN MINE Date [illegible] Local well number [illegible]

County ALPINE, CALIF Map HEENAN LAKE CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732 -09900 Altitude 6893 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 2.3 FT ABOVE LSD	Lithologic description	Summary log
						SEE BORING 10A FOR LOG	SEE BORING 10A FOR LOG
5							
10							
15							
20							
25						BOTTOM OF BORING INSTALLED 5 FT 40 SLOT PVC 20.95 FT SOLID PVC 25.95 FT TOTAL PVC CASING PACKED WITH 2.5 GALLON BUCKETS OF MONTERREY SAND AND 1 GALLON OF BENTONITE PELLETTS.	

Location LEVIATHAN MINE Date AUGUST 5, 1982 Local well number 10C

County ALPINE, CALIF Map HEENAN LAKE CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-09900 Altitude 6893.4 SFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GOUTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21 E

Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1.1 FT ABOVE LSD	Lithologic description	Summary log
						SEE 10A FOR LOG	SEE 10A FOR LOG
5							
10						SAND CAME UP HOLE 10 FT WHEN PILOT BIT REMOVED	
15						BOTTOM OF BORING INSTALLED 5 FT 40 SLOT PVC CASING 11.1 FT SOLID PVC 16.1 FT TOTAL PVC CASING	

Location LEVIATHAN MINE Date AUG 5 1982 Local well number 11A

County ALPINE, CAL Map HEEMAN LAKE Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-09900 Altitude 6890 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Rge. 21E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	AP TOP OF PVC CASING 1.5 FT ABOVE LSD	Lithologic description	Summary log
						GRAVELLEY CLAY,	ALLUVIUM - GRAVELLEY CLAY WASHED MINE WASTE RUSTY BROWN. FILL
				SMOOTH		SANDY CLAY, LIGHT BROWN, WET, LOOSE	SANDY CLAY, LIGHT BROWN, WET, LOOSE, OCCASIONAL GRAVELLEY LAYER. REDEPOSITED MINE WASTE. FILL
5				SMOOTH EASY OCCASIONAL CHATTER		SAME	
10				EASY		SAME	
15				EASY		SAME	
20				EASY BUT SOMEWHAT HARDER		SAME	
25				SMOOTH BUT FIRM		SAME BUT FIRMER AND LESS WATER	
30						FIRMER, DARKER BROWN.	
35							

Location LEVIATHAN MINE Date AUGUST 5-6, 1982 Local well number 11A

County ALPINE, CALIF Map HEEMAN LAKE, CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 473Z-09900 Altitude 6890 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Rge. 21E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action		Lithologic description (ENGINEERING)	Summary log (GEOLOGIC)
						FIRMER CLAY	
40				EASY (NO CUTTINGS)			
45				SLIGHTLY STIFFER			
50				STRONG CHATTER		STRONG WATER RETURN	TOP OF OLD LAND SURFACE? ?? VOLCANICLASTIC BEDROCK SOFT WEATHERED.
55						BOTTOM OF BORING. INSTALLED 5 FT 40 SLOT PVC CASING 50.5 FT SOLID PVC	
						55.5 FT TOTAL PVC CASING PACKED WITH 2, 5 GALLON BUCKETS MONTERREY SAND AND 1 GALLON BENTONITE PELLETS.	

Location LEVIATHAN MINE Date AUGUST 6 1982 Local well number 11B

County ALPINE, CALIF Map HEENAN LAKE, CAL-NEV Scale 1:24000 Lat. _____ Long. _____

District NEVADA, WRD Project number 4732-09900 Altitude 6890 USFS

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21E

Twsp. 10N

Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MPTOP OF PVC CASING 1.7 FT ABOVE LSD	Lithologic description	Summary log
					0.88 FT AUG 20 1982	SEE 11A FOR LOG	SEE 11A FOR LOG
5							
10							
15		NO SAMPLES			SOLID PVC CASING		
20							
25					40 SLOT PVC		
30						BOTTOM OF BORING INSTALLED 6 FT OF 40 SLOT PVC 28.16 FT OF SOLID PVC 33.16 FT TOTAL PVC CASING — 4.85 FT CUTOFF 28.31 FT TOTAL PVC PACKED WITH 2.5 GALLON BUCKETS OF MONTERREY SAND AND 1 GALLON BENTONITE PELLETS.	

Location: LEVIATHAN MINE Date: AUG 9, 1982 Local well number: 11C

County: ALPINE, CALIF Map: MEEKS LAKE, CAL-NEV Scale: 1:24000 Lat. _____ Long. _____

District: NEVADA, WRD Project number: 4782-08900 Altitude: 6890 USFS

Driller: DON FORD Helper: KIRK LAWRENCE Geologist: JOE GUNTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21 E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1.4 FT ABOVE LSD	Lithologic description	Summary log
						SEE 11A FOR LOG	SEE 11A FOR LOG.
5							
10							
15						BOTTOM OF HOLE INSTALLED 5 FT 40 SLOT PVC CASING 11.1 FT SOLID PVC 16.1 FT TOTAL PVC CASING PACKED WITH 2, 5 GALLON BUCKETS MONTERREY SAND AND 2 GALLONS BENTONITE PELLETS.	

5 FT
11.1
16.1

1406

Location LEVIATHAN MINE Date AUG 9, 1982 Local well number 18 A

County ALPINE, CALIF Map HERMAN LAKE Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-0980 Altitude 6896 USES

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GOUTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy		
silt	st	boulders	b	fine	f		
sand	s	clayey	cly	medium	m		
gravel	g	silty	sty	coarse	co		

Rge. 21E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 1-4-FT ABOVE LSD	Lithologic description (ENGINEERING)	Summary log GEOLOGIC
				CHATTER		GRAVELLY SAND, WELL GRADED LIGHT BROWN TO GRAY.	ALLUVIUM- STREAM WASHED MINE TAILINGS.. COBBLES GRAVEL AND SAND, POORLY SORTED
				SMOOTH		SANDY CLAY, LIGHT BROWN, WET, LOOSE.	SANDY CLAY, LIGHT BROWN, WET, LOOSE, MINE TAILINGS, FEES
5				▽		FIRST WATER	
				SMOOTH EASY			
10				SMOOTH EASY		SANDY CLAY, LIGHT BROWN, WET, SOFT	
15				SMOOTH EASY			
						SANDY CLAY, BROWNISH GRAY, WET, FIRMER.	
20				SMOOTH EASY (NO RETURN)			
25				SLIGHT CHATTER STIFFER		SOUPY MUD, RETURN, GRAVELLY LAYER; SAND, WET LOOSE SOUPY.	
30				SAME			
35							

Location: LEVIATHAN Date: AUG 7, 1982 Local well number: 18A

County: ALPINE CALIF. Map: HEENAN LAKE Scale: 1:2400 Lat. _____ Long. _____

District: NEVADA WRD Project number: 4732-09900 Altitude: 6896 USFS

Driller: DON FORD Helper: KIRK LAWRENCE Geologist: JOE GANTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co.

Twsp. 10N Rge. 21E Sec. 22

Depth	Scale	Sample	Graphic log	Drill action		Lithologic description	Summary log
				SPLOOSH			
40				SPLOOSH		(SAND, DARK BROWN, WET, LOOSE.	
45	15 / 35 / 26 / 19	FALL IN				SAND CAME UP IN PIPE ONE FT. SAND, OLIVE DRAB, (OVERDRIVE TO KEEP SAMPLE IN SPOON)	PROBABLE TOP OF ORIGINAL L.S. SANDSTONE, OLIVE DRAB, VOLCANICLASTIC ROCK. SOFT, WEATHERED.

2 in SPOON NO INSERTS

BOTTOM OF BORING

INSTALLED 5 FT 40 SLOT PVC
43.25 FT SOLID PVC
48.25 FT PVC CASING TOTAL

PACKED WITH 2 5 GAL. BUCKETS OF MONTERREY SAND AND 1 GALLON OF BENTONITE PELLETS

Location LEVIATHAN MINE Date AUG. 10, 1987 CALANDER Local well number 18 B

County ALPINE, CALIF Map HEFFMAN LAKE Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4232-08900 Altitude _____

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GONTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21E Twsp. 10N Sec. 22

Depth	Scale	Sample	Graphic log	Drill action	MP TOP OF PVC CASING 0.7 FT ABOVE LSD	Lithologic description	Summary log
						SEE 18A FOR LOG	SEE 18A FOR LOG
5							
10		NO SAMPLES					
15							
20							
25						BOTTOM OF BORING 5 FT 40 SLOT PVC 20 FT SOLID PVC ± FT SOLID PVC ADD ON INSTALLED 5 FT OF 40 SLOT PVC 20 FT OF SOLID PVC ± FT TOTAL PVC CASING PACKED WITH 2,5 GALLON BUCKETS OF MONTERREY SAND AND 1 GAL. OF BENTONITE PELLETS	

Location LEVIATHAN MINE Date AUG 10 1982 Local well number 18C

County ALPINE, CALIF Map MEEHAN LAKE, CALIFORNIA Scale 1:24000 Lat. _____ Long. _____

District NEVADA WRD Project number 4732-09900 Altitude 6896 USES

Driller DON FORD Helper KIRK LAWRENCE Geologist JOE GOUTHIER

Lithologic Symbols

Abbreviations

clay	c	cobbles	cob	sandy	sdy
silt	st	boulders	b	fine	f
sand	s	clayey	cly	medium	m
gravel	g	silty	sty	coarse	co

Rge. 21 E

Twp. 10N

Sec. 22

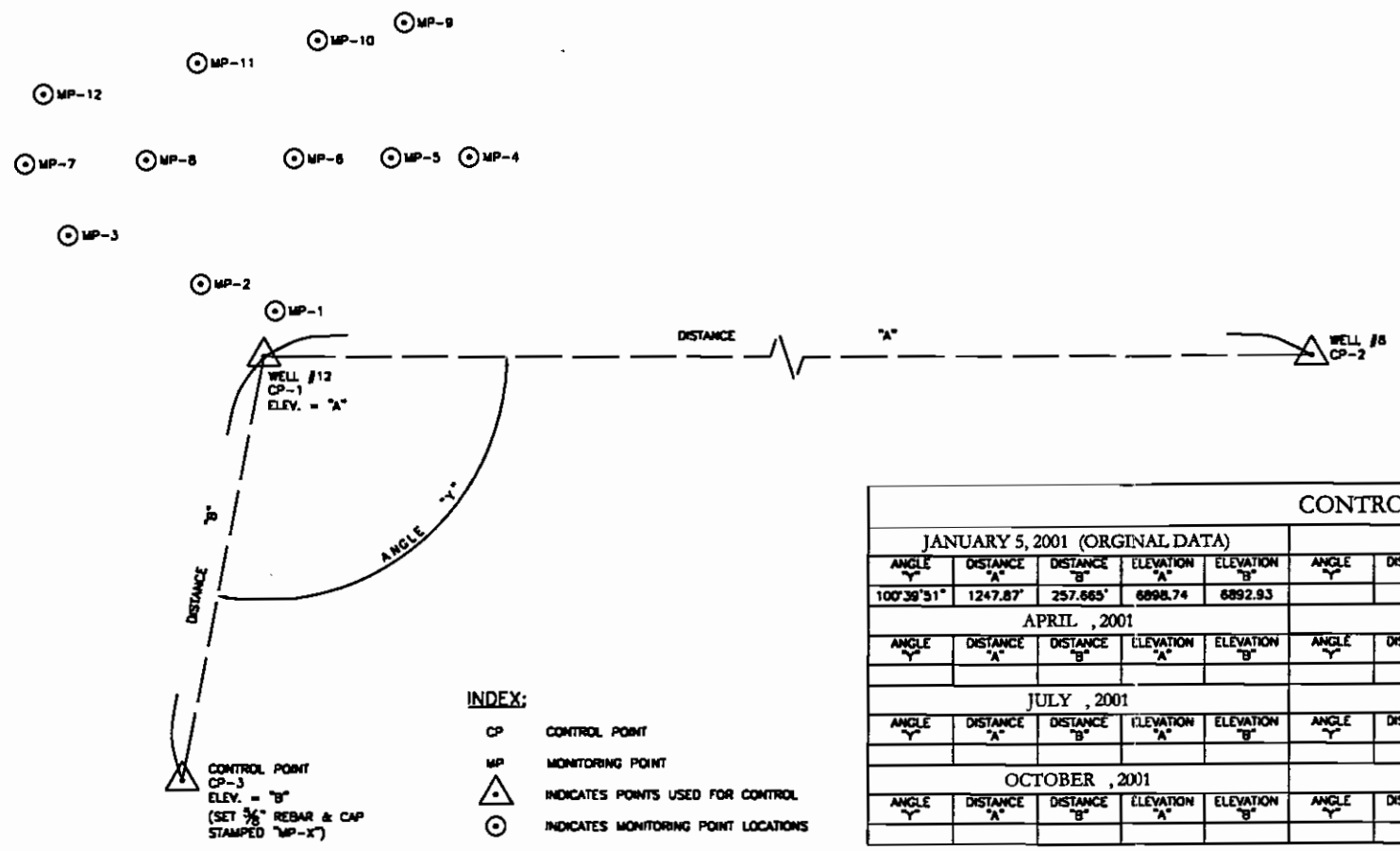
Depth	Scale	Sample	Graphic log	Drill action	FT TOP OF PVC CASING 1.5 FT ABOVE LSP	Lithologic description	Summary log
						SEE 18A FOR LOG	SEE 18A FOR LOG
5							
10							
15						BOTTOM OF HOLE INSTALLED 5 FT 40 SLOT PVC 11.1 FT SOLID PVC 16.1 FT TOTAL PVC CASING PACKED WITH 2,5GAL BUCKETS OF MONTERREY SAND AND 1GALLON OF BENTONITE PELLETS	

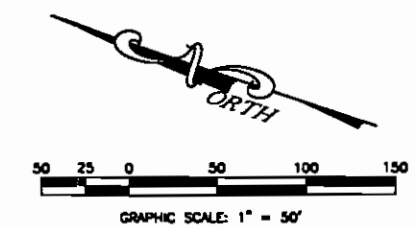
Appendix D

Slope Monitoring Data

LEVIATHAN MINE

MONITORING PLAN





INDEX:

CP	CONTROL POINT
MP	MONITORING POINT
△	INDICATES POINTS USED FOR CONTROL
⊙	INDICATES MONITORING POINT LOCATIONS

CONTROL DATA TABLE

JANUARY 5, 2001 (ORGINAL DATA)					FEBRUARY , 2001					MARCH , 2001				
ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"
100°39'51"	1247.87'	257.665'	6898.74	6892.93										
APRIL , 2001					MAY , 2001					JUNE , 2001				
ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"
JULY , 2001					AUGUST , 2001					SEPTEMBER , 2001				
ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"
OCTOBER , 2001					NOVEMBER , 2001					DECEMBER , 2001				
ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"	ANGLE "Y"	DISTANCE "A"	DISTANCE "B"	ELEVATION "A"	ELEVATION "B"

MONITORING DATA TABLE

JANUARY 5, 2001 (ORGINAL DATA)				FEBRUARY , 2001			MARCH , 2001			APRIL , 2001			MAY , 2001			JUNE , 2001		
MONITORING POINT #	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION
MP-1	283°48'18"	27.80'	6893.555															
MP-2	228°52'37"	57.155'	6883.54															
MP-3	212°03'14"	136.21'	6849.375															
MP-4	318°02'28"	171.41'	6922.765															
MP-5	302°48'42"	141.125'	6905.30															
MP-6	278°38'30"	119.01'	6892.105															
MP-7	219°06'50"	181.86'	6846.985															
MP-8	239°05'07"	136.165'	6870.185															
MP-9	292°58'31"	215.51'	6924.04															
MP-10	279°36'38"	190.47'	6901.555															
MP-11	257°05'36"	178.655'	6876.29															
MP-12	230°06'41"	203.22'	6849.805															

JULY , 2001				AUGUST , 2001			SEPTEMBER , 2001			OCTOBER , 2001			NOVEMBER , 2001			DECEMBER , 2001		
MONITORING POINT #	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION	HORIZONTAL ANGLE	HORIZONTAL DISTANCE	ELEVATION
MP-1																		
MP-2																		
MP-3																		
MP-4																		
MP-5																		
MP-6																		
MP-7																		
MP-8																		
MP-9																		
MP-10																		
MP-11																		
MP-12																		

PREPARED BY:

WESTERN
ENGINEERING & SURVEYING SERVICES
3032 SILVER SAGE DRIVE
CARSON CITY NEVADA 89701
(775) 884-3202 FAX (775) 884-3211

DAVID D. WINCHELL
P.L.S. 3741 (CALIF.)

DATE

Appendix E

Application For Authorization For Use

APPENDIX E
APPLICATION FOR AUTHORIZATION TO USE

GEOTECHNICAL INVESTIGATION REPORT
PHASE I PRELIMINARY SLOPE STABILITY EVALUATION
LEVIATHAN MINE DELTA AREA WASTE PILE
ALPINE COUNTY, CALIFORNIA

Kleinfelder, Inc.
4875 Longley Lane, Suite 100
Reno, Nevada 89502

To whom it may concern:

Applicant understands and agrees that the "Geotechnical Investigation Report, Phase I Preliminary Slope Stability Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California," dated March 16, 2001, Job No. 30-2867-01.001, for the subject site is a copyrighted document, that Kleinfelder, Inc. is the copyright owner and that unauthorized use or copying of said document for the subject site is strictly prohibited without the express written permission of Kleinfelder, Inc. Applicant understands that Kleinfelder, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

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To be Completed by Applicant

_____
(company name)

_____
(address)

_____
(city, state, zip)

_____ _____
(telephone) *(FAX)*

By: _____

Title: _____

Date: _____

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_____ disapproved, report needs to be updated

By: _____
(Kleinfelder, Inc. project manager)

Date: _____

LEVIATHAN MINE 2001 EARLY RESPONSE ACTION, CHANNEL UNDERDRAIN TREATMENT COMPLETION REPORT

(Brown and Caldwell, 2002)

SDMS Doc ID 2029934

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Appendix E Laboratory Analytical Summaries, Reports, and Chains of Custody
Appendix F Photographs

SECTION 1.0
INTRODUCTION

This completion report describes the treatability study of Channel Underdrain (CUD) flow performed by Atlantic Richfield Company (ARC) at the Leviathan Mine site. The CUD treatability test was performed as an Early Response Action (ERA) resulting from the *Administrative Order For Early Response Actions and Remedial Investigation and Feasibility Study* (Administrative Order), U.S. Environmental Protection Agency Region 9 (EPA), Docket Number CERCLA 2000-09-05. The study was conducted in accordance with the Early Response Action Work Plan (Montgomery Watson, 2001) that was submitted to the EPA and the State of California Water Quality Control Board – Lahontan Region (Board) in June 2001.

The Leviathan Mine is a former sulfur mine located on the eastern slope of the Sierra Nevada in Alpine County, California at an elevation of 7,000 feet. The site is located about 25 miles south of Lake Tahoe and six miles east of Markleeville, as shown in Figure 1. The mine began operations in 1863 with the extraction of copper sulfate for processing silver ore in the Comstock mining region of Nevada. The mine operated sporadically under a variety of owners until 1962 when the Anaconda Company sold the mine to Chris and Zelda Mann, who formed Alpine Mining Enterprises and subsequently transferred the mine to Alpine. The mine has not operated since that time. A more detailed description of the Leviathan Mine is provided in the Draft 2002 Site Management Plan (ARC, 2001).

Currently, there are four principal acid-rock drainage (ARD) sources at the site including the CUD, adit and pit underdrain discharges contained in evaporation ponds, the Delta Seep, and the Aspen Seep. If not intercepted and/or treated, these source areas can release ARD to Leviathan or Aspen Creeks. These creeks are part of the Bryant Creek Watershed, which is tributary to the East Fork of the Carson River. The CUD is made up of groundwater flow from underneath Leviathan Creek's concrete diversion channel that discharges at the downstream end of the channel into Leviathan Creek. The data and information contained in this report will assist ARC, EPA and the Board in completing a Remedial Investigation/Feasibility Study (RI/FS) and

system using calcium hydroxide (lime). The treatment lagoon, developed by ARC, is a continuous flow. calcium hydroxide contact system. designed for metal hydroxide and metal oxy-hydroxide precipitation. The system relies on optimization of calcium hydroxide dosage, iron oxidation during mechanical aeration, and an adequate layer of filtered solids within the filter bags. Figure 2 is a topographic map of the area surrounding the treatment pond (Pond #4).

The CUD treatability study builds upon information obtained from ongoing treatment of one of the other principal ARD sources at the site, adit and pit underdrain discharges contained in evaporation ponds. Since the 1999 field season the Board has operated a bi-phasic lime treatment system to treat pond water and increase capacity in the evaporation ponds, thus reducing the potential for pond overflow into Leviathan Creek.

The as-built system focused on the use of standard single-solids phase lime treatment technology, utilizing the following system components:

- Generators, electrical distribution, and electrical control system;
- CUD collection and pumping station;
- Conveyance piping for flow of CUD to the treatment area;
- Treatment components including lime slurry mixing tanks, lime-reaction tank, aeration-reaction tanks, lime delivery pumps, and associated equipment;
- Solids filtering bags and associated piping;
- Pond 4, with custom-fabricated synthetic liner and partitioned with filter screens; and
- Conveyance piping for discharge of treated CUD from the treatment area to Leviathan Creek.

For the CUD treatment test, raw CUD water was collected in a 12-inch conduit running underneath Leviathan Creek, and routed to a temporary collection tank. From the collection tank, the water was pumped up to reaction tanks at the treatment area, where it was mixed with lime using an inline lime slurry supply system, and aerated using air compressors and diffusers. From the reaction/aeration tanks, the water was gravity-fed to filter bags for solids filtration. Lime-treated and filtered water from the filter bags emptied into a settling pond (Pond #4) where

- Housing of power distribution panel and transfer switch inside one of the storage sheds

The continuous treatment system was constructed and operated under ARC's comprehensive Health and Safety Program (Brown and Caldwell, 2001), described in Section 2.0. A detailed description of the construction of the treatment system, including site grading, pumping and pipeline conveyance, electrical and mechanical components, treatment area components, and Pond #4 features, is presented in Section 3.0. System operations including start-up issues, lime dosing, modifications implemented during operations, and shutdown are described in Section 4.0. Sampling frequency and procedures are described in Section 5.0. Laboratory analytical results and field parameters measured during system operation are presented and summarized in Section 6.0. Mass balance calculations for water, solids and constituents are also included in Section 6.0. The results of the field test are discussed, and recommendations for system improvements are presented in Section 7.0. References cited are provided in Section 8.0.

2.2 On-site Implementation

All regular field personnel were Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) trained in accordance with 29 CFR 1910.120(e).

The Site Health and Safety Coordinator briefed all sub-contractor personnel directly involved with construction prior to their first entry onto the site. The site briefing included reviewing the SHSP and any Job Safety Analysis (JSA) sheets relevant to the tasks being conducted. A JSA is hazard identification technique that involves breaking a task down into basic work elements, thus identifying and eliminating or minimizing hazards before the task is performed. The JSAs and a H&S acknowledgment form were signed by all personnel involved with the tasks. Copies of signed JSAs and acknowledgement forms are provided in the on-site SHSP and in the Brown and Caldwell SHSP.

During construction and initial operation setup, safety meetings were conducted with workers and site personnel, at minimum, on a weekly basis. The on-site meetings were conducted to keep personnel apprised of changes to the plan, changes in site conditions or operations, and to address general H&S concerns. Documentation of safety meetings is available in Appendix D of the on-site SHSP and the Brown and Caldwell SHSP.

EPA Level D (modified) was the minimum PPE required during routine operations at the site when there was no potential inhalation or dermal exposure to vapors or corrosives. This level of PPE included the following: steel-toed safety boots, safety vest, safety glasses (when the potential existed for contact from splashing or spraying fluids), and hard hats (when the potential existed for moving or falling objects). Chemical-resistant Tyvek/Saranex coveralls, rubber apron, chemical-resistant face shield, steel-toed rubber or neoprene safety boots, and chemical-resistant gloves were all stored on-site in the office storage shed, and were worn when there was potential dermal or eye exposure to corrosives. Throughout construction and operation, field staff attempted to avoid dermal contact with untreated or treated water.

and continued work activities after the incident occurred. Neither of these incidents were reported within the required 24-hour time frame: the incidents were reported to the Site H&S Coordinator on September 11, 2001. Near-miss incident reports were completed by the Site H&S Coordinator and the worker on September 18, 2001, for both incidents, and a subsequent root-cause analysis was completed. Documentation of the incidents and analyses are provided in Appendix A.

3.2 Pond Lining and Settling Partitions Construction

Prior to pond lining, all of the water that existed in Pond #4 was pumped into Pond #3. Ultimately, Pond #3 water was pumped up to Pond #1 and treated through the Board's bi-phasic system. After grading was completed and the solids in the pond had partially dried, Serrot International of Sparks, Nevada installed a geo-synthetic liner over the Pond #4 bottom and the treatment and filter bag areas. The pond liner, installed to prevent the interaction of treated CUD water with solids on the bottom of the existing pond, consisted of a 6.5-ounce geo-textile fabric overlain by a 60-mil LLDPE fabric. The liner over the treatment and filter bag areas consisted of textured 60-mil HDPE. The textured side was placed face up to provide better footing in potentially slippery work areas.

The liner installation was conducted between July 17 and 20, 2001. Workers first removed rocks from the area that could potentially penetrate the liner. The liner was then rolled out over the pond and treatment area in 23-feet wide sections, which were seamed together with a heat-welding process (Photo 3 and Photo 4, Appendix F). Photo 5 shows the completed liner installation over Pond #4 and/or the treatment and filter bag areas. After initial startup, when approximately one to two feet of water had accumulated in the settling pond, the settling partitions were placed into position. Three partitions divided the settling pond into sections #1, #2, and #3 (Photo 6, Appendix F). The partitions were fabricated of plastic silt fence material, with heavy link chains for anchoring the bottom of the partitions, and enclosed styrofoam floats at the top of the partitions. This configuration allowed the partitions to rise and fall with the changing water level in the pond. Material specifications for the pond liner and settling partitions are provided in Appendix C.

3.3 General Mechanical

Mechanical components of the CUD pumping and treatment system included pumps, mixers, tanks, associated piping, valves, and water level control structures. Belt Engineering installed the majority of mechanical components. Except where noted, all piping and associated fittings were polyvinyl chloride (PVC) type, either threaded or slip-connection. Figure 5 provides the

display, variable frequency drive (VFD) pump speed controllers, and associated piping and flow control valves.

CUD flow was collected from underneath the Leviathan Creek Channel and routed through a 12-inch collection conduit and into the weir box situated alongside Leviathan Creek. From the weir box, a collection tank received the raw CUD water through a 2-inch drain line. The collection tank was situated next to Leviathan Creek, and the pump station control rack was constructed further up on the stream bank, approximately ten feet away from the tank. The pump station control rack was constructed of Unistrut© channel steel, and the VFD motor controllers, switches, tank level display, and control wiring box were bolt mounted on the rack, approximately three to four feet above ground surface (Photo 11, Appendix F). The entire control rack was bolted to a four-inch thick concrete pad approximately three feet square. A plywood cover was constructed over the control rack to shade the level display and VFDs from direct sunlight and potential overheating.

The CUD variable-speed pumps were mounted on the control rack pad, and served as the primary pumps for the system. The submersible pumps, acting as supplementary or backup pumps, were placed directly in the collection tank. From the CUD pump station, a 3-inch PVC pipe conveyed water up to the treatment system. Figure 6 shows the mechanical components and piping of the CUD pumping station.

Electrical wiring was supplied to the CUD pumping station from the distribution panel located in the office storage shed. The supply cords entered a main junction box located on the rack. From the junction box, branch circuit and control wiring was routed to the VFD motor controllers, tank level transducer and display, CUD pumps, and submersible pumps (Figure 7). All exterior wiring consisted of rubber-insulated, outdoor-rated cords, and wiring within the control junction box consisted of thermoplastic-insulated conductors connecting two motor controllers and a time-delay relay for operation of the centrifugal pumps. All wiring and control devices were sized for ampacity in accordance with the National Electric Code.

The two lime slurry tanks were equipped with paddle-type mixers to stir the lime solution. The two mixer motors were controlled either manually or automatically by two respective time clocks next to the distribution panel in the office storage shed. The minimum "on" or "off" cycle for each mixer motor was approximately 30 minutes.

Air was supplied to the three reaction/aeration tanks RT1, RT2, and RT3 by the air compressor station, a bank of four air compressors located near the reaction tanks (Photo 13, Appendix F). A manifold connected the four compressor outlet lines together, and valves allowed individual control of each line (Photo 14, Appendix F). The air compressors ran continuously, and were controlled manually from switches located at the air compressor station. Aeration was provided to the three reaction tanks through ½-inch diameter tubing from the air compressor station. Low-pressure air (5 psig) was used for mixing and agitation of the reaction tanks and as a source of oxygen for oxidation of various target metals. The air was delivered to flexible membrane fine bubble diffusers placed on the bottom of each reaction tank. Each diffuser was connected to ¾-inch diameter flexible hoses from the air compressor station. In addition to the direct air injection, each reaction tank also contained a small submersible recirculation pump equipped with a venturi eductor that provided additional mixing and aeration of the process water. Photo 15, Appendix F, is a view above reaction tank RT1, showing the lime and air delivery lines and mixing.

After lime treatment and aeration, process water exited the bottom of RT3 through a 3-inch diameter line, and entered an "H" structure and stand-pipe, which were constructed in-line between the aeration tanks and filter bags (Figures 3 and 5). The purpose of the "H" structure was to limit the water elevation in the reaction tanks and prevent siphoning. Additionally, the "H" structure provided a convenient location for placement of a pH probe in one of the vertical pipes, enabling frequent periodic measurement of pH between the treatment and filtering areas.

Following mixing and aeration in the reaction tanks (Photo 9, Appendix F) and routing through the H-structure, the effluent was gravity fed through a vertical stand-pipe located just before the filter bags. The purpose of the stand-pipe was to monitor and limit the head pressure on the filter

SECTION 4.0
SYSTEM OPERATION

Pumping of CUD water began on August 2, 2001 and continued until October 1, 2001, a period of 60 consecutive days. The site and system were attended to each day by the operations crew, consisting of staff from either Belt Engineering, Pioneer Technical Services, or Brown and Caldwell. Overall project management was conducted by ARC. Operators conducted routine monitoring of the treatment system each day and recorded observations and measurements in log books. System status checks included:

- Date and time;
- System current flow and accumulated flow;
- pH at influent, reaction tanks, "H" structure, filter bag effluent, pond outlet, and discharge;
- Air dispersion/mixing and color of water in reaction tanks;
- Lime pump on/off status, dosing feed rate, pump strokes, and stroke length;
- Lime slurry mixing time;
- CUD pump speed and submersible pump on/off status;
- CUD collection tank water level;
- Generator hours, fuel level, temperature, voltage, and oil pressure;
- Number of air compressors operating and air pressure; and
- Other comments or observations.

Logs for general operation, system status checks, generators, lime pumps and dosing rates, and pH instrument calibration are provided in Appendix B. Schedules of routine operations and maintenance, standard operating procedures for overall system power startup and shutdown, generator servicing, and individual equipment startup and reset are provided in Appendix D.

According to USGS gaging data, CUD flow at the Leviathan Mine site ranges from approximately 12 to 30 gpm. During the period of operation of the treatability study, CUD flow

the water's edge of the pond in Sections 1 and 2, and near the pond discharge outlet in Section 3. All collected water samples were tested for field parameters with portable meters, and laboratory samples were collected for analysis of metals (dissolved and total), sulfate, acidity, alkalinity, hardness, and total dissolved solids. Treated effluent that met the water quality standards was returned to Leviathan Creek through the existing pond overflow/discharge conduit. Treated water that did not meet water quality targets was treated with another dose of lime and recirculated back into Pond #4, Section 1. Figure 3 is a process flow diagram of the ERA CUD Treatment process.

To facilitate technology testing and optimization, the system design allowed for flexible operation. Cell dividers (silt screens) were moveable to enable adjustment of cell configurations. Lime dosing rates were adjusted to achieve desired pH and water quality. Equipment was cord-and-plug connected to allow re-positioning if necessary. The pumping rate of CUD water to the treatment area was variable, either automatically according to actual CUD flow, or manually. Backup submersible pumps were installed in the event of normal CUD pump failure or inability to handle CUD flow.

The system was started up on August 2, 2001. Initially, CUD water was pumped from the CUD pump station until the reaction tanks were filled to treatment level. After checks and observations were completed on the pumping components of the system, lime dosing was initiated. The following sections provide specific descriptions of operation for each individual component in the treatment system.

4.1 CUD Collection and Pumping

The CUD pumping station received CUD water from the existing collection pipe and CUD weir box. The water was collected in a 500-gallon collection tank, and then pumped out of the tank with centrifugal pumps up to the treatment and filter bag areas along the north side of Pond #4 (Figures 3 and 5). The water level in the CUD collection tank was continuously monitored by a tank level probe (transducer), which allowed variable-speed pumping of the CUD water with variable frequency drive (VFD) motor controllers.

CUD Pump Station-Initial Startup

Initial static pressure at the CUD pumps was recorded, and CUD pump #2 was turned on and operated manually at constant speed (approximately 50% of maximum speed). The pump speed was increased incrementally until maximum speed was achieved. At each speed, the system pressure and flow were observed and recorded. A correlation was established between pump speed, registered at the variable frequency drive (in hertz), and flow, registered at the flow meter (Figures 12 and 13). This correlation assisted in approximating system flow while standing at the CUD pump station. The water level in the CUD weir box was monitored to ensure that the water did not reach overflow (above the v-notch) or underflow (below the top of the discharge port) condition. Radios were used between personnel at the CUD pumping station and the treatment area to convey observed pressure and flow readings, respectively. For the first two days of operation, the CUD pump #2 was operated manually instead of being controlled by the collection tank level transducer. The pump speed was set to a corresponding pump rate that was slightly less than the total flow from the CUD. This procedure was implemented so that the CUD pump would not run dry. The difference in flow was accommodated by the periodic operation of one of the submersible pumps in the CUD collection tank.

After two days, a relatively steady-state pumping rate was determined, and the VFD controller was switched to automatic. Pumping rate and collection tank levels were observed over the next two days, resulting in establishment of a VFD setpoint for collection tank water level. The setpoint was programmed into the VFD controller, enabling the CUD pump(s) to operate at whatever speed was necessary to keep the water level in the tank at setpoint. Both setpoint and actual tank water level were displayed at the control rack, on the VFD controller display and tank level probe display, respectively.

Setup adjustments were also performed on the submersible pumps to ensure their operation at proper collection tank water levels. The float switch on each pump was raised or lowered until the pump turned on and off at the desired tank water level, some inches above normal CUD pump operation. A schematic of CUD pump and submersible pump on/off operation relative to collection tank levels is provided as Figure 11.

2001. The initial lime dosing was accomplished using the lime dosing pumps, set up next to their respective lime slurry tanks, with ¼-inch diameter tubing to convey the slurry from the slurry tanks into reaction tank RT1 (Photo 15, Appendix F). The initial lime-dosing rate was 1,472 mg lime per liter (mg/L) of CUD water. During the first few days of operation, the lime pumps experienced frequent clogging of delivery lines and pump heads. Cleaning out the plugged lines or pump head, and restarting the pumps mitigated these problems.

The lime slurry was delivered to the site as a 45% solution. This solution was used initially, but was later diluted to an approximately 25% solution to facilitate pumping of the slurry through the ¼-inch diameter lines. Tank LS1 was used as the delivery tank, and the intake lines from the slurry pumps were positioned in LS1 to withdraw lime slurry. Tank LS2 was used as a backup storage tank for slurry, which could be transferred to LS1 as needed. On September 8, 2001, an additional 1,015 gallons of lime slurry was delivered to replenish the supply in the tanks LS1 and LS2.

4.4 Reaction Tanks

From the flow meter, water was routed into a series of three 925-gallon HDPE reaction tanks RT1, RT2, and RT3. Lime slurry was added to RT1 and RT2 through a metered dosing system, and aeration was performed in RT1, RT2, and RT3. The three reaction tanks were connected in series with 3-inch diameter hose with the bottom of the previous tank feeding into the top of the next. Lime slurry solution was delivered from the slurry tanks to the reaction tanks via two positive-displacement chemical pumps, manually adjusted to a pre-determined delivery rate. Turbulent mixing and aeration occurred as air was delivered to each reaction tank through air diffusers positioned in the bottom of each tank. Each reactor tank had a theoretical hydraulic residence time of approximately 48 minutes (900 gallons operating volume at 18.5 gpm). The system contained valves that allowed any combination of lime addition and/or aeration in each of the three reaction tanks, and the ability to control hydraulic residence (contact) time.

Reaction Tank RT1 was originally planned as the sole tank for introduction of lime slurry. However, problems with armoring of the added lime with chemical precipitates led to a less than

4.6 Filter Bags

From the hydraulic structures, the water was gravity-fed to a series of six 15-feet wide by 15-feet long fabric filter bags for filtration of particles. The filter bags were situated on a lined, bermed pad, with a breach in the berm to allow filtered water to flow openly over the liner from the bags to Pond #4. The entrance to each bag contained a valve to allow isolation from the system or to adjust flow into the bag. The valves allowed the operator to shut off flow to a particular bag while it was being disconnected from the system, and a new one installed. The filter bags relied on the buildup of a sludge layer inside the bag to filter out progressively smaller particles. The filter bags were approximately two feet maximum thickness when completely expanded with water flowing through them.

Filter Bags – Change-out

Observation of the water level in the stand-pipe, the quantity and appearance of water flowing from the bags, and the physical appearance of the inflated bags, aided operators in deciding when to take a filter bag offline and/or add another bag. As the layer of trapped particles coated the inside of a new bag placed online, the filtering efficiency increased, and the water became visibly clearer each day. This phenomenon also resulted in increased expansion and inflation of the bag as the flow through the bag became more restricted.

4.7 Settling Pond #4

Lime-treated and filtered water from the filter bags emptied into the settling Pond #4, where settling of remaining particles and potential further metals precipitation occurred. Particle settling was facilitated by the routing of the treated water through three cells, defined by the placement of partitions (silt screens) in the lined pond (Figure 3). To facilitate technology testing and optimization, the system design allowed for flexible operation (i.e., the pond partitions were moveable to enable adjustment of section configurations). Water from the filter bags entered Section 1 first, where settling of relatively dense particles that were not filtered out in the bags occurred. The water then moved through Sections 2 and 3, where further particle settling of less dense particles occurred. On calm days, the difference in water turbidity from

CUD Pump Station-Modifications

During the initial testing and startup of the CUD pumps, it was discovered that CUD pump #2 pumped at a maximum flow rate of 21.1 gpm, while CUD pump #1 pumped at a considerably lower rate of 18.3 gpm. Because of piping restrictions, running both pumps at the same time resulted in no net increase in flow. Therefore, CUD pump #2 was used as the primary pump for most of the operating period. CUD pump #2 was taken off line on September 28, 2001 because of the pump's inability to maintain flow and remain primed. CUD pumping for the remaining 2.5 days of operations was accomplished with the two submersible pumps in the collection tank.

After approximately three days of operation, the piping configuration at the CUD pump station was changed to improve pumping efficiency. The new configuration would also prevent air from entering the CUD pump when the weir box water level dropped below the top of the 2-inch discharge port. Instead of drawing moving water from the line between the weir box and the collection tank, the CUD intake lines were moved to the inside of the collection tank (Photo 18, Appendix F). This modification allowed relatively quiescent water uptake, reducing the intake of air bubbles, and allowing the weir box water level to drop to below the discharge port without affecting the normal performance of the CUD pumps.

The CUD collection tank water level probe was changed after approximately four days of operation. The existing elevation of the probe did not allow adequate monitoring of the range of water levels normally being observed in the collection tank. The probe was removed from the still well in which it was installed, and the length of the still well was increased approximately 10 inches. The probe was re-installed in the well, at an elevation that allowed monitoring from 10 to 33 inches of tank height.

Treatment Area - Modifications

As a result of low pH values and suspected inadequate oxygen transfer, different types of air diffusers were built and installed in reaction/aeration tanks RT1, RT2 and RT3. The initial diffusers were T-shaped and constructed of 1.5 -inch PVC pipe with 0.125-inch diameter holes

pumps LM1 and LM2 withdrew lime slurry from a short 2-inch diameter standpipe installed on the suction side of the lime recirculation pump. This arrangement prevented solids from accumulating in the intake lines of the lime pumps, which had been causing plugged lines or pump heads. The recirculation pump was generally operated for a few minutes each day to clean out the solids buildup in the lines.

Early problems with clogging of lime slurry lines with lime solids resulted in the fabrication of screen filters to filter out precipitated lime that had dried on the interior surface of the lime slurry tanks and become mixed in the slurry. The filters were effective, but were difficult to keep on the end of the intake lines because of the agitation caused by the mixer blades inside the slurry tanks. A peristaltic pump was placed into service when problems with clogging of pump heads began to occur in the LMI positive displacement slurry pumps. Eventually, the original pump heads were replaced with heads that were better suited for transfer of the slurry solution, and the peristaltic pump was removed from service.

Lime dosage was measured in terms of milligrams of lime per liter (mg/L) of raw CUD water. The lime delivery tubing was temporarily pulled from the reaction tank, and 500-mL aliquots of lime slurry were pumped over a recorded time period, to determine the slurry volumetric pump rate. The dosage was then estimated from slurry lime concentration, wet density of the lime slurry. and the volumetric pump rate. Target dosages were difficult to maintain due to frequent plugging of the LMI pump heads or lines by solids in the slurry. A complete record of lime dosage over the course of the treatment trial is summarized on Table B1, Appendix B. The lime pump calibration log is provided in Appendix B. After switching to two stage lime addition, the target dosage for achieving pH adjustment and treatment objectives was reduced from the initial 1,472 mg/l to approximately 1,000 mg/l. Average lime dosage over the entire trial was 1,010 mg/l. A more complete discussion on liming dosing results is provided in Section 6.4.

Discharge- Modifications

The existing pond outlet discharge line was a 12-inch PVC pipe connected to a discharge snorkel in the northwest corner of the pond. The pipe was routed underground from the Pond #4 outlet

After the reaction tanks were allowed to drain down through the filter bags, pond water was also pumped through the reaction tanks and associated piping to clean out those components. The remaining lime slurry in the storage tanks was slowly pumped into the suction intake of a recirculation line that was recirculating water in Pond #4. Final samples from Pond #4 were collected on October 4, 2001. Water from Pond #4 was pumped into all of the empty tanks until each tank was approximately half-full, to prevent movement of the tanks by strong winds over the winter.

All equipment that could be readily disconnected was moved to one of the storage sheds and stored for the winter. The air compressor station, flow meter, lime delivery pumps, pH probe, and recirculation pumps were disconnected from the treatment system and stored in the storage sheds for the winter.

At the CUD pumping station, the control rack was removed from the concrete pad it was mounted on. The entire rack, including all electrical components, was stored in a storage shed for the winter. The CUD pumps were disconnected and removed from the pad, and sent back to the manufacturer for repair or replacement. The submersible pumps were removed from inside the CUD collection tank, drained of water, and stored in one of the storage sheds. All rental equipment including the generators, fuel tank, dumpsters and portable toilet were removed by the vendors.

Some changes were made in the field, to address special conditions, or to provide a more up-to-date account of water quality. These modifications included:

1. Labeling the sample bottle immediately after collecting the water sample instead of before, to avoid loss or disfigurement of the label from exposure to pond water while being submerged,

2. Rinsing of the sample collection bottle three times prior to actual sample collection in a location downstream of where the sample was to be collected, to avoid collecting disturbed water.

Monitoring procedures are described below.

Field Parameters

Field information was recorded in a field notebook. For each sampling event, the following information was recorded in the field notebook:

- Weather conditions
- Calibration performed and calibration test results
- Sample location
- Sampling date and time
- Any unusual conditions, special activities, or other pertinent observations
- Field parameter measurements (pH, water temperature, conductivity and flow)
- Drift test results (an after-sampling check of instrument drift from calibration)

Field Sampling

Prior to sampling, the pH probe was calibrated and the conductivity probe was checked with a standard. After sampling was completed, a drift check was performed with each instrument, using the same standard solutions used to calibrate. The purpose of the drift check was to assess the loss of accuracy that often occurs when measurements are performed at different locations.

Field parameters were measured after each sample was collected, to avoid possible cross-contamination at the sample location. Pond measurements were collected from two to three inches below the pond surface, approximately two feet off the shoreline. Care was taken to

to prevent disturbance of the pond sediment or soil along the bank that could roll down into the pond. Latex gloves were used to handle bottles and equipment throughout each sampling event. The gloves were changed between each sample location.

Both total metals (unfiltered) and dissolved metals (filtered) samples were each collected in 500-milliliter (mL) bottles. Filtered samples were field-filtered using a hand-held vacuum apparatus and 0.45 µm disposable cartridge-type filters. A new filter was used between every sample. Laboratory-supplied aliquots of nitric acid were added to each bottle for metals analysis. Non-metals samples were collected in 1,000-mL bottles, unfiltered, with no acid preservation.

Collection of quality assurance/quality control (QA/QC) samples included one blank (distilled water) and one duplicate (randomly chosen) for each sample cooler sent to the analytical laboratory. The QA/QC samples were collected and prepared in the same manner as the primary samples, with the exception of the blank sample. Sample bottles for the blank were not triple-rinsed prior to being filled, so that any contamination from bottles alone would be detected.

Laboratory Analyses

Collected samples were labeled, logged on a chain-of-custody form, sealed in zip-loc© bags, and placed in a cooler with ice. Cooler ice was contained in double zip-loc© bags to avoid leakage during shipment. All samples were kept secure in the custody of the sampler until they were transferred to the project laboratory via a certified carrier. Typical sample shipments were sent to the laboratory within 24 hours of collection, although occasional delays were encountered, resulting in slightly longer shipping times. Chain-of-custody protocol was followed throughout the transport process.

Water samples were analyzed for dissolved metals, total metals, sulfate, acidity, alkalinity, hardness, and total dissolved solids. Laboratory analyses were performed by HKM Labs of Butte, Montana. Analyses were performed in accordance with the June 2001 ERA Work Plan (Table E-1, Appendix E).

- Sample identification
- Date and time of sample collection
- Sample matrix
- Number and volume of sample containers
- Analyses requested
- Filtration completed or required
- Method of shipment

5.3 Sampling Schedule

Water samples were collected from the surface of Pond #4, and the raw CUD influent, once per week. Samples of treated discharge to Leviathan Creek were collected daily when discharge was occurring between the period September 13 through October 3, 2001, to provide an up-to-date account of discharge water quality. Table 2 provides the monitoring locations and sampling schedule for the CUD treatment system.

below effluent discharge objectives throughout the project (Table 4). These effluent discharge objectives are consistent with the Board's discharge requirements for the bi-phasic pond water treatment, and were identified in Table 1 of the June 2001 ERA Work Plan

6.2 pH, Conductivity and Temperature Results

A summary of Pond #4 discharge field parameters from September 12, 2001 to October 3, 2001, is provided as Table B2, Appendix B. Table 6 provides a statistical summary of these data, along with influent summary statistics. Figure 12 is a graph of influent and effluent (discharge) pH during the treatment study. The influent (raw CUD water) pH, remained relatively unchanged throughout the study, an average 4.6 pH units. The effluent (discharge to Leviathan Creek) pH varied between 4.7 and 9.3, with an average 8.3. The minimum pH value of 4.7 likely occurred as a result of an apparent breach in the discharge conduit below the Pond #4 liner, conceivably allowing discharge water to come in contact with soil below the pond liner. After bypassing this conduit, pH values returned to the 8.3 to 9.3 range. Influent and effluent temperatures ranged from 53.1 to 60.8 degrees Fahrenheit. Influent conductivity and effluent conductivity were relatively unchanged, as indicated in Table 6, ranging from 2030 to 2870 micro-siemens per centimeter.

6.3 Flow and Pressure Results

Figures 13 and 14 are graphs of CUD pump flow and pressure relative to pump speed (in terms of hertz) for CUD pumps #1 and #2, respectively. The maximum speed of the CUD pumps corresponded to 60 Hz. As previously stated, pump #2 was used as the primary pump throughout the project. Figures 13 and 14 indicate that pump speeds (frequencies) of 47 hertz and 43 hertz were necessary to initiate flow through the system at CUD pumps #1 and #2, respectively. Changes in flow and system pressure as a function of pump speed were each linear in relationship. The maximum pump speed resulted in a CUD flow of 27.7 gpm and a system pressure of 23.0 psi.

manganese concentrations were also significantly reduced. Lesser concentration reductions were achieved for other constituents. Average calcium concentrations were higher in the effluent in response to lime addition. Average total sulfate concentrations were higher in the effluent samples compared to influent concentrations, potentially due to evaporation in Pond #4, and consequent concentrating of sulfate.

6.6 Water Mass Balance

The amount of water processed through the system was tracked via a cumulative flow meter on the raw CUD influent line, through flow calculations based on recorded depths in a discharge weir over time, and by a surveyed stage level gage in Pond #4. The influent flow meter showed a total of 1,432,733 gallons of raw CUD influent was treated, and effluent flow calculations estimated 1,149,731 gallons of the treated water effluent was discharged to Leviathan Creek. The effluent accumulative flow was calculated by multiplying depth of water in the discharge weir by weir dimensions to establish a volume discharge over time. The water depth in the weir was electronically recorded on regular timed intervals by a transducer and automatic data logger.

The Pond #4 level gage predicted approximately 159,000 gallons of treated water remained in Pond #4 on October 4, 2001, the day after discharging was completed. The 283,002 gallon difference between measured influent and effluent accumulative flows compared to the estimated 159,000 gallons of water remaining in Pond #4 can be explained by net evaporation of water from Pond #4 combined with measurement accuracy limitations associated with the Pond #4 level gage, and to a lesser degree the influent/effluent flow measurement devices. The daily water flow record is summarized in Table B3, Appendix B.

6.7 Solids Mass Balance

As noted previously, testing of filter bag solids density and chemistry was delayed to allow the solids to densify over the winter. However, in the absence of test results, the mass of solids produced following lime treatment of water from the CUD and their chemical properties can be approximated using two theoretical calculation methods. The first method uses influent and effluent total dissolved solids (TDS) concentrations to estimate the mass of material that

production rates estimated by Methods 1 and 2 (867 mg solids per L water treated), the total volume of water treated over the study period and assuming that all of the resulting solids are retained in the filter bags, the total amount of solids produced and retained within the bags was 10,369 lbs.). Based on the October 19 estimated bag volumes, the mass of solids per total wet volume of the solids (i.e. the dry bulk density) retained in the filter bags was 0.08 grams per cubic centimeter or 5.0 lbs/ft^3. The wet volume of solids produced per volume of treated influent was a 0.01 liter of solid per liter of treated influent, or 0.0015 ft^3 solids per gallon of treated influent.

These estimates of solids accumulation are very sensitive to estimates of the solids dry bulk density. The dry bulk density of the solids is likely to increase over time, because of compaction and other physical and chemical processes. Therefore, it is suggested that the material within the filter bags be sampled at the initiation of the next field season to assess the dry bulk density of the solids in the filter bags.

6.8 Effect on Leviathan Creek

The daily average pH of treated water discharged to Leviathan Creek from Pond #4 ranged between 6.4 and 9.3 (with the exception of September 16 when a breach in the discharge conduit apparently caused a temporary pH drop in a small volume of discharge; the discharge conduit was subsequently replaced with a pump and new discharge line). Table B2 provides a summary of Pond #4 discharge field parameters, including pH. Since the discharge water pH was slightly above 9.0 on September 17 and 18, it was decided in consultation with the EPA that field pH measurements would be collected in Leviathan Creek. Therefore, in addition to water quality monitoring of influent and effluent concentrations, pH was also monitored in Leviathan Creek above and below the Pond #4 discharge point when treated effluent was being discharged. The pH data, shown in Figure 16, indicates that Leviathan Creek pH stayed within a range between 5.6 and 7.8 downstream of the discharge point (at Delta Seep) during those days when discharge was occurring.

SECTION 7.0
RECOMMENDATIONS

This section presents recommendations to improve the treatment system for the channel underdrain flow tested during the 2001 Early Response Action.

7.1 Lime Addition

Consideration should be given to automatic control of the lime feed pump(s) by pH monitoring, using a pH setpoint. There are two significant advantages to this approach. Automated lime feed, if calibrated and operating properly, eliminates the need for daily supervision and manual adjustment of the slurry feed rate based on observed pH. Secondly, pH adjustment could occur more frequently, resulting in a more precise pH target, with less swings in pH because of uncorrected feed rate. With the appropriate software and programmable controller, it would be possible to utilize the Troll 8000 probe that was installed in the "H" structure. This probe needed cleaning only once per week, and was able to maintain accuracy within 0.1 pH standard units. The pH/lime system should be capable of adjusting the delay between "real-time" pH and addition of lime, and allow for pH drift +/- a certain fraction of pH point.

If effluent pH values do not achieve the discharge objective for pH over a set period of time, a recirculation pump could be programmed to turn on and begin recirculating a portion of the Section 3 pond water through the treatment system at some point. The point of re-introduction should be determined empirically, and may be simply through the settling pond again, or through one or more reaction tanks.

Consideration should also be given to the use of a 0.5-inch diameter air diaphragm pump for lime addition instead of the LMI pumps. The duration of the pump on/off cycles could be controlled by the pH monitor/controller. During the "on" part of the cycle the pump could be set at a high enough rate to flush out both the suction and delivery lines.

and/or ice can cut off access to the site via road during the winter. The site is accessible by snowmobile, but daily checks during winter months creates potential health risks associated with cold-weather, particularly if a maintenance person is alone.

The presence of surrounding mountain terrain may preclude the use of conventional tower radio signals for off-site monitoring, possibly requiring dependence on a satellite signal/relay system.

Power System

A reliable long-term power source is critical to year round operations. If the system is to be powered by generators during winter months, then up to 6 months of fuel storage capacity should also be provided.

Lime Storage

Sufficient storage capacity (i.e., up to 6 months) of 45 percent lime slurry should be provided. (This would be approximately 11,000 gallons, based on the average 60 gallons of lime slurry used each day during the 2001 treatment study). Potentially lower average CUD flows would require less volume of slurry storage. A properly sized mixer would also need to be provided.

Site Access

Even with remote monitoring and automation, some periodic maintenance will still be required. Personnel performing maintenance activities will need a safe means of accessing the site. Vehicles such as snowmobiles or snow cats, and the means to transport these vehicles on the highway or safe storage, may be required.

Storage Container Access

Personnel performing maintenance activities on-site will need access to equipment and supplies stored in the storage containers. The storage containers should be raised up off the ground and placed on railroad ties. The area in front of the doors should have a covered porch built to keep the snow off and the open areas between the storage containers should be covered to provide additional protection from the elements.

7.4 Solids Management

Filter Bag Area

The filter bag pad probably needs to be enlarged to provide enough capacity for year round operations, including potential housing of bags in an insulated building. Consideration should also be given to separating the bags into isolated cells so that full bags can dry out and be removed while other bags continue to receive water.

7.5 Electrical Equipment

After some initial trouble-shooting during the first two days of operation, the 30,000 watt generators performed well throughout the project and could be expected to perform satisfactorily under similar conditions. The transfer switch performed as required, and allowed servicing of the main generator while the backup was running. The use of heavy-duty cords with outdoor-rated plugs instead of conduit and wiring for branch circuit power enabled greater flexibility in terms of equipment mobility (e.g., re-positioning the lime slurry pumps) and setup. It would be advantageous to use cords with plugs again, although the plugs should be located outside of the bermed treatment area to prevent them from becoming submerged if the area were to fill with water.

7.6 Mechanical Equipment

The CUD pumps, even initially, did not achieve the flow rate that they were rated for under the total head that was present during pumping. The reason(s) for this was never clear, although debris found in one of the pumps after shutdown certainly had a deleterious effect. A regular maintenance schedule for the CUD pumps is recommended, including cleaning out the volute, discharge port, and inlet port. This should probably occur approximately every three to four months, based on the amount of ferric precipitate and dirt observed in the pumps during disassembly.

Based on the effluent chemistry results, the reaction tanks were of adequate size and proportion to provide enough hydraulic residence time for the CUD flow experienced during the project

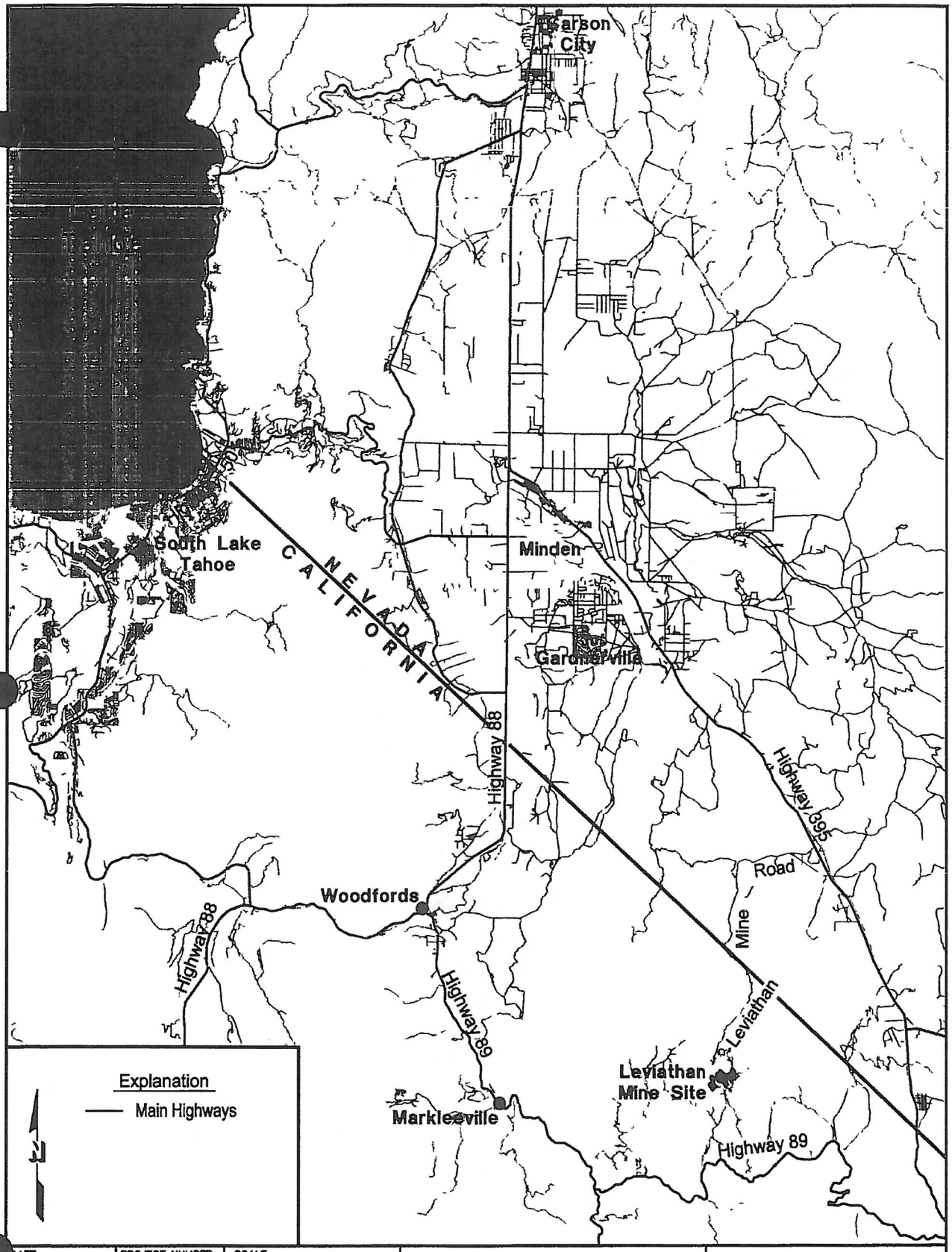
SECTION 8.0
REFERENCES

Montgomery and Watson, 2001. *Leviathan Mine Site. Early Response Action Work Plan. June 2001.*

Montgomery Watson Harza, December 2001. *Leviathan Mine Site 2002 Site Management Plan, prepared for ACRO Environmental Remediation, LLC*

Tetra Tech EM Inc., January 2002. *Draft Oversight Summary Report, Leviathan Mine Superfund Site, Alpine county, California, prepared for U.S. Environmental Protection Agency, Region IX.*

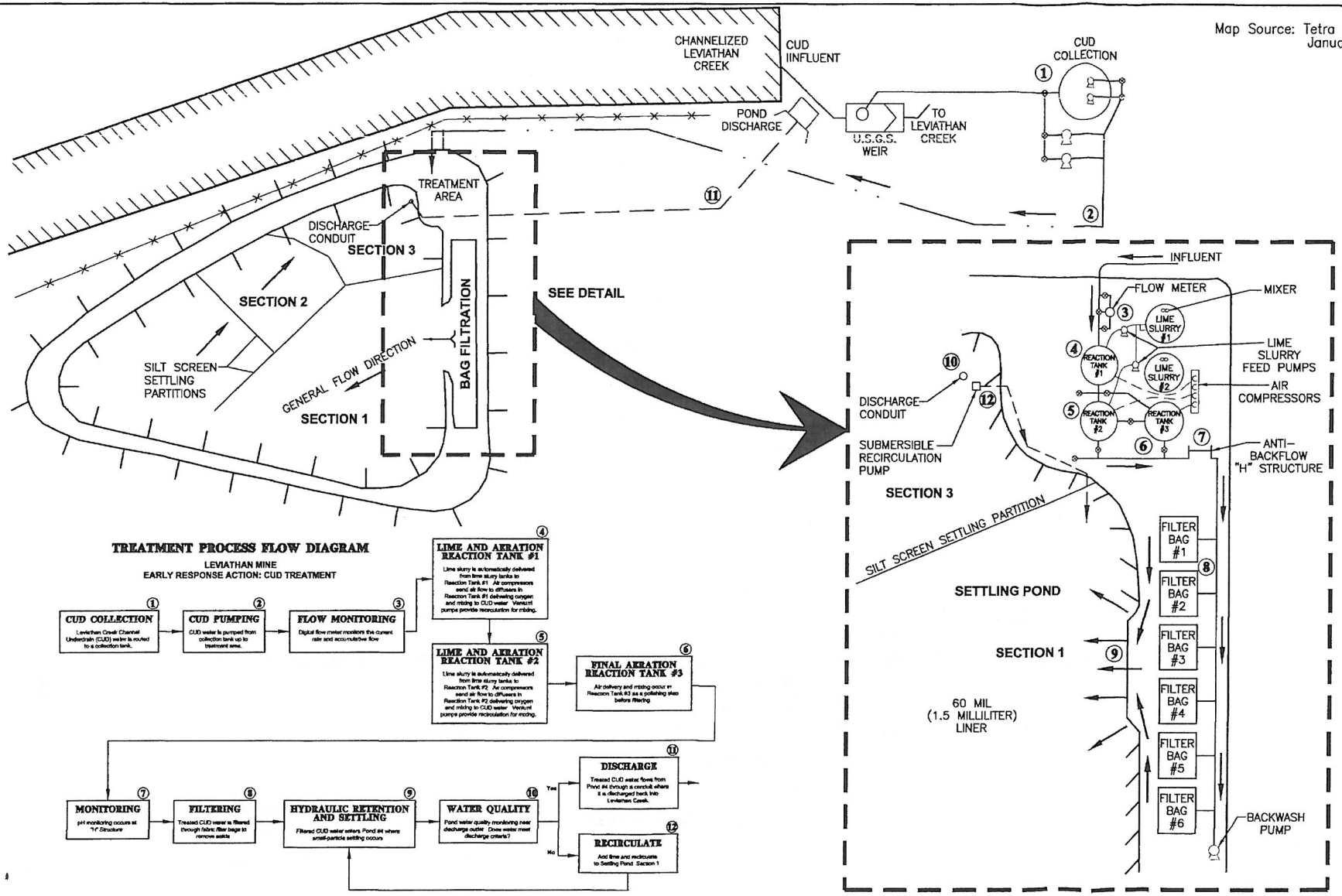
Brown and Caldwell, 2001. *Leviathan Mine 2001 Early Response Action Site Health and Safety Plan, July 2001. Prepared for ARC Environmental Remediation, LLC.*



DATE:	PROJECT NUMBER:	SCALE:		
OCTOBER_2001	21478	0 10,000' 20,000 SCALE IN FEET	LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM	Figure 1 Site Location Map
BROWN AND CALDWELL Carson City, Nevada				

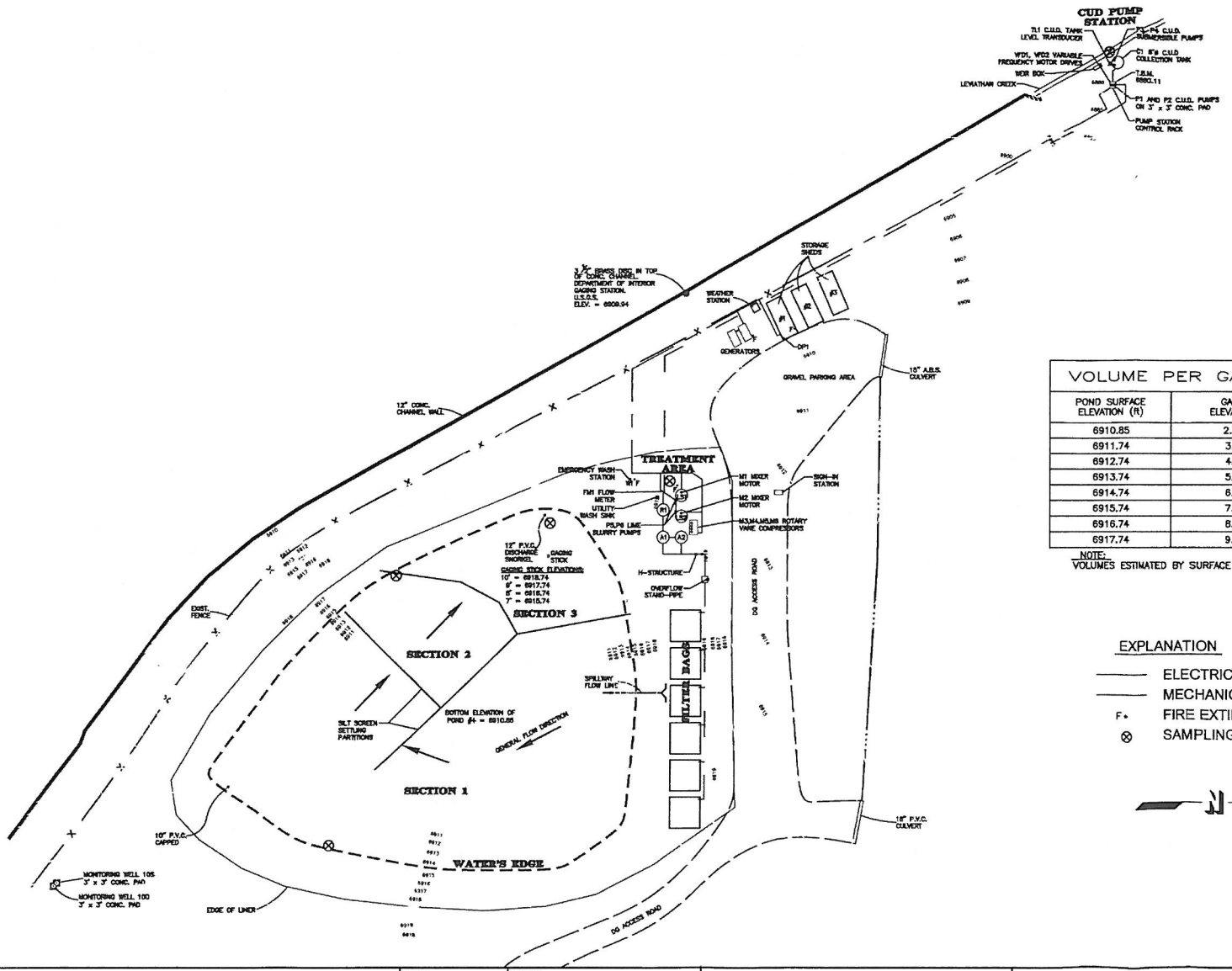
Carson City Cad: P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478001.dwg (1=1) 02/18/2002 15:38:35 RJJ

Map Source: Tetra Tech EM, Inc.
January 2002



BROWN AND CALDWELL Carson City, Nevada	DATE: Feb. 2002 PROJECT NUMBER: 21478	LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM	**Figure 3** **Treatment Process Flow Diagram**

Carson City Cad P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478003.dwg (1=1) 02/16/2002 15:42:17 RJJ



VOLUME PER GAGE ELEVATIONS		
POND SURFACE ELEVATION (ft)	GAGE ELEVATION	VOLUME (ft^3)
6910.85	2.11	X
6911.74	3.0	16,772
6912.74	4.0	37,671
6913.74	5.0	60,634
6914.74	6.0	85,906
6915.74	7.0	113,728
6916.74	8.0	144,189
6917.74	9.0	177,645

NOTE:
VOLUMES ESTIMATED BY SURFACE AREA AVERAGING.

EXPLANATION

- ELECTRICAL LINES
- MECHANICAL LINES
- F• FIRE EXTINGUISHER
- ⊗ SAMPLING LOCATION

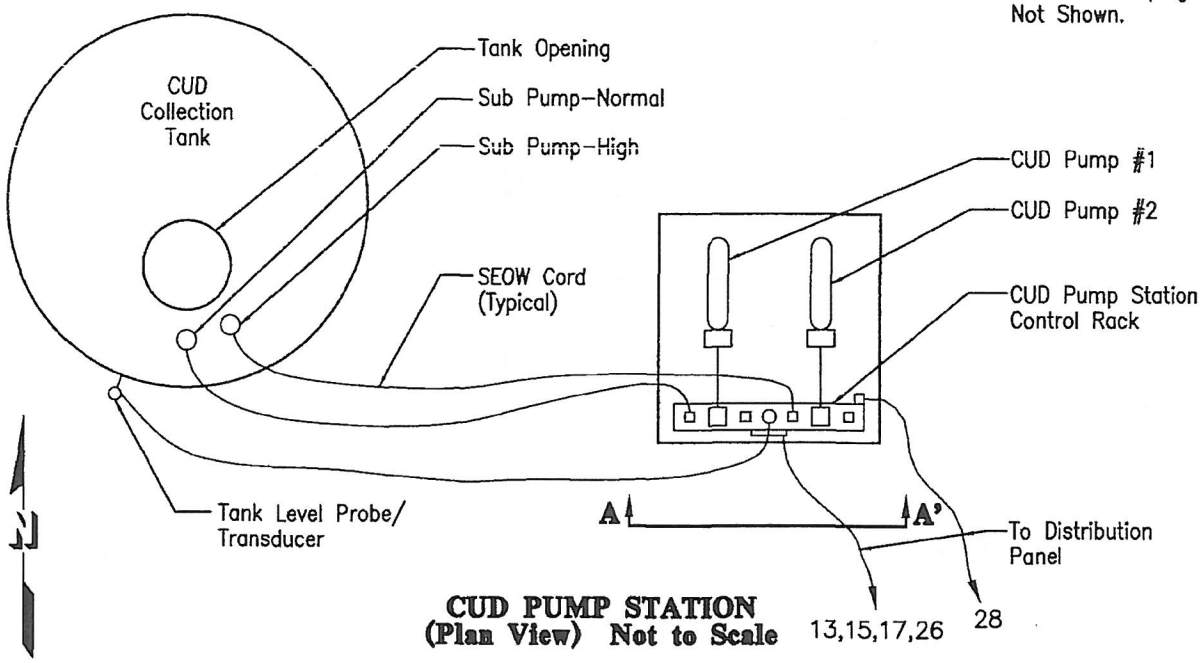
N

BROWN AND CALDWELL Carson City, Nevada	DATE: February 2002 PROJECT NUMBER: 21478	SCALE: 0 25' 50' SCALE IN FEET	LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM	Figure 5 CUD Treatment System Layout

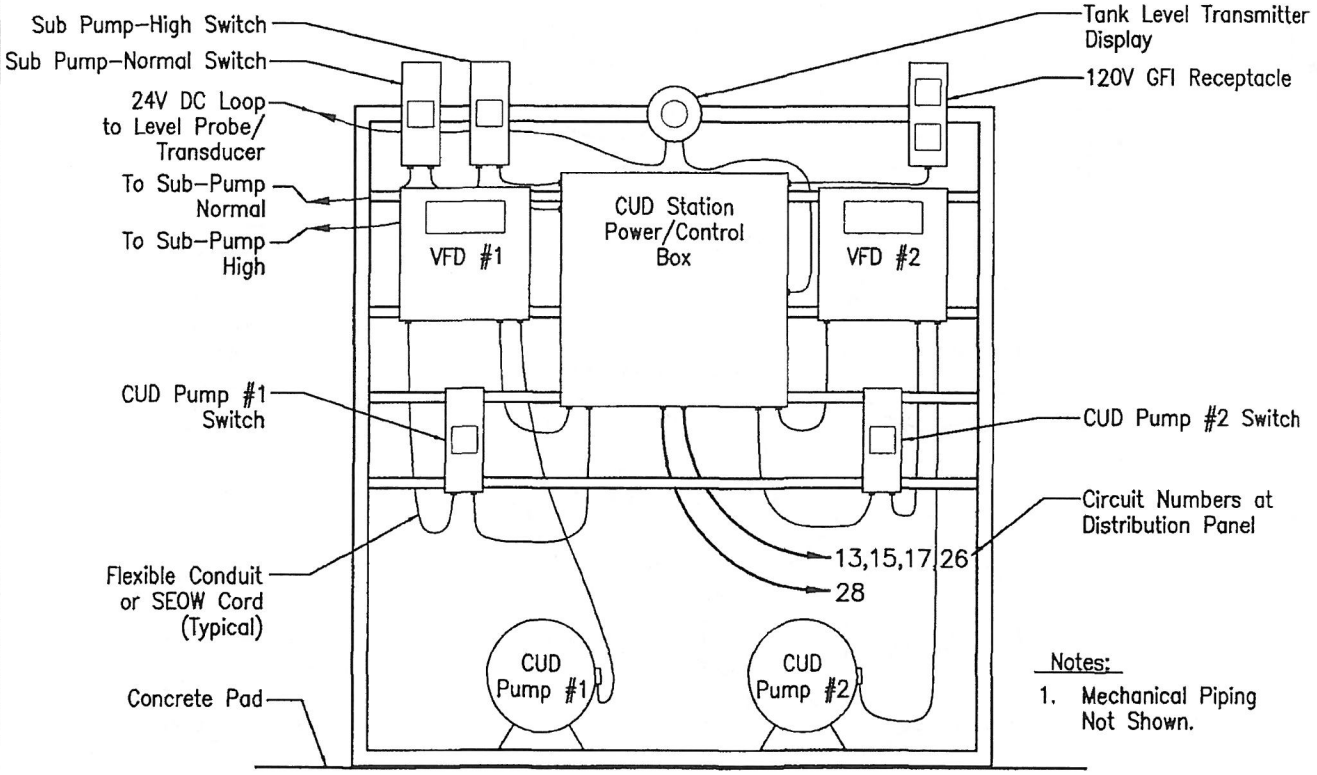
Carson City Cad P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478005.dwg (1=1) 02/16/2002 16:16.03 RJJ

Notes:

1. Mechanical Piping Not Shown.



CUD PUMP STATION (Plan View) Not to Scale



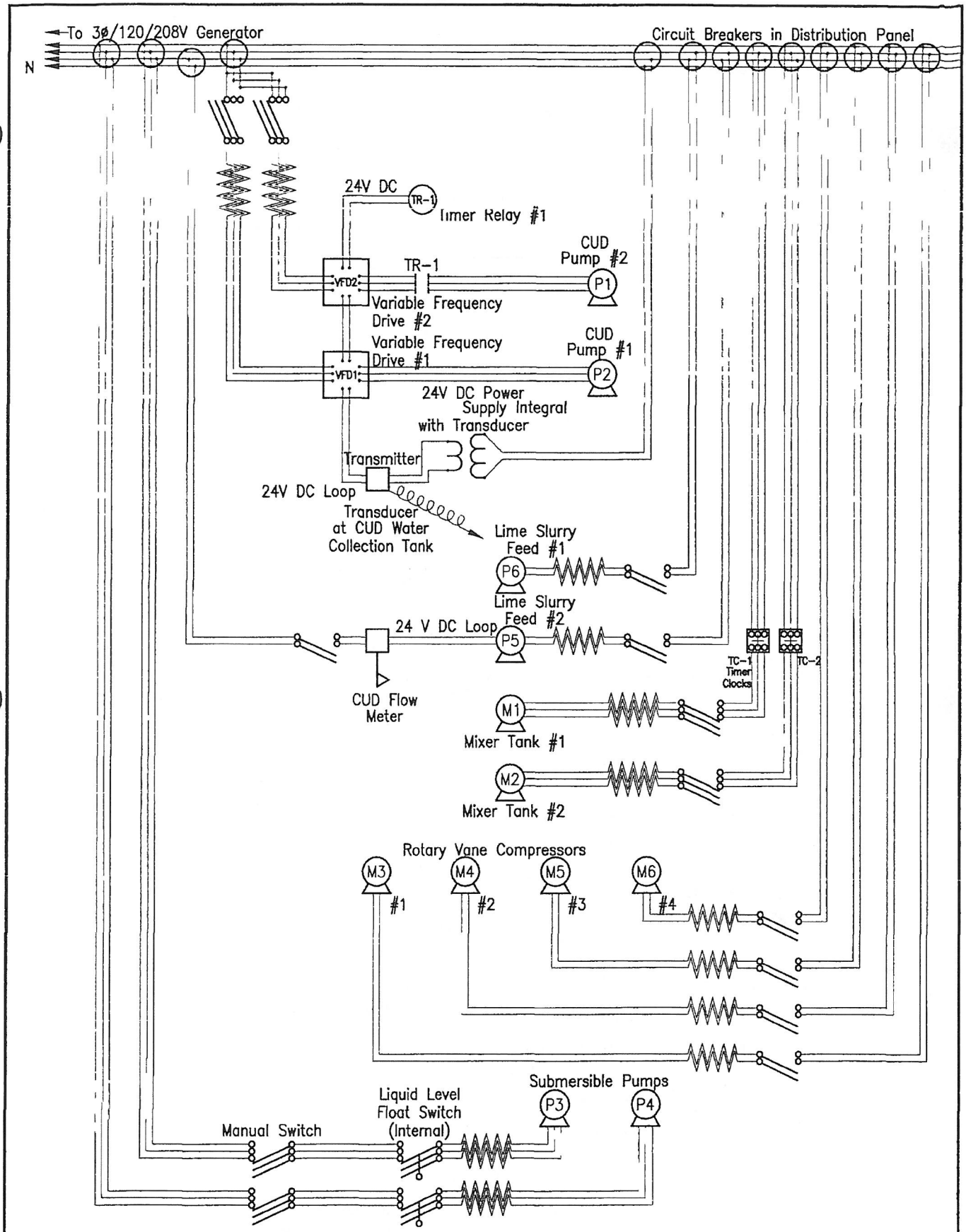
Notes:

1. Mechanical Piping Not Shown.

DETAIL A-A'
CUD PUMP STATION CONTROL RACK
(Elevation) Not to Scale

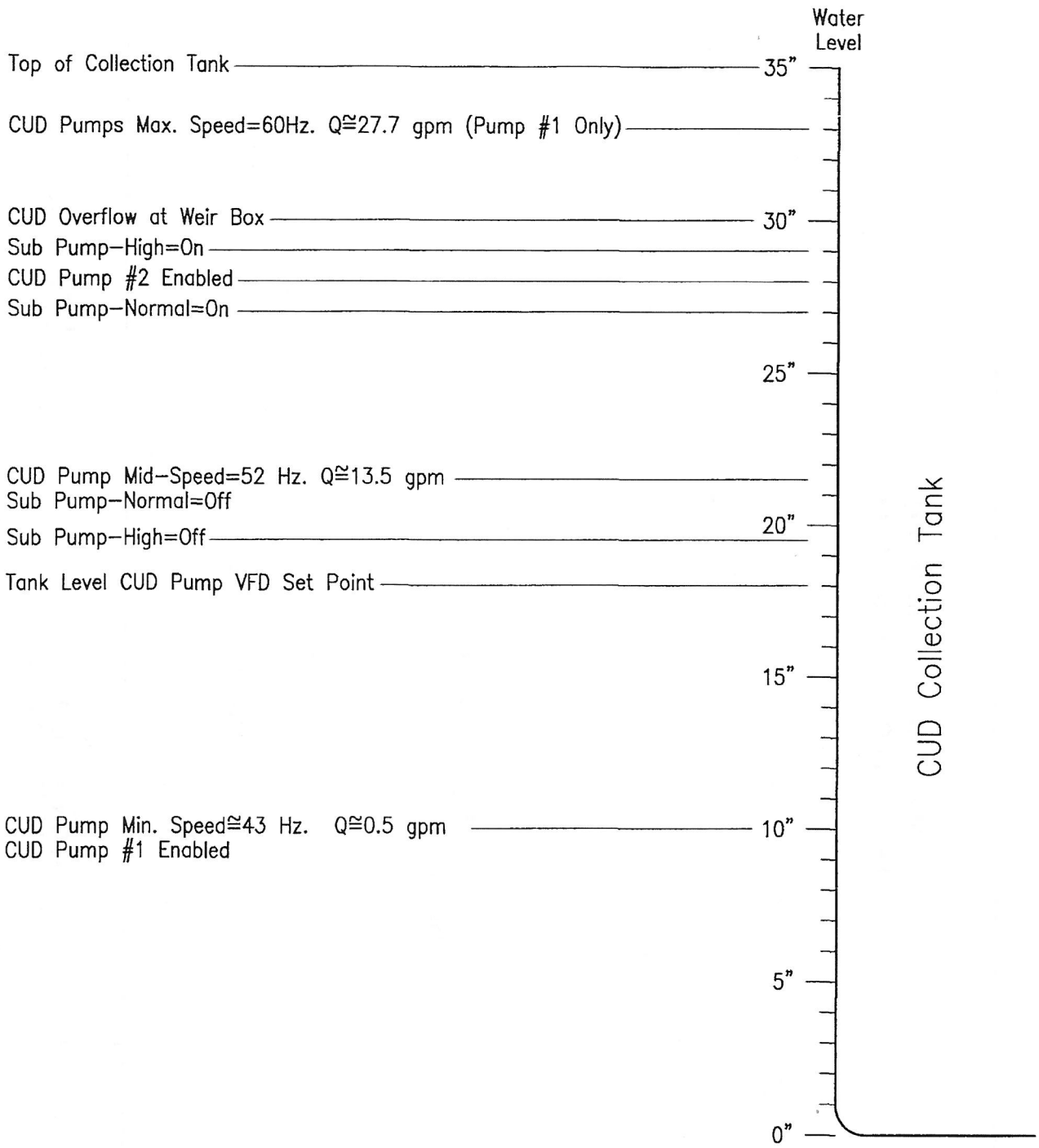
DATE:	PROJECT NUMBER:		
October 2001	21478	**LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM**	**Figure 7** **CUD Pump Station Electrical Layout and Control Rack Detail**
BROWN AND CALDWELL Carson City, Nevada			

Carson City Cad: P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478007.dwg (1=1) 02/16/2002 15:47:53 RJJ



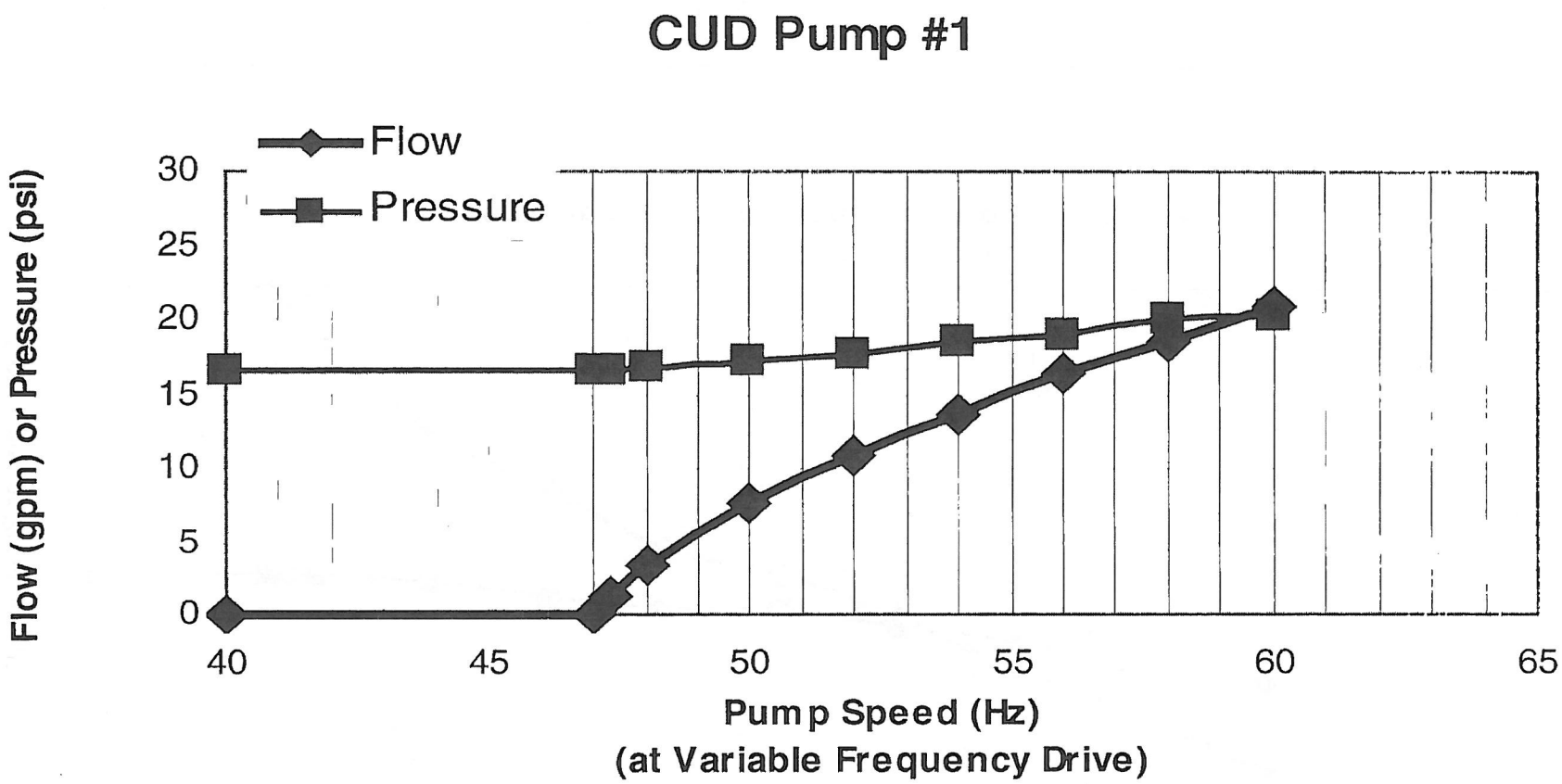
DATE.	PROJECT NUMBER		
October 2001	21478	**LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM**	**Figure 9**
BROWN AND CALDWELL Carson City, Nevada			**CUD Treatment Motor Control Wiring Schematic**

Carson City Cad P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478009.dwg (1=1) 02/18/2002 16:24:24 RJJ



DATE: October 2001	PROJECT NUMBER: 21478	LEVIATHAN MINE EARLY RESPONSE ACTION CUD TREATMENT SYSTEM	Figure 11
BROWN AND CALDWELL Carson City, Nevada			CUD Collection Tank Pump Control Level Schematic

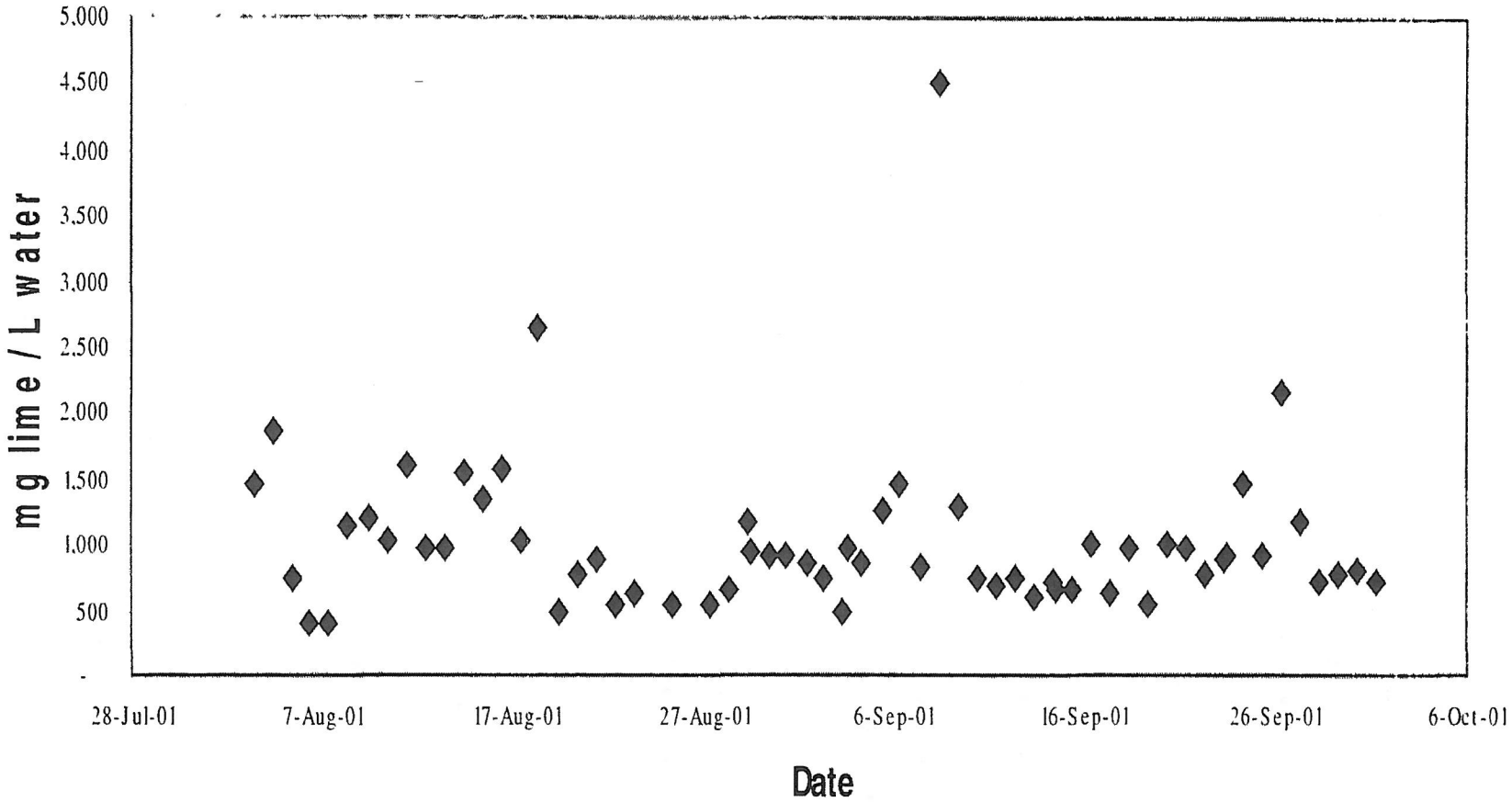
Carson City Cad: P:\ARCO\21478\Cad\Drawings\February2002\Final CUD Report\F21478011.dwg (1=1) 02/16/2002 16:20:15 RJJ



BROWN AND CALDWELL

LEVIATHAN MINE
EARLY RESPONSE ACTION
CUD TREATMENT SYSTEM

Figure 13
Correlation of CUD Pump Speed and Flow



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LEVIATHAN MINE
EARLY RESPONSE ACTION
CUD TREATMENT SYSTEM

Figure 15
Lime Dosage Results

Tables

TABLE 2. MONITORING LOCATIONS AND SAMPLING SCHEDULE			
Location	**Monitoring Point**	**Sample Type**	**Frequency**
Discharge	Discharge outlet pipe near the CUD pump station	Field Parameters	Daily during discharge
		Laboratory Analyses	Daily during discharge
Pond 4	Section 3, near outlet, along shoreline	Field Parameters	Weekly
		Laboratory Analyses	Weekly
	Section 2, along shoreline	Field Parameters	Weekly
		Laboratory Analyses	Weekly
	Section 1, along shoreline	Field Parameters	Weekly
		Laboratory Analyses	Weekly
Raw CUD	Sampling port at influent line before RT1 and flow meter	Field Parameters	Weekly
		Laboratory Analyses	Weekly

TABLE 6: FIELD DATA SUMMARY: INFLUENT AND EFFLUENT						
	pH		Temperature (deg.F)		Conductivity (uS/cm)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Average	4.6	8.3	55.3	57.5	2530	2599
Maximum	4.9	9.3	60.0	60.8	2870	2784
Minimum	4.3	4.7	53.1	53.6	2030	2175

NOTES

Average values are over the 60-day treatment period

Data for effluent includes values for treated CUD water at the discharge

Data for influent is raw CUD water

Minimum effluent pH was temporary, apparently due to a breach in the discharge conduit on September 16, 2001

Effluent pH discharge objective was 6 5 to 9 0 (*Montgomery and Watson, 2001, Leviathan Mine Site Early Response Action Work Plan June 2001)*

TABLE 8 FILTER BAG DIMENSIONS AND VOLUMES*			
Bag #	Height (in)	Area** (ft^2)	Volume ft^3)
1	22	225	413
2	19	225	356
3	23	225	431
4	20.5	225	384
5	17	225	319
6	9.5	225	178
		TOTAL VOLUME	**2081**

* as measured on October 19, 2001

** each filter bag was 15 ft by 15 ft square

GEOTECHNICAL INVESTIGATION REPORT: PHASE II PRELIMINARY SLOPE STABILITY EVALUATION, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA

(Kleinfelder, 2001b)

Previous investigations at the site by Kleinfelder included a Phase I Preliminary Slope Evaluation and a Phase II Slope Stability Evaluation that involved aerial photograph review, geologic field mapping, field investigations, and laboratory testing and preliminary stability analyses. Information from these previous investigations has been used to augment this investigation.

DESCRIPTION OF THE LANDSLIDE

The landslide is roughly 250 feet in length by about 150 feet in maximum width and is about 80 feet in height. It is located on the steep, northwest limit of the waste pile, adjacent to Leviathan Creek, referenced as the Delta Area. Access near the toe of the study slope is restricted due to the steep terrain.

The landslide appears to consist of an upper rotational slide and a lower debris flow or planar slide. A well defined but erosion-modified scarp, several feet in height, has formed near the top of the slope with evidence of toe bulging and movement at the toe of the slope. This primary scarp extends for over 200 feet along the top of the slope. A second smaller scarp is present below the primary scarp. Evidence of previous slope movement has been reported with areas near the crest of the slope exhibiting several feet of subsidence.

A lower less-defined scarp is present at the base of the rotational portion of the landslide. The lower debris flow or planar portion of the landslide is below this lower scarp and exhibits evidence of saturation, springs, and more moisture than the upper rotational portion of the slide. Small trees on the lower slope face also show signs of creep-type movement in their curved trunks. The approximate limits of the landslide are shown on Plate 2 in Appendix A.

Also shown on the site plan, as requested by DGS staff, are pre-mine topographic contours that were provided to Kleinfelder by the RWQCB during preparation of our preliminary reports. Discrepancies can be noted between the pre-mine topographic contours and subsurface information coupled with the most recent topographic information (February 10, 2003 topographic survey by PSOMAS). The accuracy of the pre-mine elevations is unknown and appears to be suspect.

FIELD EXPLORATION

The Phase II Slope Stability Evaluation included drilling nine soil borings using a track-mounted hollow-stem auger drill rig to depths of 26 to 58.5 feet below ground surface in September and October 2001. Most of the borings within the landslide limits were sampled continuously by driving split-spoon samplers. Continuous logs of all of the borings were recorded by our field geologist and groundwater levels were measured at the time of drilling and at several other times. Slope inclinometer casing was installed in four of the borings (B-1, B-3, B-5, and B-6) and groundwater monitor wells were installed in the remaining five borings (B-2, B-4, B-7, B-8, and B-9). The surface completion consisted of steel Christy boxes.

For the current investigation ten test pits ranging in depths of 8.5 to 17.5 feet were excavated in May 2003. The test pits were excavated using a Case 9030B track hoe provided by the

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California Regional Water Quality Control Board. The test pits were continuously logged by a Kleinfelder engineer who classified the materials and collected bulk samples.

The locations of the subsurface explorations are presented on Plate 2. The logs of the soil borings for the current and previous Kleinfelder investigations are presented in Appendix A and Appendix B, respectively.

LABORATORY TESTING

Because a toe buttress will not be constructed as part for the final design, laboratory testing was not performed on the collected soils samples for the current investigation. Laboratory tests from the previous Phase II investigation included direct shear, density and moisture content of the mine tailings and were used for the analyses performed for this investigation as discussed in the following sections of this report.

SUBSURFACE CONDITIONS

Current and previous field investigations conducted by Kleinfelder indicate that the mine tailings consist primarily of clayey sand with gravel, sandy clay, gravelly clay, and sandy silt to depths ranging from 28.5 feet in boring B-4, to 58 feet in boring B-2. Mine tailing material was reportedly encountered in well MW-12 (installed by others) to a depth of 52 feet below ground surface. Varying amounts of cobbles and boulders were encountered in most of the explorations.

Andesite bedrock was encountered in borings B-1 through B-6 immediately below the fill materials. Bedrock was encountered at a depth of 12.5 feet below grade in TP-3 below native soils. Borings B-7 through B-9, located above the slide area, and all other test pits did not penetrate to bedrock.

Groundwater was encountered in all soil borings and all but two of the test pits (located above the head scarp). The soil boring logs from these previous investigations by Kleinfelder and test pits for the current investigation are presented in Appendices A and B, respectively, and should be reviewed for details of the encountered subsurface conditions.

Various potential slide planes were encountered in both the soil borings as well as the test pits that consisted of saturated, very soft, sandy clay or clayey sand zones. For purposes of our analyses, the interface between the bedrock and mine tailings was selected as the location of the slide plane for our stability analyses.

DESIGN RECOMMENDATIONS

Stability analyses were conducted for various graded slopes to obtain the most efficient final design slope. Both block and circular failure analyses were conducted using both computer program and hand calculation methods. A description of the analyses, input values, and assumptions are presented in Appendix C.

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INFLUENCE OF NATURAL SOURCES ON MERCURY IN WATER, SEDIMENT AND AQUATIC BIOTA IN SEVEN TRIBUTARY STREAMS OF THE EAST FORK OF THE UPPER CARSON RIVER, CALIFORNIA

(Fischer and Gustin, 2002)

Bioassessment Results from the Project Database
Fischer and Gustin (2002)
Leviathan Mine Site
Alpine County, California

BiologicalStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Poison Creek	6/1/1999	Hg	0.0240	µg/g dry	Composite sample	FIS-002
Poison Creek	6/1/1999	Hg	0.0350	µg/g dry		FIS-002
Poison Creek	6/1/1999	Hg	0.0360	µg/g dry		FIS-002
Poison Creek	6/1/1999	Hg	0.0380	µg/g dry	Composite sample	FIS-002
Poison Creek	6/1/1999	Hg	0.0400	µg/g dry		FIS-002
Poison Creek	6/1/1999	Hg	0.0520	µg/g dry	Composite sample	FIS-002
Poison Creek	9/1/1999	Hg	0.0520	µg/g dry		FIS-002
Poison Creek	9/1/1999	Hg	0.0620	µg/g dry		FIS-002
Poison Creek	9/1/1999	Hg	0.0770	µg/g dry		FIS-002
Poison Creek	9/1/1999	Methyl Hg	0.0640	µg/g dry		FIS-002
Poison Creek	9/1/1999	Methyl Hg	0.0660	µg/g dry		FIS-002
Poison Creek	9/1/1999	Methyl Hg	0.0890	µg/g dry		FIS-002
Upper Mountaineer Creek	6/1/1999	Hg	0.0310	µg/g dry	Composite sample	FIS-002
Upper Mountaineer Creek	6/1/1999	Hg	0.0330	µg/g dry	Composite sample	FIS-002
Upper Mountaineer Creek	6/1/1999	Hg	0.0490	µg/g dry	Composite sample	FIS-002
Upper Mountaineer Creek	9/1/1999	Hg	0.0300	µg/g dry		FIS-002
Upper Mountaineer Creek	9/1/1999	Hg	0.0690	µg/g dry		FIS-002
Upper Mountaineer Creek	9/1/1999	Hg	0.0760	µg/g dry		FIS-002
Upper Mountaineer Creek	9/1/1999	Hg	0.2320	µg/g dry		FIS-002

Notes:

Informaton obtained from database source code FIS-002 within the project database. The original source was from *Influence of Natural Sources on Mercury in Water, Sediment, and Aquatic Biota in Seven Tributary Streams of the East Fork of the Upper Carson River, California* . By Fischer and Gustin (2002).

Methyl Hg = Methylmercury, Hg = Mercury

ng/g = nanograms per gram, ug/g = micrograms per gram

Sediment Quality
Results from the Project Database
Fischer and Gustin (2002)
Leviathan Mine Site
Alpine County, California

SoilSedStation	SampleDate	Parameter	Value	Units	Comments	SourceCode
Cottonwood Creek	6/14/1999	Hg	0.1	µg/g	Streambed sediment	FIS-002
Cottonwood Creek	6/14/1999	Hg	0.07	µg/g	Streambed sediment	FIS-002
Sta 23	6/14/1999	Hg	0.4	µg/g	Streambed sediment, location approximate	FIS-002
BC-BRC	6/14/1999	Hg	0.2	µg/g	Streambed sediment	FIS-002
Sta 24	6/14/1999	Hg	9999	µg/g	Streambed sediment, location approximate	FIS-002
Barney Riley Creek	6/29/1999	Hg	0.09	µg/g	Streambed sediment	FIS-002
Poison Creek	7/9/1999	Hg	0.04	µg/g	Streambed sediment	FIS-002
Upper Mountaineer Creek	7/9/1999	Hg	0.05	µg/g	Streambed sediment	FIS-002
Cottonwood Creek	9/12/1999	Hg	0.07	µg/g	Streambed sediment	FIS-002
Upper Mountaineer Creek	9/19/1999	Hg	0.05	µg/g	Streambed sediment	FIS-002
Poison Creek	9/19/1999	Hg	0.04	µg/g	Streambed sediment	FIS-002
Sta 23	9/20/1999	Hg	0.19	µg/g	Streambed sediment, location approximate	FIS-002
Sta 23	9/23/1999	Hg	0.1	µg/g	Streambed sediment, location approximate	FIS-002
Sta 24	9/23/1999	Hg	9999	µg/g	Streambed sediment, location approximate	FIS-002
BC-BRC	9/23/1999	Hg	0.11	µg/g	Streambed sediment	FIS-002
Upper Mountaineer Creek	9/19/1999	Methyl Hg	6.62	ng/g	Streambed sediment	FIS-002
Poison Creek	9/19/1999	Methyl Hg	1.34	ng/g	Streambed sediment	FIS-002
Sta 23	9/20/1999	Methyl Hg	0.09	ng/g	Streambed sediment, location approximate	FIS-002

Notes:

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GEOTECHNICAL SLOPE STABILITY EVALUATION, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA

(Kleinfelder 2003)

KLEINFELDER
An employee owned company

July 30, 2003
File: 29398.01

California Department of General Services
Design Services Section
Real Estate Services-Professional Services Branch
707-3rd Street, Suite 4-105
West Sacramento, California 95605

Attention: Mr. Saeid Rashidian, P.E.

SUBJECT: Geotechnical Slope Stability Evaluation
Leviathan Mine Delta Area Waste Pile
Alpine County, California

References:
1) "Geotechnical Investigation Report, Phase I Preliminary Slope Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California," Kleinfelder, Inc. report dated March 16, 2001, File No. 30-2867-01.001.
2) "Geotechnical Investigation Report, Phase II Preliminary Slope Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California," Kleinfelder, Inc. report dated April 30, 2001, File No. 30-2867-02.001.

Dear Mr. Rashidian:

This letter presents the results of our supplemental field investigation and slope stability recommendations of the Delta Area waste pile at the Leviathan Mine in Alpine County, California. The purpose of our field investigation was to perform additional subsurface explorations at the project site and to develop a final design profile to mitigate the subject landslide. Services were performed in accordance with our proposal dated February 5, 2003, a State of California Standard Agreement dated February 25, 2003, and various conversations during the course of the project.

PROJECT DESCRIPTION

The project site is an inactive sulfur mine, which was mined from the 1800's until the early 1960's. The site is remote and located in steeply sloping terrain at an elevation of about 7,000 feet. The subject landslide has occurred in a portion of the Delta Area waste pile in the northwest area of the mine. The landslide could potentially impact Leviathan Creek and water treatment facilities at the site. A site vicinity map is presented as Plate 1 in Appendix A.

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DESCRIPTION OF THE LANDSLIDE

The landslide is roughly 250 feet in length by about 150 feet in maximum width and is about 80 feet in height. It is located on the steep, northwest limit of the waste pile, adjacent to Leviathan Creek, referenced as the Delta Area. Access near the toe of the study slope is restricted due to the steep terrain.

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Andesite bedrock was encountered in borings B-1 through B-6 immediately below the fill materials. Bedrock was encountered at a depth of 12.5 feet below grade in TP-3 below native soils. Borings B-7 through B-9, located above the slide area, and all other test pits did not penetrate to bedrock.

Groundwater was encountered in all soil borings and all but two of the test pits (located above the head scarp). The soil boring logs from these previous investigations by Kleinfelder and test pits for the current investigation are presented in Appendices A and B, respectively, and should be reviewed for details of the encountered subsurface conditions.

Various potential slide planes were encountered in both the soil borings as well as the test pits that consisted of saturated, very soft, sandy clay or clayey sand zones. For purposes of our analyses, the interface between the bedrock and mine tailings was selected as the location of the slide plane for our stability analyses.

DESIGN RECOMMENDATIONS

Stability analyses were conducted for various graded slopes to obtain the most efficient final design slope. Both block and circular failure analyses were conducted using both computer program and hand calculation methods. A description of the analyses, input values, and assumptions are presented in Appendix C.

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Various alternates were considered (including our original alternates 2 and 3 of our Phase II investigation) that would require toe buttresses and, horizontal and vertical drains for stabilization of the landslide. However, because the mine tailings and any other on-site sources cannot be used for toe buttress materials, importing the materials from an off-site borrow source would be required. In addition, based on our test pits, due to the nature of the groundwater regime encountered in the slide and amounts of boulders, installation of vertical and horizontal drains would be difficult and costly. Based on conversations with DGS staff, a design that would only require flattening the existing grades at the slide was deemed the most cost effective and appropriate method.

The recommended design involves grading the existing slope to a 3:1 (horizontal to vertical) beginning at the top of the active zone (approximately elevation 6,847), constructing benches at regular intervals along the slope and installing trench drains to depths of 10 feet on the benches. The width of the benches should be approximately 20 feet with the exception of the first bench, which should be about 60 feet wide. The benches should be graded to a 3 percent minimum slope and 2-foot deep drainage swales should be constructed at the back of each bench. The swales should also have minimum of 3 percent slopes and should preferably be lined with reinforced concrete that is at least 3 inches thick. The trench drains should be located on the benches approximately 10 feet from the uphill slope. Plate 3 shows a cross-section through the landslide with the proposed final grades as well the locations of the final benches. Plate 4 shows a detail of the proposed trench drain. The trench drains will need to be connected to drainpipes located along both sides of the landslide.

A preexisting mapped landslide is located in the area above the subject landslide however, no indications of movement were noted in this area during our geologic mapping. Because grading will encroach into a minor portion of this landslide, the upper slopes should be flattened to an inclination from 2:1 to 3:1. In general, the slopes that terminate in the uphill portions of the preexisting landside will need to be flatter. Based on a 3:1 slope, the maximum extent that the cut will extend beyond the existing dirt road (which we understand can be relocated) will be approximately 100 feet. The final design limits will need to be field verified prior to finalization of the construction documents. Plate 3 shows both the approximate location of the centerline of the existing road and location of the proposed slope.

CONSTRUCTION CONSIDERATIONS

Due to the high variability of the subsurface materials and groundwater conditions at the site and lack of compete subsurface information, many unknowns exist which will need to be dealt with during construction. Appropriate modifications to the grades and exact locations of the benches should be anticipated during construction. The locations of the drainage trenches will also need to be modified as needed by the geotechnical engineer during construction. Finger drains and additional trenches should also be expected, as required. It may be necessary to sequence the construction in order that the up-gradient (highest) benches and trenches are installed first in order that the working areas are not below groundwater. This could allow for overall rough grading of the slopes initially then beginning finished grading operations from the top to the bottom as required.

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A qualified geotechnical engineer or designated inspector should be on site full time during grading operations to make the modifications as necessary. Reassessment of the stability will need to be ongoing as construction progresses and revisions are made. The construction documents should be prepared to allow for the flexibility to make changes during construction, as conditions require.

POST-CONSTRUCTION MONITORING

Maintaining proper drainage will be critical for the long-term stability of the landslide. Because of this a monitoring program consisting of both visual inspections and monitoring wells should be installed at locations above and on the landslide. The visual inspections should be performed on a regular basis to look for signs of instability as well as groundwater seeps. In the event high groundwater conditions occur that could potentially affect the stability of the landslide, additional drainage mitigations should be taken which could include surface water controls, trench drains, and possibly horizontal and vertical drains or wells.

Due to the current condition of the toe of the landslide, some additional slow movement (creep) should be anticipated. This movement is expected to be very slow and should not pose a threat to the global stability of the landslide or threaten blockage of Leviathan Creek. In the event continued movement occurs, debris fences or similar mitigations could possibly be used to help limit the extent the materials move towards the creek.

LIMITATIONS

The recommendations presented above are to increase the global stability of the subject landslide and was performed using a mutually agreed upon scope of work. It is our opinion that this study was a cost-effective method to geotechnical conditions and provides workable design parameters for the subject project. The soils data used in the preparation of this report were obtained from borings made for this investigation. It must be anticipated that variations in soils will exist between the points explored. If the Client wishes to reduce the uncertainties beyond the level associated with this study, Kleinfelder should be contacted for additional consultation.

This report has been prepared for specific application to the subject project in accordance with the generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made.

This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors including advances in man's understanding of applied science may change over time and could materially affect our findings. Therefore, this letter report should not be relied upon after 36 months from its issue. Kleinfelder should be notified if the project is delayed by more than 24 months from the date of this report so that a review of site conditions can be made, and recommendations revised if appropriate.

Any party other than the Client who wishes to use this report shall notify Kleinfelder of such intended use by executing the "Application for Authorization to Use" which follows this

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document as Appendix D. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

We appreciate this opportunity to be of service to you and look forward to future endeavors. If you have any questions about this report or need additional information, please contact either of the undersigned in our Reno office.

Sincerely,

KLEINFELDER, INC.

Al Stilley, P.E., G.E.
Regional Manager

Mike Klein, P.E., G.E.
Geotechnical Department Manager

REGISTERED PROFESSIONAL ENGINEER
MICHAEL K. KLEIN
No. 2488
Exp. 9/30/04
GEOTECHNICAL
STATE OF CALIFORNIA

AS:MK:vd

Appendices:

A – Plates
B – Boring Logs from Previous Investigations
C – Slope Stability Analyses
D – Application for Authorization to Use

Distribution: (Addressee, 5 Originals)

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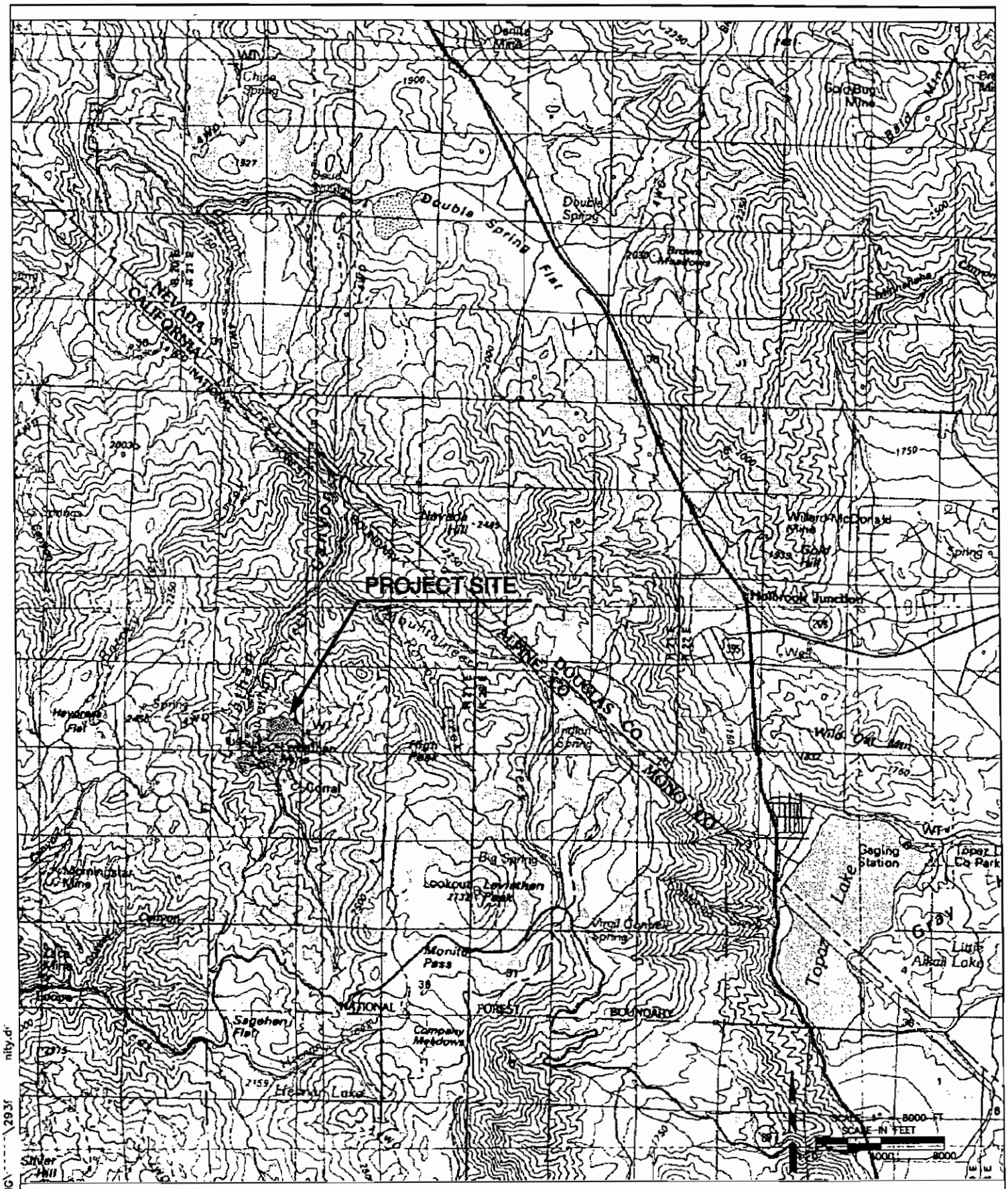
APPENDIX A

PLATES



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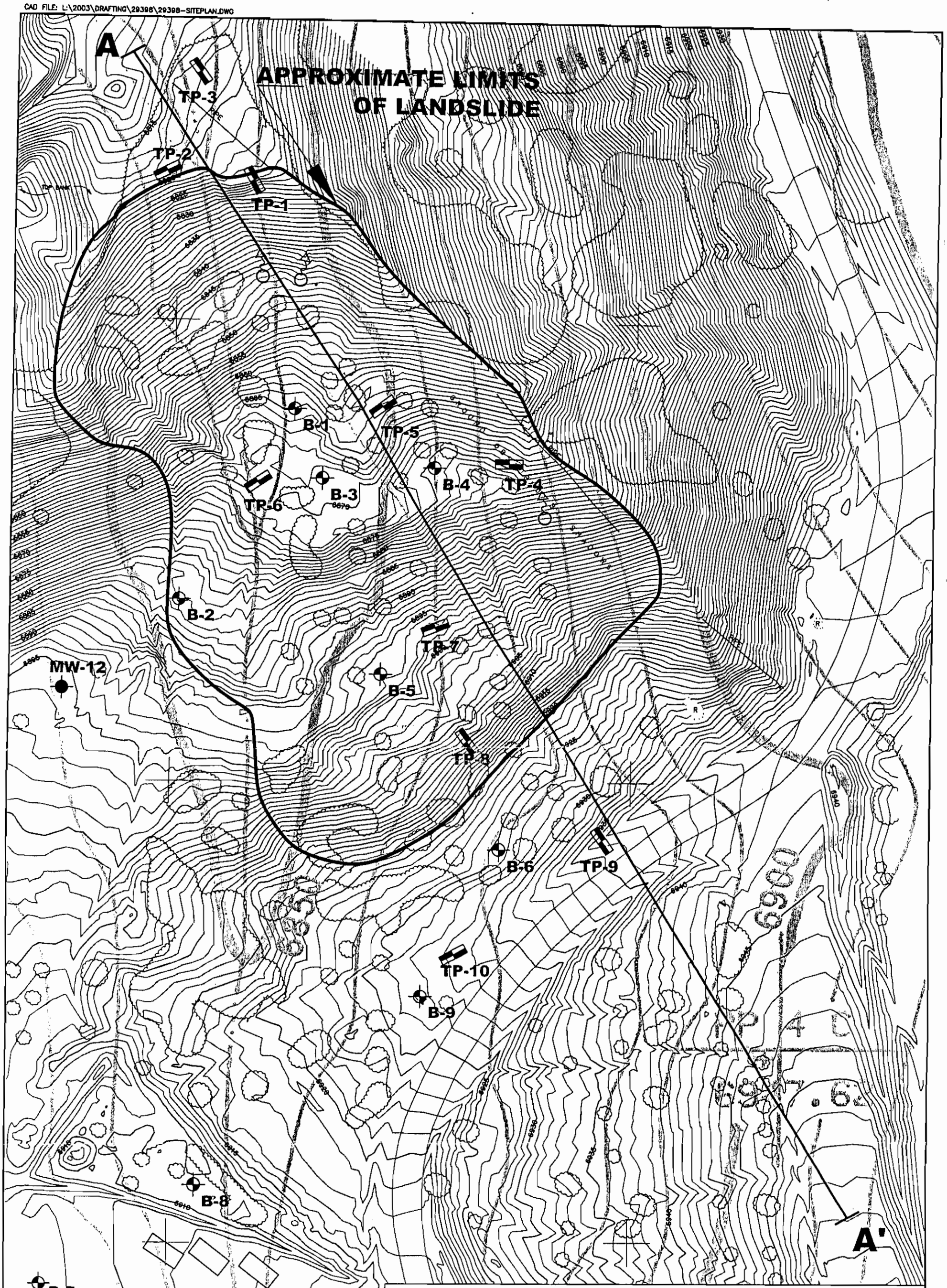
SITE VICINITY MAP

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE

1

CAD FILE: L:\2003\DRAFTING\29398\29398-SITEPLAN.DWG



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PROJECT NO. 29398.01

SITE PLAN

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, CALIFORNIA

PLATE
2

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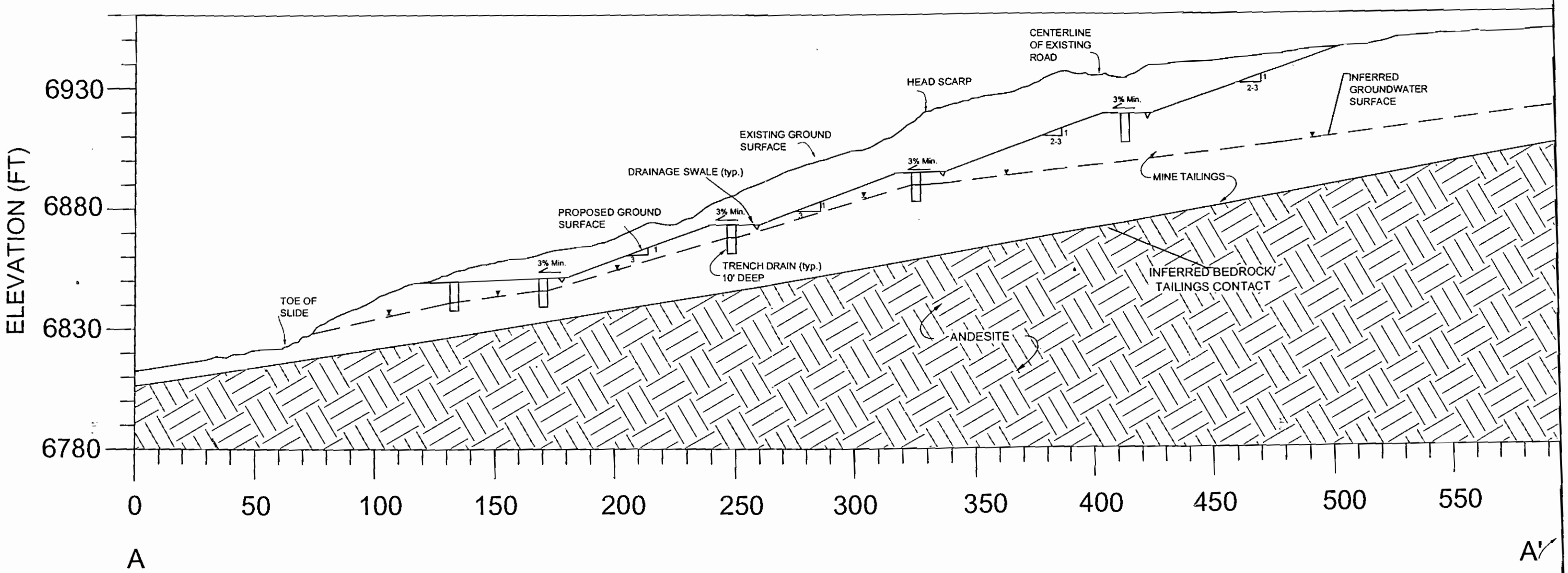

SCALE IN FEET
0 40

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CROSS-SECTION A-A'

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE
3

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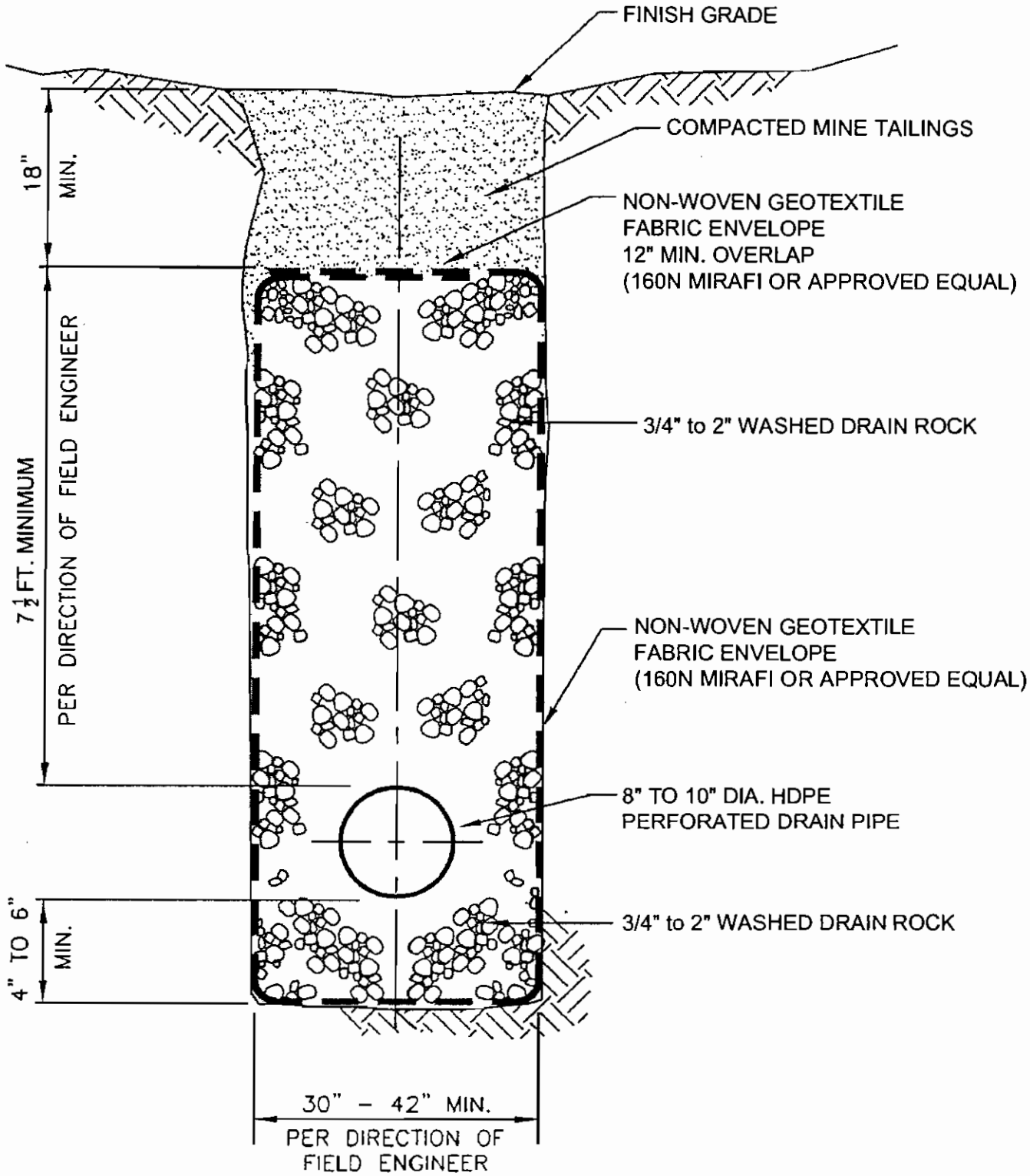

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PROJECT NO. 29398.01

TRENCH DRAIN DETAIL

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE

4

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND WITH GRAVEL (SC) wet, some cobbles and boulders up to 2' in diameter.
						TAN WELL GRADED SAND WITH GRAVEL (SW) wet, loose, brown staining.
						Trench begins sloughing, groundwater encountered
						Black, with organics

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-28-03

TOTAL DEPTH: 10.0 feet

LOGGED BY: M. KLEIN

KLEINFELDER

PROJECT NO. 29398.01

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-1

PLATE 5

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND (SC) wet, some gravel, cobbles and boulders up to 3' in diameter.
						GRAY BROWN WELL GRADED SAND WITH GRAVEL (SW) wet, loose, some clay, few cobbles and boulders.
						Tan with brown staining, groundwater encountered
						Trench begins sloughing

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-28-03

TOTAL DEPTH: 8.5 feet

LOGGED BY: M. KLEIN

KLEINFELDER

PROJECT NO. 29398.01

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-2

PLATE 6

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: BROWN SILTY SAND (SM) some moisture, roots to 5'.
						POORLY TO WELL GRADED SAND WITH SILT AND CLAY (SW/SP) moist, medium dense, some gravel, multi-colored zones, disturbed (possible slide deposits).
						Increasing moisture
						Wet
						BLACK WELL GRADED SAND AND ORGANICS (SP/OH) wet, medium dense, some gravel.
						BLACK POORLY GRADED SAND (SP) wet, medium dense, few gravel, less organics. Increasing coarse sand
						Bedrock refusal at 12.5'.

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-28-03

TOTAL DEPTH: 12.5 feet

LOGGED BY: M. KLEIN

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-3

PLATE 7

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND (SC) moist, some gravel, cobbles and boulders up to 3' in diameter.
						Wet
						Trench begins sloughing
						Flowing groundwater
						TAN BROWN WELL GRADED SAND WITH GRAVEL (SW) wet, roots, brown staining.
						Black, with gravel, cobbles, and organics

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-28-03

TOTAL DEPTH: 11.0 feet

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-4

PLATE 8

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND (SC) moist, zones and clumps of multi-colored clay to rock material types, some gravel, few cobbles and boulders.
						Very moist
						Wet
						Flowing groundwater, trench begins sloughing

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-28-03

TOTAL DEPTH: 14.0 feet

LOGGED BY: M. KLEIN

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-5

PLATE 9

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND (SC) dry, zones and clumps of multi-colored clay to rock materials, some gravel, few cobbles and boulders, roots to 5'.
						Moist
						Wet, flowing groundwater

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: 05-29-03

TOTAL DEPTH: 17.5 feet

LOGGED BY: M. KLEIN

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PROJECT NO. 29398.01

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-6

PLATE 10

Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: LIGHT BROWN CLAYEY SAND (SC) moist, some gravel, few cobbles.
						Trench begins sloughing
						Very moist, multi-colored clay to rock materials.
						Wet zone
						Moist to very moist

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

DATE: **05-29-03**

TOTAL DEPTH: **16.0 feet**

LOGGED BY: **M. KLEIN**

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-7

PLATE

11

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: LIGHT BROWN CLAYEY SAND (SC)** moist, some gravel, zones of multi-colored clayey materials.
2							
4							Flowing groundwater
							Moist to wet
6							
8							
10							
12							
14							
16							
18							

DATE: **05-29-03**

TOTAL DEPTH: **16.0 feet**

LOGGED BY: **M. KLEIN**

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-8

PLATE

12

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: BROWN SILTY SAND (SM)** moist, some gravel, cobbles and boulders.
2							
4							
6							
8							No free water encountered.
10							
12							
14							
16							
18							

DATE: **05-29-03**

TOTAL DEPTH: **8.0 feet**

LOGGED BY: **M. KLEIN**

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PROJECT NO. **29398.01**

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-9

PLATE

13

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Plasticity Index %	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: BROWN SILTY SAND (SM)** moist, numerous cobbles and boulders up to 3' in diameter, difficult digging.
2							
4							Trench begins sloughing
6							
8							
10							
12							No free water encountered.
14							
16							
18							

DATE: 05-29-03 LOGGED BY: M. KLEIN

TOTAL DEPTH: 12.0 feet

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LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

LOG OF TP-10

PLATE 14

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOIL More than 50% of the material is LARGER than the No. 200 sieve.	GRAVELS More than 50% of coarse part is LARGER than the No. 4 Sieve.	CLEAN GRAVELS Less than 5% finer than No. 200 Sieve.	PI<4	GW	Well graded gravels, gravel – sand mixtures, little or no fines, Cu>4 & 1<Cc>3
			PI>7	GP	Poorly graded gravels or gravel – sand mixtures, little or no fines Cu<4 or 1>Cc<3
		GRAVEL More than 12% finer than No. 200 Sieve.		GM	Silty gravels, gravel – sand – silt mixtures
				GC	Clayey gravels, gravel – sand – clay mixtures
	SANDS More than 50% of coarse part is SMALLER than the No. 4 Sieve.	CLEAN SANDS Less than 5% finer than No. 200 Sieve.		SW	Well graded sands, gravelly sands, little or no or no fines, Cu>6 & 1<Cc>3
				SP	Poorly graded sands or gravelly sands, little or no fines Cu<6 or 1>Cc<3
		SAND More than 12% finer than No. 200 Sieve.	PI<4	SM	Silty sands, sand – silt mixtures
			PI>7	SC	Clayey sands, sand – clay mixtures
FINE GRAINED SOIL More than 50% of the material is SMALLER than the No. 200 sieve.	SILTS AND CLAYS Liquid limit LESS than 50		PI–Below A–Line	ML	Inorganic silts, rock flour, or clayey silts of low plasticity
			PI–Above A–Line	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & organic clays of low plasticity
	SILTS AND CLAYS Liquid limit GREATER than 50		PI–Below A–Line	MH	Inorganic silts, clayey silts, or silts of high plasticity
			PI–Above A–Line	CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat & other highly organic soils

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

12" 3" 3/4" #4 #10 #40 #200 0.002 mm

DESCRIPTIVE TERMS USED WITH SOILS

CONSISTENCY & APPARENT DENSITY		
	SILTS & CLAYS	SANDS & GRAVELS
Strongest	Hard	Very Dense
	Very Stiff	Dense
	Stiff	Medium Dense
	Medium Stiff	Loose
Weakest	Soft	Very Loose
	Very Soft	

MOISTURE CONTENT	
Wettest	Wet
	Very Moist
	Moist
	Slightly Moist
Driest	Dry

▽ – Water Level Observed During Exploration

▼ – Water Level Observed After Exploration

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KEY TO SOIL CLASSIFICATION AND TERMS

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE 15

CAD FILE: L:\2003\DRAFTING\29398\29398-USCS.dwg

APPENDIX B

BORING LOGS FROM PREVIOUS INVESTIGATIONS

Depth (DEPTH IN FEET)	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: MULTI-COLORED CLAYEY SAND WITH GRAVEL** moist, stiff, medium to high plastic fines, gravel up to 1.5" in diameter, mine waste, zones of sandy clay and gravel.
2							
4							
			16				LL = 89 PI = 58
6		28	21				
8			2				Possible Slide Zone - Fill: Gravelly clay, saturated, soft, shelby tube sample attempted, no recovery.
10			6				**FILL: MULTI-COLORED CLAYEY SAND WITH GRAVEL** moist, medium stiff, medium to high plastic fines, mine waste, zones of sandy clay.
			6				
12	73	45	9				
14			10				
16			9				
		▽	9				Decreasing moisture Groundwater at 17.5' when drilling started on September 15, 2001.
18							
20			8				**FILL: CLAYEY SAND WITH GRAVEL** mottled orange, purple, and green, fill, moist to very moist, layers of gravelly clay, medium to high plastic fines, mine waste.
			6				
22							
			15				Possible slide zone at 23' to 24', soft saturated clay.
24							

DATE:	9-15-01	LOGGED BY:	K. PETERSON
TOTAL DEPTH:	35.0 feet	EQUIPMENT:	CME 850
DIAMETER:	6 inch	ELEVATION	Approx. 6865 feet

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LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-1

PLATE
B-1

PROJECT NO. 30-2867-02

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
		12	32			LL = 80 PI = 49
72	42	12				FILL: CLAYEY SAND WITH GRAVEL mottled orange, purple, and green, fill, moist to very moist, layers of gravelly clay, medium to high plastic fines, mine waste.
		12				
		12				
		5				
		17				Possible slide zone at 33' to 34.5', soft saturated clay.
	▼					FILL: SANDY CLAY wet, soft, brown-shelby tube sample attempted, no recovery. Groundwater at 34' when drilling ended on September 15, 2001.
		50/4"				ANDESITE ROCK hard, fractured, red. Auger refusal at 35'.

DEPTH IN FEET: 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

NOTES:

Slope inclinometer casing installed.
Groundwater measured at:

33.6' on 09/24/01
33.9' on 10/05/01
33.7' on 10/17/01
33.7' on 10/24/01

DATE:	9-15-01	LOGGED BY:	K. PETERSON
TOTAL DEPTH:	35.0 feet	EQUIPMENT:	CME 850
DIAMETER:	6 inch	ELEVATION	Approx. 6865 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B-1

PROJECT NO. 30-2867-02

LOG OF B-1

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: CLAYEY SAND** moist, medium stiff, gray-brown, scattered gravel up to 1" in diameter, zones of gravel and sandy clay, fill mine waste.
2							
4			9		■		
6							
8							
10			8		■		Coarse, loose gravel layer at 9.5' to 11'.
12							
14							Clayey sand and sandy clay layer at 14.5', wet, loose.
	68	∇ 53	4		■		Groundwater measured at 14.8' at start of drilling on September 20, 2001.
16							Soft, wet zone near 15'.
18							
20			7		■		
22							Saturated zones.
24					■		

DATE: 9-20-01
TOTAL DEPTH: 58.5 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6882 feet

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PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-2

PLATE
B-2

Depth (DEPTH IN FEET)	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
			8	38			LL = 72 PI = 31
26			10				Zones of clayey sand near 25'.
28	77	43	4				FILL: CLAYEY SAND moist, medium stiff, gray-brown, scattered gravel up to 1" in diameter, zones of gravel and sandy clay, fill mine waste.
30		52	7				Soft, wet zone at 29' to 31'.
32		47	18				
		32	20				
34			33				Layers of gravelly clay. Mottled purple and red zones.
36		37	41				
38			35	46			LL = 95 PI = 47
40		43	19				
		53	29				FILL: CLAYEY SAND moist with saturated zones, stiff, multicolored, red, gray, brown, scattered zones of gravelly clay, clayey sand and gravelly clay, medium to high plastic fines, mine waste.
42		39	22				
44			18	41			LL = 94 PI = 52
46		41	24				
48		35	24				
50							

DATE: 9-20-01
TOTAL DEPTH: 58.5 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6882 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B-2

PROJECT NO. 30-2867-02

LOG OF B-2

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
50		44	25				**FILL: CLAYEY SAND** moist with saturated zones, stiff, multicolored, red, gray, brown, scattered zones of gravelly clay, clayey sand and gravelly clay, medium to high plastic fines, mine waste.
		40	43				
52							
		49	25				
54							
		25	25				
56		24	13	20			LL = 45 PI = 10
		14	50/3"				
58							**ANDESITE BEDROCK** hard, fractured, moist, black.
							Auger refusal at 58.5'.
60							
62							NOTES: Monitor well installed. Groundwater measured at:
64							45.6' on 09/24/01 50.0' on 10/05/01 50.1' on 10/17/01 50.6' on 10/24/01
66							
68							
70							
72							
74							

DATE: 9-20-01
TOTAL DEPTH: 58.5 feet
DIAMETER: 6 Inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6882 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B-2

PROJECT NO. 30-2867-02

LOG OF B-2

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
50		44	25				**FILL: CLAYEY SAND** moist with saturated zones, stiff, multicolored, red, gray, brown, scattered zones of gravelly clay, clayey sand and gravelly clay, medium to high plastic fines, mine waste.
		40	43				
52		49	25				
54		25	25				
56		24	13	20			LL = 45 PI = 10
58		14	50/3"				**ANDESITE BEDROCK** hard, fractured, moist, black. Auger refusal at 58.5'.
60							
62							NOTES: Monitor well installed. Groundwater measured at:
64							45.6' on 09/24/01 50.0' on 10/05/01 50.1' on 10/17/01 50.6' on 10/24/01
66							
68							
70							
72							
74							

DATE: 9-20-01
TOTAL DEPTH: 58.5 feet
DIAMETER: 6 Inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6882 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLA

B

PROJECT NO. 30-2867-02

LOG OF B-2

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ FL	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: CLAYEY SAND** moist, medium stiff, gray-brown, scattered gravel up to 1" in diameter, layers of gravelly clay and gravel, medium to high plastic fines, mine waste.
2							
4							
		27	13	34			LL = 81 PI = 52
6			13				
8			12				
10		31	27	34			LL = 73 PI = 29
12			14				Multicolored orange, gray, and brown layers.
			9				Very moist to saturated at 14.5' to 16'.
14							
			18				Shelby Tube attempted at 15', no recovery.
16		41	10				LL = 85 PI = 44
18			10				
							Very wet at 19 to 20'.
20		43	10				**FILL: CLAYEY SAND** moist to wet, medium stiff, multicolored, purple, gray, scattered gravel up to 1" in diameter, occasional layers of sand. LL = 80 PI = 43
22			9	41			
			12				
24							

DATE: 9-18-01
TOTAL DEPTH: 29.0 feet
DIAMETER: 6 inch

LOGGED BY: K. PETERSON
EQUIPMENT: CME 850
ELEVATION Approx. 6870 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B-3

PROJECT NO. 30-2867-02

LOG OF B-3

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
		41	7				FILL: CLAYEY SAND moist to wet, medium stiff, multicolored, purple, gray, scattered gravel up to 1" in diameter, occasional layers of sand. Very wet, orange sand lense at 27' to 28'.
26			9				
28	77	43	6				
30		49	16				Gravel layer at 30.5' to 31'.
32	97	27	24				Clayey sand layers below 30'.
			19				
34	79	39	21				
36	83	37	50/3"				Possible slide zone at 35' to 36.5".
							ANDESITE BEDROCK hard, fractured, moist, black.
							Auger refusal at 37'.
38							No free water encountered at time of drilling (09/18/01).
40							NOTES:
							Slope inclinometer casing installed.
42							Groundwater measured at:
44							36.0' on 09/24/01 no water on 10/05/01 36.2' on 10/17/01 36.2' on 10/24/01
46							
48							
50							

DATE: 9-18-01
TOTAL DEPTH: 29.0 feet
DIAMETER: 6 inch

LOGGED BY: K. PETERSON
EQUIPMENT: CME 850
ELEVATION Approx. 6870 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-3

PLATE
B-3

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: CLAYEY SAND** loose, moist, scattered gravel, brown-red, mine waste.
2							
4							
			5				**FILL: GRAVELLY CLAY** moist to wet, medium stiff, brown-red, medium to high plastic fines, scattered gravel.
6							
8							
10	72	40	6				
12							
14			5				Clayey sand/sandy clay layer from about 14' to 18.5'.
16	72	46					
18							
20			10				**FILL: GRAVELLY CLAY** moist, medium stiff, multicolored, purple, gray, red, medium to high plastic fines, scattered gravel up to 1.5" in diameter, mine waste.
22							
24							

DATE: 9-18-01
TOTAL DEPTH: 29.0 feet
DIAMETER: 6 inch

LOGGED BY: K. PETERSON
EQUIPMENT: CME 850
ELEVATION Approx. 6875 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B-4

PROJECT NO. 30-2867-02

LOG OF B-4

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
75	37	10				**FILL: GRAVELLY CLAY** moist, medium stiff, multicolored, purple, gray, red, medium to high plastic fines, scattered gravel up to 1.5" in diameter, mine waste.
		25				
		50/4"				
						ANDESITE BEDROCK hard, fractured, moist, black.

DEPTH IN FEET: 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

Auger refusal at 29'.

No free water encountered at time of drilling (09/18/01).

NOTES:

Monitor well installed.

Groundwater measured at:

no water on 09/24/01
27.5' on 10/05/01
25.4' on 10/17/01
24.1' on 10/24/01

DATE:	9-18-01	LOGGED BY:	K. PETERSON
TOTAL DEPTH:	29.0 feet	EQUIPMENT:	CME 850
DIAMETER:	6 inch	ELEVATION	Approx. 6875 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-4

PLATE

B-4

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: GRAVELLY CLAY** moist, brown-yellow, medium stiff, scattered gravel up to 2.5" in diameter, medium to high plastic fines, layers of sandy clay, mine waste.
2							
4							**FILL: SANDY CLAY** moist, multicolored, red, brown, gray, medium stiff, scattered gravel, mine waste.
6							
8							
10							LL = 77 PI = 41
12				50			**FILL: CLAYEY SAND WITH GRAVEL** moist with wet zones, multicolored, gray, red, brown, medium stiff, medium to high plastic fines, mine waste, wet layer at 11' to 12'.
14							
16							
18							
20							**FILL: CLAYEY SAND WITH GRAVEL** moist with wet layers, multicolored, brown, red, stiff, scattered gravel up to 2" in diameter, mine waste.
22							
24							Gravel and sand layers near 25'.
26							

DATE: 9-13-01
TOTAL DEPTH: 45.0 feet
DIAMETER: 6 inch

LOGGED BY: K. PETERSON
EQUIPMENT: CME 850
ELEVATION Approx. 6896 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-5

PLATE
B-5

PROJECT NO. 30-2867-02

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: CLAYEY SAND WITH GRAVEL moist with wet layers, multicolored, brown, red, stiff, scattered gravel up to 2" in diameter, mine waste.
93	26		34			Possible slide plane at 35' to 37', very soft, saturated, gravelly clay. LL = 75 PI = 37
						FILL: SANDY CLAY very moist, stiff to soft, brown-gray, medium to high plastic fines, scattered gravel, mine waste.
						Refusal at 45' on possible bedrock. NOTES: Monitor well installed. Groundwater measured at: 34.7' on 09/24/01 35.0' on 10/05/01 26.9' on 10/17/01 27.1' on 10/24/01

DEPTH IN FEET: 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

DATE:	9-13-01	LOGGED BY:	K. PETERSON
TOTAL DEPTH:	45.0 feet	EQUIPMENT:	CME 850
DIAMETER:	6 inch	ELEVATION	Approx. 6896 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-5

PLATE

B-5

DEPTH IN FEET	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: CLAYEY SAND** moist, medium stiff, brown-red, scattered gravel and gravelly clay layers, medium to high plastic fines, mine waste.
2							
4			14				
6		27	10	25			
8		25	11				
10			12				
12		33	30				
14		22	22				
16		19	18				
18			15				
20			12				**FILL: SANDY SILT** moist, stiff, scattered gravel, medium to high plastic fines, mine waste, layers of clayey and gravelly sand. LL = 81 PI = 33
22			10	62			
24			9				
			11				

DATE: 9-21-01
TOTAL DEPTH: 31.0 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6926 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-6

PLATE
B-6

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
		12				**FILL: CLAYEY SAND** saturated, medium dense, scattered gravel, mine waste.
		14				
		15				
		42	30			**FILL: CLAYEY SAND** saturated, medium dense, scattered gravel, mine waste. LL = 69 PI = 28
						ANDESITE BEDROCK very hard, purple, fractured.

DEPTH IN FEET: 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

Auger refusal at 31'.

No free water encountered at time of drilling (09/21/01).

NOTES:

Slope inclinometer casing installed.

Groundwater measured at:

22.3' on 09/24/01
21.0' on 10/05/01
21.9' on 10/17/01
22.0' on 10/24/01

DATE:	9-21-01	LOGGED BY:	J. FORTMANN
TOTAL DEPTH:	31.0 feet	EQUIPMENT:	CME 850
DIAMETER:	6 inch	ELEVATION	Approx. 6926 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-6

PLATE

B-6

Depth (DEPTH IN FEET)	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							**FILL: SANDY CLAY** moist, stiff, brown, medium to high plastic fines, mine waste.
2							
4			27				
6							
8							
10			17				
12							
14	66	30	19				
16							
18							
20			15				**FILL: SANDY CLAY** very moist with wet zones, stiff, yellow-gray, purple, medium high plasticity, mine waste.
22							
24			18				Wet zone at 24' to 26'.
26							No free water encountered at time of drilling (09/21/01).
28							NOTES:
30							Monitor well installed.
32							Groundwater measured at:
34							25.0' on 09/24/01 24.1' on 10/05/01 24.2' on 10/17/01 24.2' on 10/24/01

DATE: 9-21-01
TOTAL DEPTH: 26.0 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6908 feet

KLEINFELDER

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-7

PLATE
B-7

PROJECT NO. 30-2867-02

Depth (DEPTH IN FEET)	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
0							FILL: CLAYEY SAND moist, medium dense, yellow, scattered gravel, mine waste.
2							
4							
			19				FILL: GRAVELLY CLAY moist medium stiff, brown, gray, medium to high plastic fines, scattered gravel up to 1" in diameter, mine waste.
6							
8							
10			20				
12							
14							
			10				
16		26					
18							
20			12				FILL: GRAVELLY CLAY moist with wet layers, brown-gray, medium to high plastic fines, mine waste.
22							
24							
		36	46				
26							No free water encountered at time of drilling (09/21/01).
28							NOTES:
30							Monitor well installed.
32							Groundwater measured at:
34							10.2' on 09/24/01 09.8' on 10/05/01 10.5' on 10/17/01 10.6' on 10/24/01

DATE: 9-19-01
TOTAL DEPTH: 26.0 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6911 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-8

PLATE
B-8

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
						FILL: SANDY CLAY moist, stiff, brown, medium to high plastic fines, scattered gravel up to 2" in diameter, mine waste.
		27				
		11				
		19				
		20				

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

DATE: 9-21-01
TOTAL DEPTH: 31.0 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6928 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-9

PLATE
B-9

Dry Density lb/ft3	Moisture Content %	Blows/ FL	Percent Passing #200	Sample	USCS	SOIL DESCRIPTION
72	▽ 40	13				Wet at 25'.
						FILL: SANDY CLAY moist, stiff, brown, medium to high plastic fines, scattered gravel up to 2" in diameter, mine waste.
		19				
						No free water encountered at time of drilling (09/21/01).
						NOTES:
						Monitor well installed.
						Groundwater measured at:
						23.1' on 09/24/01 22.2' on 10/05/01 22.8' on 10/17/01 22.8' on 10/24/01

DEPTH IN FEET: 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

DATE: 9-21-01
TOTAL DEPTH: 31.0 feet
DIAMETER: 6 inch

LOGGED BY: J. FORTMANN
EQUIPMENT: CME 850
ELEVATION Approx. 6928 feet

KLEINFELDER

PROJECT NO. 30-2867-02

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

LOG OF B-9

PLATE
B-9

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOIL More than 50% of the material is LARGER than the No. 200 sieve.	GRAVELS More than 50% of coarse part is LARGER than the No. 4 Sieve.	CLEAN GRAVELS Less than 5% finer than No. 200 Sieve.	PI<4	GW	Well graded gravels, gravel – sand mixtures, little or no fines, Cu>4 & 1<Cc>3
			PI>7	GP	Poorly graded gravels or gravel – sand mixtures, little or no fines Cu<4 or 1>Cc<3
		GRAVEL More than 12% finer than No. 200 Sieve.		GM	Silty gravels, gravel – sand – silt mixtures
				GC	Clayey gravels, gravel – sand – clay mixtures
	SANDS More than 50% of coarse part is SMALLER than the No. 4 Sieve.	CLEAN SANDS Less than 5% finer than No. 200 Sieve.		SW	Well graded sands, gravelly sands, little or no or no fines, Cu>6 & 1<Cc>3
				SP	Poorly graded sands or gravelly sands, little or no fines Cu<6 or 1>Cc<3
		SAND More than 12% finer than No. 200 Sieve.	PI<4	SM	Silty sands, sand – silt mixtures
			PI>7	SC	Clayey sands, sand – clay mixtures
FINE GRAINED SOIL More than 50% of the material is SMALLER than the No. 200 sieve.	SILTS AND CLAYS Liquid limit LESS than 50	PI–Below A–Line		ML	Inorganic silts, rock flour, or clayey silts of low plasticity
		PI–Above A–Line		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & organic clays of low plasticity
	SILTS AND CLAYS Liquid limit GREATER than 50	PI–Below A–Line		MH	Inorganic silts, clayey silts, or silts of high plasticity
		PI–Above A–Line		CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat & other highly organic soils

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

12" 3" 3/4" #4 #10 #40 #200 0.002 mm

DESCRIPTIVE TERMS USED WITH SOILS

CONSISTENCY & APPARENT DENSITY		
	SILTS & CLAYS	SANDS & GRAVELS
Strongest	Hard	Very Dense
	Very Stiff	Dense
	Stiff	Medium Dense
	Medium Stiff	Loose
Weakest	Soft	Very Loose
	Very Soft	

MOISTURE CONTENT	
Wettest	Wet
	Very Moist
	Moist
	Slightly Moist
Driest	Dry

▽ – Water Level Observed During Exploration

▼ – Water Level Observed After Exploration

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KLEINFELDER
4875 LONGLEY LANE, SUITE 100
RENO, NEVADA 89502
Tel. (775) 689-7800

PROJECT NO. 30-2867-02.001

KEY TO SOIL CLASSIFICATION AND TERMS

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE
B10

SYMBOLS

Disturbed Bag or Bulk Sample

Standard Penetration Sample
(1.4 inch I.D., 2.0 inch O.D.)

Modified California (Porter) Sample
(2.0 inch I.D., 2.56 inch O.D.)

* No Sample Recovery

Water Level Observed During Drilling

Water Level Observed After Drilling

COMMENTS

NOTE: Blow count represents the number of blows required to drive a sampler through the last 12 inches of an 18 inch penetration. A standard 140 lb hammer with a 30.4 inch free fall is used to drive the sampler.

NOTE: The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings.

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KLEINFELDER
4875 LONGLEY LANE, SUITE 100
RENO, NEVADA 89502
Tel. (775) 689-7800

PROJECT NO. 30-2867-02.001

KEY TO BORING LOGS

LEVIATHAN MINE PHASE II
SLOPE STABILITY INVESTIGATION
ALPINE COUNTY, CALIFORNIA

PLATE

B11

APPENDIX C

SLOPE STABILITY ANALYSIS

APPENDIX C
SLOPE STABILITY ANALYSES

GEOTECHNICAL SLOPE STABILITY EVALUATION
LEVIATHAN MINE DELTA AREA WASTE PILE
ALPINE COUNTY, CALIFORNIA

SLOPE STABILITY ANALYSIS AND RESULTS

Slope Stability Analysis

A Slope stability analysis using limit equilibrium methods was conducted to estimate the stability of the proposed design grades. Methods of evaluating the stability that were used included the Bishop method of slices and a sliding block method of analysis. Both circular and block failures analyses were conducted using the computer program X-STABL by Purdue University. Hand calculations were performed to check the block failure analyses.

The following items describe information used in the analyses to evaluate the stability of the landslide.

1. Slope Geometry – Accurate profiles of slopes are necessary to perform slope stability analyses. The February 10, 2003 topographic survey by PSOMAS (augmented by additional land surveys) was used to generate a true-scale cross section for stability analyses.

2. Soil Strength Parameters along failure plane – Stability analyses require selecting appropriate strength parameters for the given soil conditions. Laboratory test results coupled with back calculations were used to arrive at design values. Strength parameters from previous investigations were also reviewed. For our analyses, a total-stress (angle of internal friction set to zero) approach to model the strength of the mine tailings was used. A cohesion of 950 psf and unit weights of 120 pcf and 110 pcf for saturated and unsaturated conditions, respectively, were used for the mine tailings. An angle of internal friction of 50 degrees, a cohesion of 10,000 psf and saturated unit weight 135 pcf were used for the andesite bedrock.

3. Location of Failure Plane – Location of the plane of movement is required for sliding-block analyses and limiting the failure plane for global stability analyses and was conservatively assumed to be between the bedrock and mine tailings. In reality, multiple failure planes probably exist through the mine tailings that have resulted in noted secondary features and the creep condition at the toe. The location of the failure plane (interface of the bedrock and mine tailings) was selected based on subsurface information obtained from this and previous investigations. This inferred location of the slide plane is shown Plate 3.

4. Location of Groundwater – Groundwater has a significant impact on slope stability. For our Analyses, groundwater levels were selected from previous data collected

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from monitoring wells during our previous investigations. The slope was evaluated assuming the high water level measured in MW-12 extended to the elevation of the springs at the toe of the slope. The groundwater seeps near the toe were conservatively assumed to be the top of the groundwater table. With the exception of the groundwater encountered at the toe (test pits TP-1, TP-2 and TP-3) water appears to be following preferential paths within the slide and is not a static phreatic surface.

5. Seismicity – A seismic event can have a significant impact on stability of the landslide. A pseudo-static approach was used for our analyses that incorporated a seismic coefficient of 0.1. Stability was evaluated for both static and dynamic conditions as discussed below.

Given the geometry of the land slide and assumption that the primary slide plane is located between the interface of the bedrock and mine tailings, the most appropriate model for the overall land slide is a sliding block analysis (Sliding Block Method of Analysis) which models movement along a predefined plane. However, local signs of movement present in the upper portions of the landslide indicate that that a rotational failures (Bishop Method of Slices) are also possible. Based on this, both methods were used to estimate factors of safety of the proposed geometry of the slide. Failure along a near-surface layer parallel to the existing slope (Infinite Slope Analysis) was also considered however, due to the lack of evidence of such failures and cohesive nature of the materials, this method was deemed inappropriate.

A general description of each of the two methods used for our stability analyses with specific assumptions are discussed below.

- *Sliding Block Method of Analysis*
  With this method, the slide mass is broken into discrete blocks by linear plane surfaces. The forces tending to cause and resist movement on each block are calculated and an overall factor of safety against movement is calculated. The visual geometry of the slide is usually used in establishing the location of the sliding blocks. In this instance, the slide was modeled assuming a plane of movement extended downward from the upper scarp at a steep angle to near the contact between the waste pile and the original ground surface. From this point, it was assumed the plane of movement was located along the original ground surface until it daylighted near the toe.

- *Bishop Method of Slices*
  With this method, a trial and error method is used to locate circular failure planes and corresponding factors of safety are calculated. Each circular failure surface is divided into a number of slices and the forces tending to cause failure (gravity, hydrostatic pressure and seismic forces) are calculated. The forces tending to resist movement (friction and cohesion) are also calculated. A factor of safety is then calculated for the circular failure surface as the ratio of the forces resisting movement, divided by the forces tending to cause movement. Theoretically, when this factor of safety is less than one, movement will occur.

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Results of Stability Analysis

The results of our analyses are briefly summarized below which present the calculated minimum factors of safety. The factors of safety meet the generally accepted minimum requirements for both long- and short-term stability

1. **Sliding Block Analysis** – Factors of safety were calculated to be 1.5 and 1.1 for static and seismic conditions, respectively. In our analysis the major plane of movement was assumed to be along the original contact between the ground and the waste pile. The X-STABL printouts showing the minimum factors of safety for these analyses are shown as Plates C-1 and C-2.

2. **Circular Method of Slices Analysis** – Factors of safety were calculated to be 1.7 and 1.3 for static and seismic conditions, respectively. In our analysis, failure surfaces were restricted to locations in the upper portions of the waste pile where evidence of previous rotational failures occurred. The X-STABL printouts showing the minimum factors of safety for these analyses are shown as Plates C-3 and C-4.

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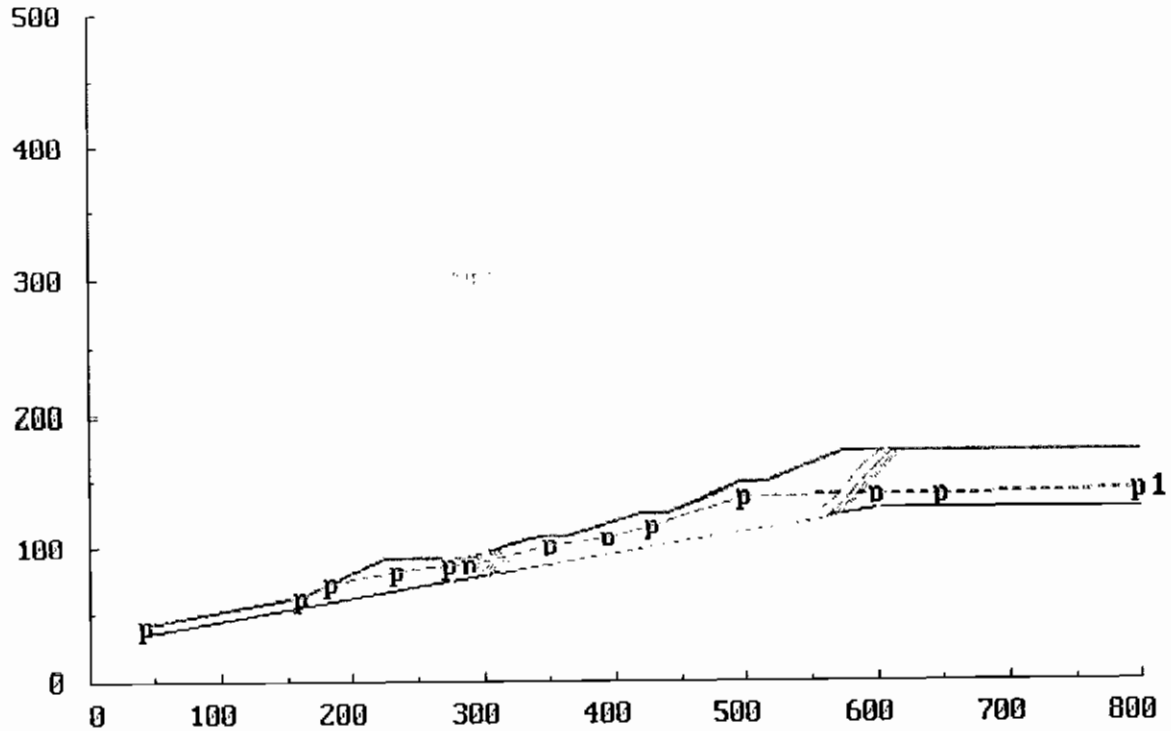
Leviathon Block Analysis
10 most critical surfaces, MINIMUM JANBU FOS = 1.533



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SLIDING BLOCK ANALYSIS
STATIC CONDITION

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE
C-1

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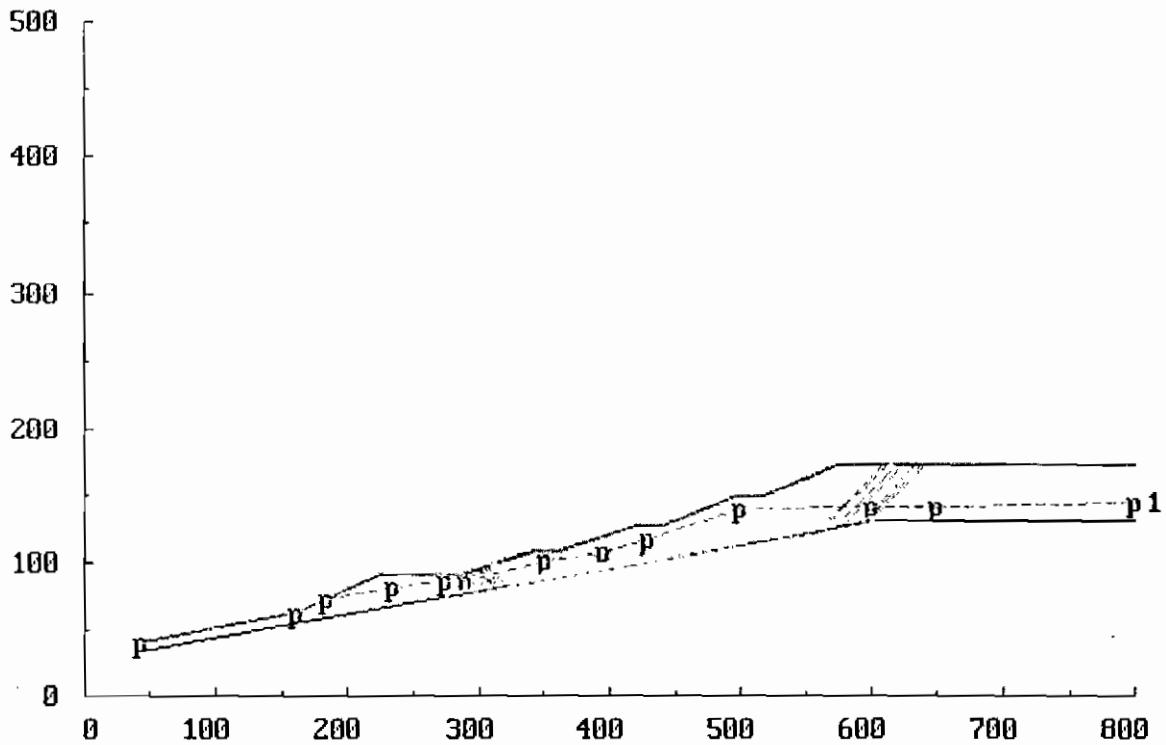
CAD FILE: L:\2003\DRAFTING\29398\29398-SITEPLAN

Leviathon Block Analyis w/seismic
10 most critical surfaces, MINIMUM JANBU FOS = 1.113



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SLIDING BLOCK ANALYSIS
SEISMIC CONDITION

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE
C-2

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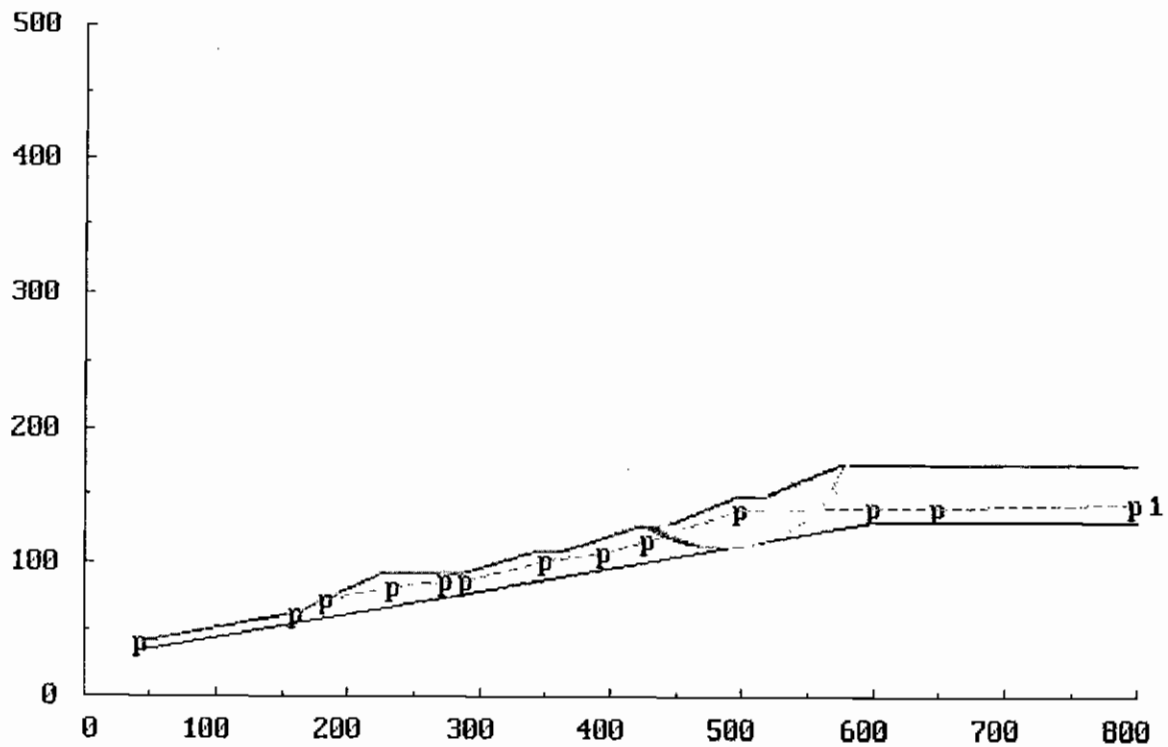
CAD FILE: L:\2003\DRAFTING\29398\29398-SITEPLAN

Leviathon Circular Analysis
10 most critical surfaces, MINIMUM BISHOP FOS = 1.677



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CIRCULAR FAILURE ANALYSIS
STATIC CONDITION

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE
C-3

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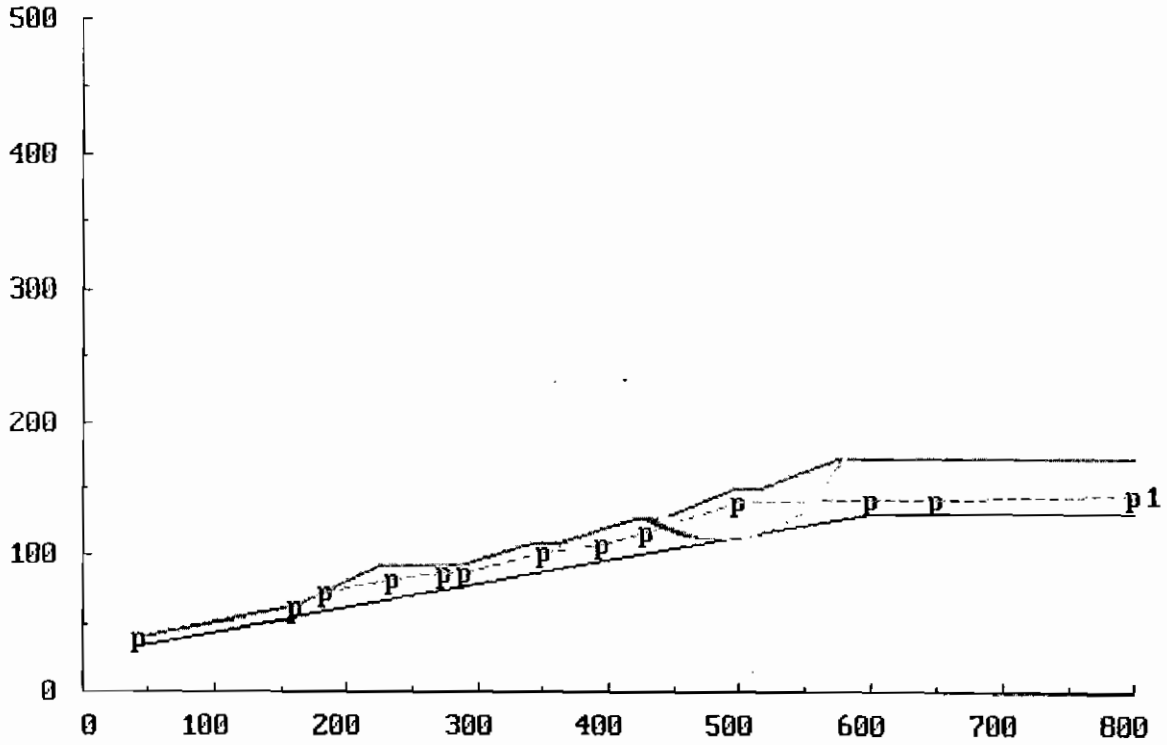
Leviathon Circular Analysis w/seis.
10 most critical surfaces, MINIMUM BISHOP FOS = 1.266



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PROJECT NO. 29398.01

CIRCULAR FAILURE ANALYSIS
SEISMIC CONDITION

LANDSLIDE REPAIR PROJECT
LEVIATHAN MINE
ALPINE COUNTY, NEVADA

PLATE
C-4

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CAD FILE: L:\2003\DRAFTING\29398\29398-SITEPLAN

APPENDIX D

APPLICATION FOR AUTHORIZATION TO USE

APPENDIX D
APPLICATION FOR AUTHORIZATION TO USE

GEOTECHNICAL SLOPE STABILITY EVALUATION
LEVIATHAN MINE DELTA AREA WASTE PILE
ALPINE COUNTY, CALIFORNIA

Kleinfelder, Inc.
4875 Longley Lane, Suite 100
Reno, Nevada 89502

To whom it may concern:

Applicant understands and agrees that the "Geotechnical Slope Stability Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California," dated July 30, 2003, Job No. 29398.01, for the subject site is a copyrighted document, that Kleinfelder, Inc. is the copyright owner and that unauthorized use or copying of said document for the subject site is strictly prohibited without the express written permission of Kleinfelder, Inc. Applicant understands that Kleinfelder, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

Applicant agrees to accept the contractual terms and conditions between Kleinfelder, Inc. and California Department of General Services originally negotiated for preparation of this document. Use of this document without permission releases Kleinfelder, Inc. from any liability that may arise from use of this report.

To be Completed by Applicant

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Date: _____

BIOASSESSMENT MONITORING OF ACID MINE DRAINAGE IMPACTS IN STREAMS OF THE LEVIATHAN MINE WATERSHED: AN UPDATE FOR 2003 SURVEYS

(Herbst, 2004b)

Bioassessment Monitoring of Acid Mine Drainage Impacts in Streams of the Leviathan Mine Watershed: An Update for 2003 Surveys

Final Report to the Lahontan Regional Water Quality Control Board

[contract # 02-103-160-0]

And the U.S. Environmental Protection Agency

October 28, 2004

Submitted by:

David B. Herbst, Ph.D.

Sierra Nevada Aquatic Research Laboratory - University of California

Route 1, Box 198 - Mammoth Lakes, CA 93546

(760) 935-4536 - herbst@lifesci.ucsb.edu

Background

Leviathan Mine is an abandoned open pit mine site located just north of Monitor Pass on highway 89 in Alpine County, California. Covering an area of 650 acres (250 with visible mining disturbance), the mine last operated on a large scale in the 1950s, primarily for sulfur extraction. Acid mine drainage (AMD) from this site enters Leviathan Creek and Aspen Creek, flowing then into Bryant Creek, and enters the East Fork of the Carson River in Douglas County, Nevada. Though some of the annual run-off is contained by collecting ponds, until recently these have regularly overflowed during late winter and spring snow-melt periods, and along with seepage and other sources, contribute flows of low pH water containing a mixture of dissolved and particulate toxic metals, and orange ferric hydroxide precipitates ("yellow-boy"). Active chemical treatment of AMD sources began in earnest in the Autumn of 1999 and has continued since, with the result that the ponds have not overflowed since the Spring of 1999. A second major source of AMD, the "channel underdrain" (where contaminated groundwater "daylights" from beneath a concrete-lined channel constructed to reduce contact of Leviathan Creek with mine spoils) has also been actively treated during the summers of 2001 (Aug-Sep), 2002 (June-Oct), and 2003 (June-Sept). These actions have substantially reduced, but not eliminated the discharge of AMD to Leviathan Creek. Other recent site restoration measures have included the construction of biological treatment systems at AMD seeps (on Aspen Creek), which utilize iron-reducing bacteria to precipitate toxic metals. These "passive" treatment systems have also reduced AMD discharges from the site. In May of 2000 the USEPA listed Leviathan Mine as a Superfund site to facilitate further site remediation.

Bioassessment monitoring of aquatic invertebrates such as insects has been conducted since 1995 in streams of the Leviathan Mine watershed to provide an ecological evaluation of AMD effects on aquatic life and the progress of restoration. Benthic stream invertebrates are sensitive to chemical pollution and physical habitat disturbance and provide a useful indicator tool for assessment of biological integrity. Aquatic macroinvertebrate bioassessment has been previously used to define the spatial extent of biological impacts in the Leviathan-Bryant Creek watershed in 1995, 1997,

1998, 1999 and 2000 (Herbst 1995, Herbst 1997, Herbst 2000, Herbst 2002, Herbst 2004). These data have established the existing condition of the benthic invertebrate community in receiving waters and reference streams, and documented seasonal and year-to-year changes and natural variability. The objective of this report is to provide an update on the results of bioassessment monitoring at sites exposed to mine discharges, and continued development of a data set for evaluating changes in the biological health of stream habitats in the Leviathan watershed.

A group of 6 sample stations was surveyed in June of 2003, and the central 3 stations in September of 2003. The sample sites were located just below the mine on Aspen and Leviathan Creeks, on Leviathan Creek just above its confluence with Mountaineer Creek, on Mountaineer Creek just above confluence with Leviathan, on Bryant Creek below the confluence formed by Leviathan and Mountaineer, and on Bryant Creek near the stateline boundary. The collection periods were selected to represent changing hydrologic conditions during spring run-off and fall base-flow, and phenological changes in the development of insect populations. Mountaineer Creek has served as the primary control site or reference for biomonitoring throughout the history of this survey program. A topographic map of site locations is shown in Figure 1.

Bioassessment Monitoring and Methods

The purpose of the monitoring program described here is to provide biological measures of ecological health using the stream invertebrate community as an indicator. These data will assist managers in delineating the area impacted by AMD, and establish a status condition for continued monitoring of the extent and progress of ecological recovery of stream habitat. Biological structure and function of aquatic ecosystems are not always obvious features of the environment, so practical field techniques are needed to assess the ecological health of streams. Aquatic insects and other invertebrates are central to the function of stream ecosystems, consuming organic matter (wood and leaf debris) and algae, and providing food to higher trophic levels (fish and riparian birds). These native organisms also have varying degrees of pollution tolerance and so may be used as indicators of water quality and habitat conditions. For example, distinctive shifts in the structure and function of the aquatic invertebrate community can often be detected

above and below a pollution source. Such use of the stream invertebrate fauna in evaluating stream ecosystem health is known as bioassessment. This technique uses collections of the benthos (bottom-dwelling fauna) to evaluate the relative abundance of different taxa, feeding guilds, pollution indicators, and diversity, in order to develop a quantitative basis for measuring ecological attributes of the stream. Monitoring relative to reference sites (having little or no impact but similar physical setting), and/or over time within subject sites, then permits impact problems or recovery to be quantified (Rosenberg and Resh 1993). Previous studies of AMD impacts on stream communities have also utilized macroinvertebrate biomonitoring (e.g., Peckarsky and Cook 1981, Chadwick et al. 1986, Vinyard and Watts 1992, Clements 1994, Clements et al. 2000).

The approach taken for the set of collections reported here was to use bioassessment sampling at a reference site (Mountaineer) for contrast to a core group of impact sites located just below the Leviathan Mine AMD source, and above and below the confluence with Mountaineer Creek. Data on the chemical properties of sediments and water from each sample site was also collected to aid interpretation of biological patterns but are not included in this report. Trends have shown gradual improvements in biological conditions progressing upstream toward the mine site contamination source area (Herbst 2004). Previous reports have examined patterns of biological impairment over the greater Leviathan Mine watershed including samples from streams above the mine, on the receiving waters of the East Carson River above and below inflow from Bryant Creek, and on reference streams adjacent to the watershed. As with previous monitoring, sampling was conducted in mid-June and late September, within the index periods established for this study.

Bioassessment sampling was conducted by collecting benthic invertebrates from riffle habitats in shallow stream sections within established survey reaches. Riffles are turbulent flows of water over rocky, shallow stream reaches and contain the greatest abundance and diversity of benthic stream fauna. Samples were taken by kicking and flushing organisms by hand from rocks for 20-30 seconds into a 250-micron mesh D-frame net held just downstream of the 25 x 25 cm sample area (width and depth of the net). Large wood or rock debris was washed and removed from the net and the sample procedure repeated at 2 more locations across each riffle transect. This composite sample

from 3 collections was then processed to separate mineral from biological fractions (elutriation), the mineral fraction inspected in a shallow white pan, remaining invertebrates collected, and the sample preserved in 95% ethanol. Such a collection contains benthic invertebrates in proportion to their relative abundance within the riffle sample areas. Five replicates of these composite kick-samples were taken at each site (moving upstream in randomly located riffle transects) for purposes of statistical description and comparison. The invertebrates collected were identified to the lowest practical taxonomic level (usually genus, species, or species group except oligochaetes and ostracods). Samples were sorted in the lab, organisms identified and counted, and data entered onto an Excel spreadsheet for analysis. Some dense samples were subsampled using a rotating-drum splitter and others were counted in their entirety (counts per sample typically averaged between 250-500 organisms). Reference collections of all taxa have been retained for further comparisons of any taxa of uncertain status. This provides a resource that may be used as a reference collection for future comparison and verification of identifications. For more details on sampling methods and QA/QC procedures followed for these studies, see: http://www.swrcb.ca.gov/rwqcb6/QAPP/QAPP_Index.htm

Data were analyzed using descriptive statistics and graphical contrasts among sites and by season and time. The primary metrics used in interpreting community structure and biological integrity were based on measures of diversity, tolerance, density, and dominance. Mean taxa richness is a measure of overall taxonomic diversity for each site and should increase with heterogeneity of habitat spatial and food resources. Mean EPT richness index is a measure of the diversity of generally sensitive insects belonging to the mayfly (Ephemeroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) orders and will increase in clean, cold, well-oxygenated waters exposed to minimal chemical pollution or habitat alteration (calculated as the sum number of taxa in these groups in each sample). The biotic index is a composite measure of overall community tolerance to pollution and will increase (over a scale of 0-10) as water and habitat quality are degraded (it is calculated as the product of relative abundance and tolerance value for each taxon, summed over all taxa). The percent midges comprising the sample often increase under degraded conditions of water and habitat quality, particularly among

certain indicator taxa. Dominance is a measure of the relative abundance of the most common taxon and levels above 50% of the total community often indicate an imbalance or disturbance in food or habitat resources that permit one or a few species to dominate. Invertebrate density is often quite variable and unreliable as an indicator, but when pollution is severe, density of even tolerant taxa can be reduced as stream conditions become unsuitable for life.

Results and Discussion

From the 2003 surveys there were over 20,000 individual organisms counted and identified, comprised of 149 taxa (listed in the Appendix to this report). In previous surveys over this set of sites the most prominent pattern was of poor biological performance measures at the sites closest to the mine source area (Leviathan below mine, Leviathan above Mountaineer, and Aspen below mine). Recovery at Aspen Creek below the mine, first noted in fall of 1999 as an improved biotic index, continued with the accrual of both total taxa and EPT taxa (Figures 2, 3 and 4). This site was first re-colonized by opportunistic taxa including the mayfly *Baetis* and the black fly *Simulium*, followed by the Nemourid stoneflies *Malenka* and *Zapada*. From low levels of abundance, the density of invertebrates has gradually increased at this site (Figure 5) along with decreased dominance (Figure 6) as a mixed community becomes established. Note that for clarity of presentation only the means of the metrics (for the 5 sample replicates in each case) are shown in these trend graphs, and seasons have not been separated.

The Leviathan Creek below site, closest to the mine, shows in 2003 the early signs of recovery – increased taxa diversity, EPT numbers, reduced biotic index values, and lower levels of dominance by tolerant chironomids, though total density still remains low. The next site downstream, Leviathan @Mountaineer (above Mountaineer confluence), exhibits further indications of progressive recovery, evident in stabilization of the biotic index (as was noted in the initial recovery phase of Aspen Creek) and continued increase in diversity and density. The amount of yellow-boy deposition also appears to be decreasing here. Data on density were included in this report despite the variability in this measure (coefficient of variation typically 50-100% or more compared to about 20%

or less for most other metrics) because it shows how severely AMD can depress biological activity, and because it is an indicator of food resource recovery. Productive streams can also have a great deal of local and seasonal variation in benthic abundance of different taxa and this probably accounts for the large differences in density seen in the Mountaineer Creek samples over time. Though there appears to be an increase over time, there were no significant differences (large and overlapping CV values).

At sites below the mixing zone with clean flows from Mountaineer Creek, biological impairment has usually been evident but less marked than at the sites above Mountaineer and immediately below the mine. The Bryant below sample station (sometimes referred to as the compliance point) and Bryant middle station (also known as the stateline site) appear to be the locations where the most extensive recovery has occurred. While streambed substrates in these areas still show traces and deposits of yellow-boy iron oxides, these sites were densely covered by this precipitate when sampling began in 1995 and 1997. In the early stages of colonization, these sites still contained elevated numbers of some pollution-indicating taxa such as certain midges (e.g. *Eukiefferiella claripennis* grp., *Corynoneura* sp.), empidids (*Chelifera* sp.), and mites (*Sperchon* sp.), but have accumulated more total diversity and EPT taxa with time. The variable trends associated with these locations are typical of instable habitats in transitional phases of recovery, but suggest environmental improvements are sustaining increased biological health on upper Bryant Creek.

Annual and seasonal trends for selected sites over the monitoring period 1997-2003 are presented in most of the figures. The exclusion of spring 1995 surveys in these cases is because the method used then involved collection from only one sample area for each of 3 replicates (resulting in low counts), while all other samples from 1997 and after had sufficient counts or collected three combined or composited samples for each of 5 replicates. The 1995 data will therefore underestimate measures of diversity and community composition. The mean taxa richness (Figure 2) shows that this measure of total diversity is typically in the range of 35 to 50 taxa at the Mountaineer reference site, and previously less than about 30 at the AMD-exposed sites. Improving trends are recently apparent since 2002 at all sites, including early signs at Leviathan Creek nearest the mine. As conditions improve in AMD-impaired streams, the community may shift

from one of low-diversity, inhabited consistently by a few species of very stress-tolerant organisms, to a transitional community of instable composition, dominated by "weedy" species (opportunistic colonizers such as the mayfly *Baetis*, and the black fly *Simulium*) and a mix of more sensitive organisms. As improved water and habitat quality conditions persist, this instable phase is expected to be replaced by a more diverse and stable community of more equally distributed taxa with varied food and habitat requirements. Evidence of such patterns in community structure are present in this data set and should become more clear and predictable with further monitoring of trends during the on-going restoration of AMD-impaired stream segments.

Stages in progressive biological degradation attributable to AMD may be identified based on changes in community structure. About one-third of the total taxonomic diversity is found within one family - the Chironomidae or midges. Within this group are some of the best indicators or signal taxa for AMD pollution impact. Imbalance in community structure may first become apparent at moderately polluted sites (or those in initial stages of recovery) where *Baetis* sp. alone may come to dominate >50% of all taxa. As severity of AMD exposure increases, *Baetis* sp. abundance decreases while the relative abundance of midges increases. With further pollution the midge community itself comes to be dominated by *Corynoneura* sp. and *Eukiefferiella claripennis* sp. group. Other taxa that appear in smaller numbers but are most prevalent at polluted sites include the empidid *Chelifera* sp., the midges *Pseudorthocladius* sp., *Pseudosmittia* sp., the crane fly *Molophilus* sp., and the biting midge *Monohelea* sp. (Ceratopogonidae). *E. claripennis* dominates where AMD pollution is chronic, and is present only in low numbers at unimpaired sites. This species group is a known indicator of degraded water quality (Bode 1983). Recovering communities are first recolonized by opportunistic taxa with rapid growth (*Baetis* and *Simulium*), and by a more diverse group of moderately sensitive taxa that are common and widely distributed (e.g. *Malenka*, *Parapsyche*, *Ceratopsyche*, *Pagastia*, *Optioservus*). Dominance by these groups is then reduced as other more rare taxa become established with further easing of AMD stress.

Conclusions:

Bioassessment monitoring in the Leviathan Mine watershed continues to show clear and consistent signals of progressive improvement in biological integrity on Aspen and Leviathan Creek below the mine. The sites on Bryant Creek downstream of Mountaineer Creek are approaching the reference stream condition in several indicators including diversity and tolerance measures. The instability of community structure and tolerance measures over time at these downstream sites of intermediate pollution attests to their being in a state of flux as the level of exposure to chemical toxicity changes.

Long-term assessment of the biological integrity of streams in the Leviathan Mine watershed will require development of a monitoring strategy to optimize data gathering at a reasonable cost. Biomonitoring observations over the past several years (refer to earlier reports) provide the following guidance: (1) sampling on the East Carson River has revealed no convincing evidence of any current impact from Bryant Creek inflow, (2) Bryant lower is impaired by local impacts independent of AMD, (3) Bryant above Doud has been within the range of reference indicators for all previous samples, (4) sampling in both spring and fall produces some redundant patterns but seasonal shifts in taxa are present and effects of remediation treatment activities in the summer may best be detected through this within-year seasonal contrast, and (5) the reference sites above the mine, on Aspen and Leviathan Creek, are less appropriate locations than Mountaineer Creek for establishing standards for biological recovery, but other control stations should be sampled to frame the target range for the desired community composition. Further sampling can be made more efficient by changing the monitoring strategy as follows (these recommendations revised from Herbst 2002):

1. discontinue sampling at all East Carson River sites, and on Bryant lower and Bryant above Doud stations (though sampling above River Ranch on the East Carson may be useful to confirm biological similarity above and below potential AMD inputs coming from irrigation return flows at that location)
2. conduct sampling both during spring and fall at the core 6 sites documented in these 2003 surveys (to obtain the most cost-effective resolution of remediation

success and track shifts in the aquatic invertebrate community related to flow and season effects as well as the timing of treatment activities)

3. exclude Leviathan and Aspen sites above the mine from regular reference sampling but periodically re-sample, and search for other reference sites (some potential options: Poison Creek, Monitor Creek above the mining district – before reservoir releases in spring, Snodgrass Creek, Pleasant Valley Creek, Pennsylvania Creek above mine site)

The following (new) recommendations are also offered for consideration:

1. In order to interpret how different remediation activities are related to the encouraging trends for recovery of stream ecosystems in the Leviathan Mine drainage, the biological response patterns need to be coupled to a chronology of the timing, locations, and types of operations that have affected the volume and quality of treated flow. This information, along with water chemistry monitoring, should provide a basis for evaluating the effectiveness of individual and cumulative treatment projects, and correlation of chemical improvements in water and sediment with ecological recovery.
2. Further analysis of bioassessment data should also include (1) measures of community similarity between control and impaired streams, and (2) the development of a multimetric index that standardizes and combines separate indicator metrics into a single measure of biological integrity.

Acknowledgements

Field work has been made considerably more enjoyable with the company of Ned Black, who has conducted concurrent sampling for water and sediment chemistry. Laurie Scribe also has assisted in the field and contributed useful review comments. Tom Suk has played an integral role in facilitating the monitoring program, providing thoughtful editorial review, and maintaining continuity in combining science with management. To them and all who have been supportive of this work I give my thanks. Past support has also been provided by the USFS, ARCO, LRWQCB and the USEPA.

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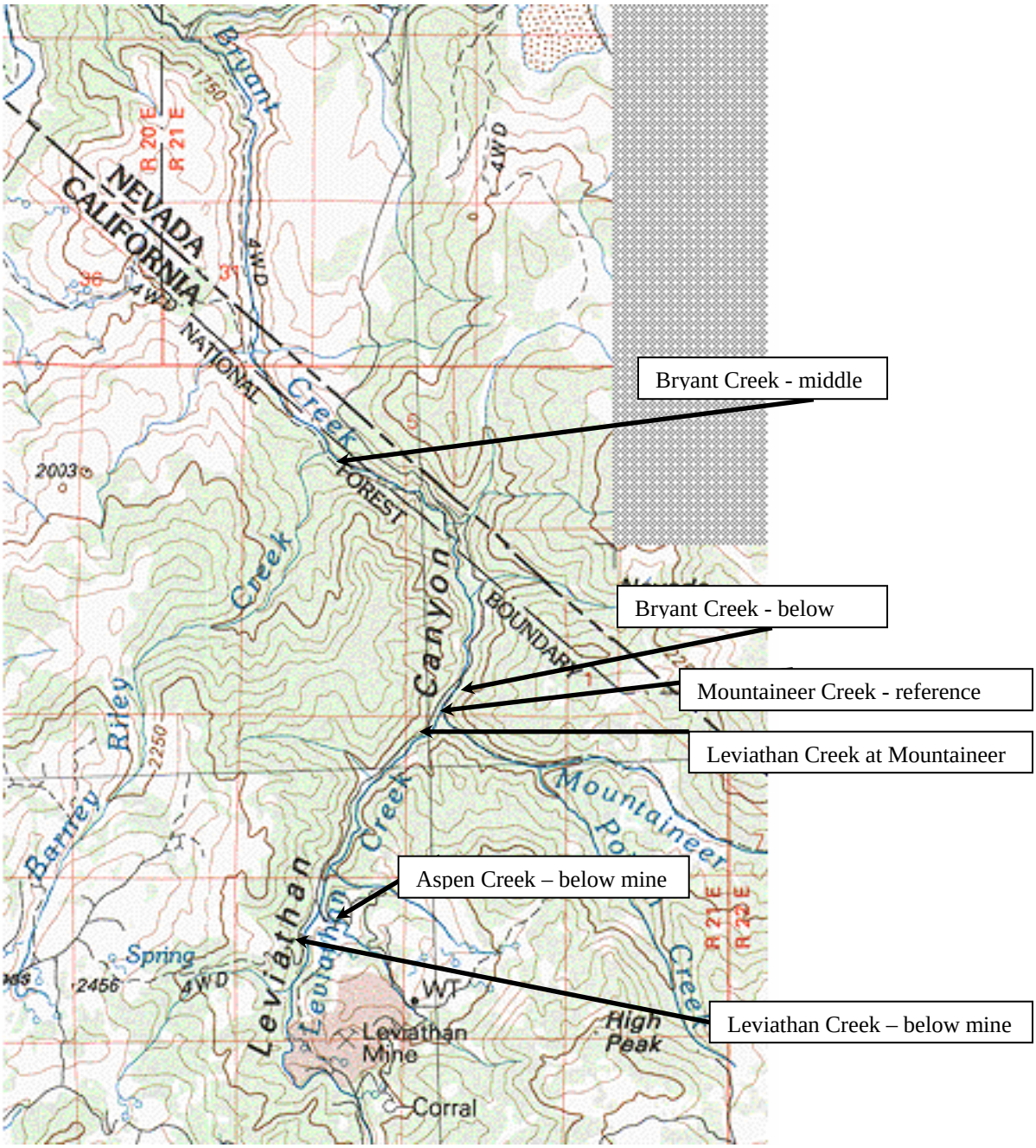

Figure 1. Locations of sample sites surveyed for aquatic invertebrate biomonitoring of the Leviathan Mine watershed in 2001 and 2002.

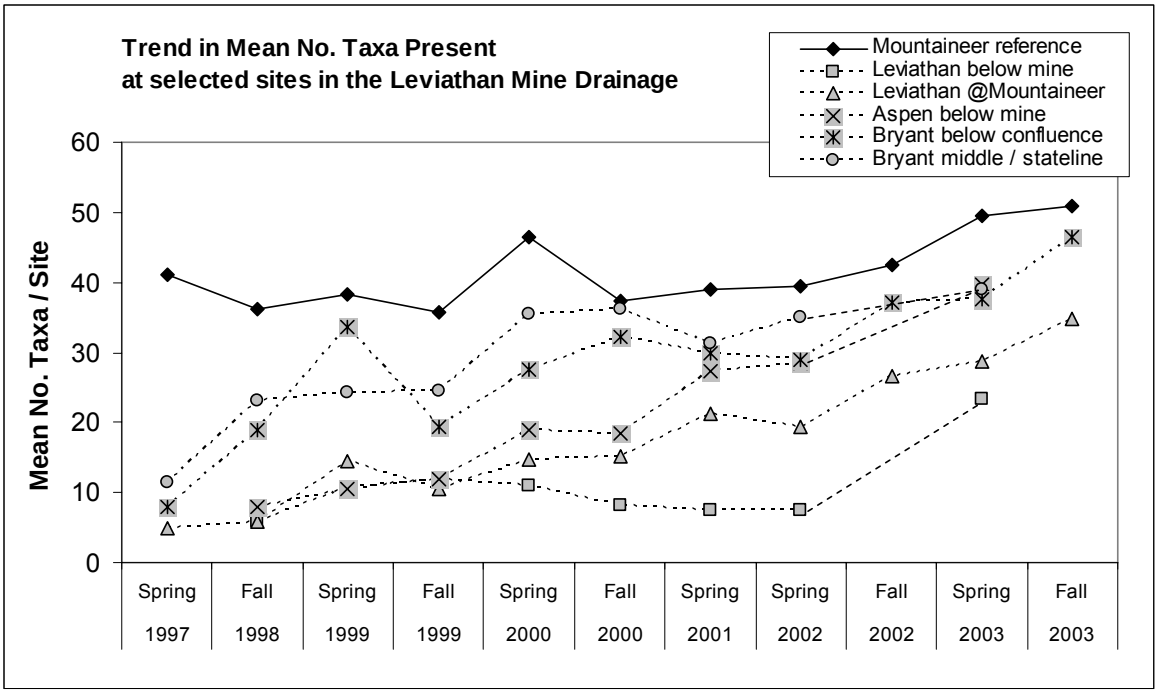

Figure 2. Mean number of taxa present at each site over time (season and year) for selected sites in the Leviathan Mine watershed. Solid line for reference site, dashed lines for AMD-exposed sites.

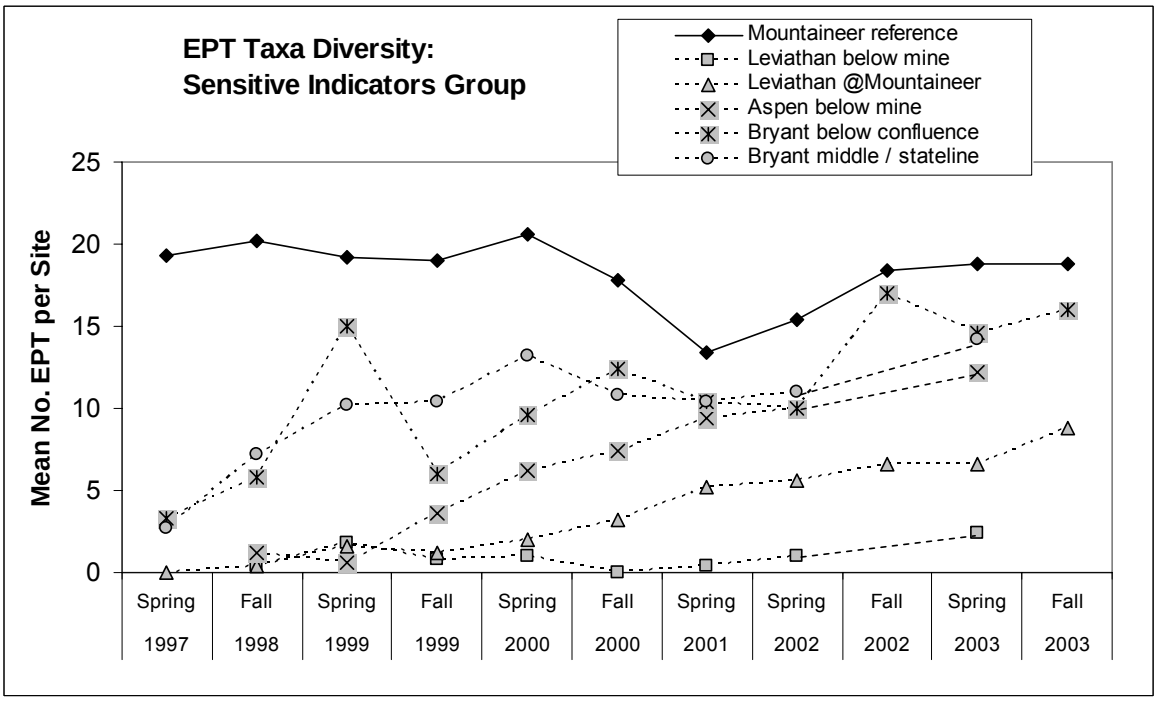

Figure 3. Mean number of EPT taxa present at each site over time (season and year) for selected sites in the Leviathan Mine watershed. Solid line for reference site, dashed lines for AMD-exposed sites.

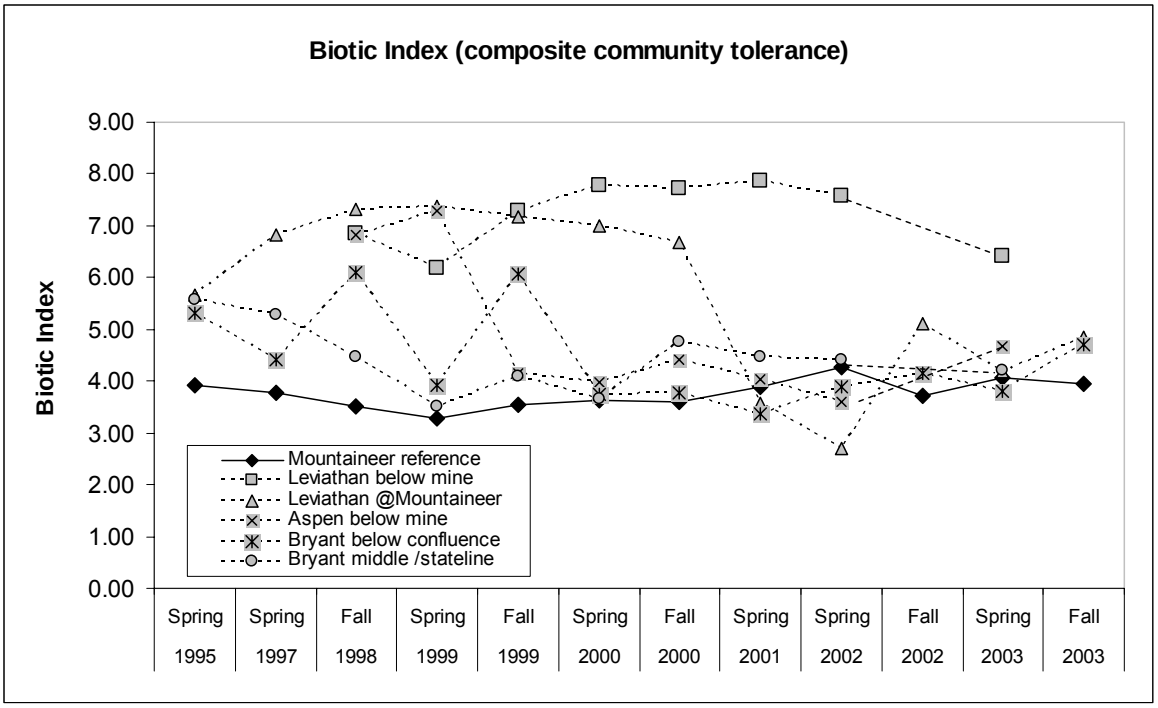

Figure 4. Biotic Index at each site over time (season and year) for selected sites in the Leviathan Mine watershed. Solid line for reference site, dashed lines for AMD-exposed sites.

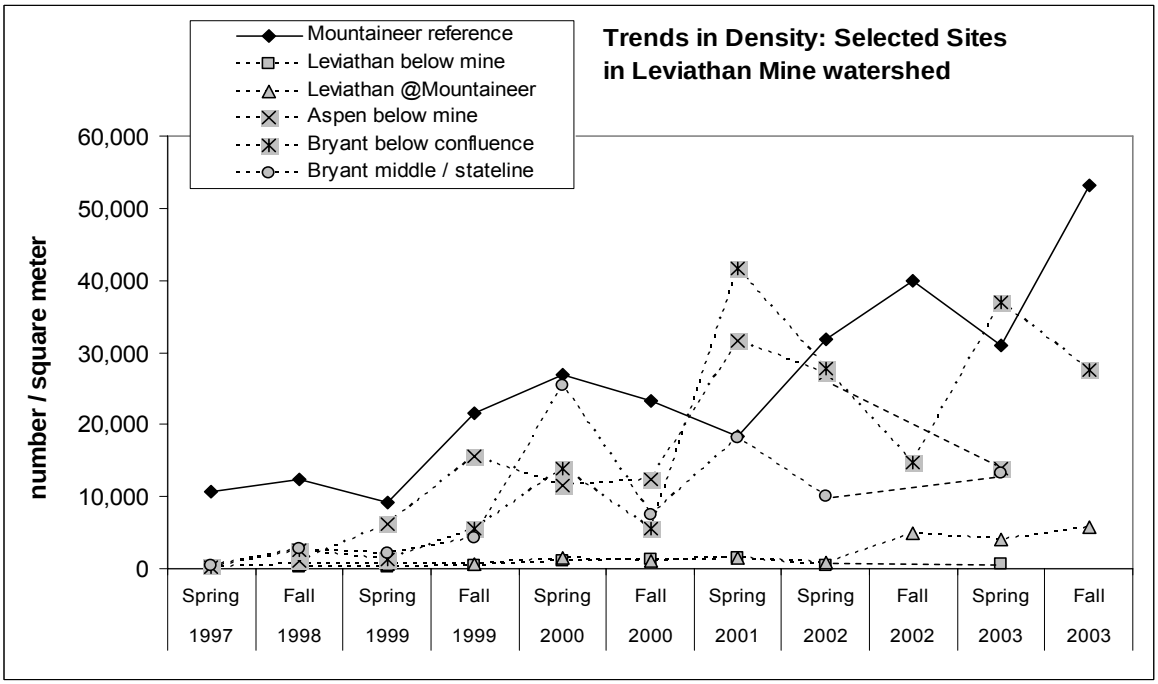

Figure 5. Density (number per square meter) of total invertebrates at each site over time (season and year) for selected sites in the Leviathan Mine watershed. Solid line for reference site, dashed lines for AMD-exposed sites.

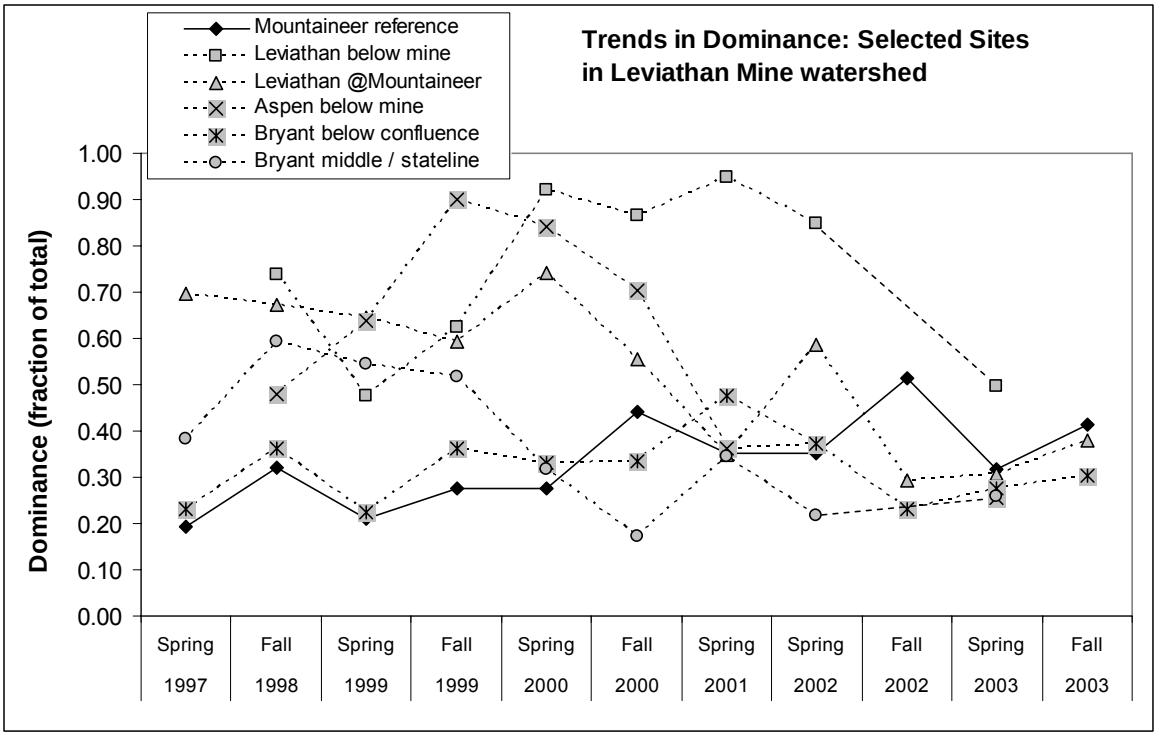

Figure 6. Dominance of the most common invertebrate taxon at each site over time (season and year) for selected sites in the Leviathan Mine watershed. Solid line for reference site, dashed lines for AMD-exposed sites.

APPENDIX: 2003 Leviathan Mine Stream Invertebrate Monitoring: Taxa List and Count Sums					Spring						Fall		
Class	**Order**	**Family**	**Genus and species**	TVs	Lm	Bm	Bb	Mr	Al	La	Lm	Mr	Bb
INSECTA	Ephemeroptera	Baetidae	Baetis sp.	4	9	106	614	98	490	6	15	94	39
			Diphetor sp.	5	3	14	1	4	0	0	1	80	4
			Centroptilum sp.	2	0	3	0	0	0	0	0	0	0
		Ameletidae	Ameletus sp.	0	0	5	0	3	0	0	0	1	0
		Leptophlebiidae	Paraleptophlebia sp.	1	0	63	10	7	1	0	0	15	0
		Ephemerellidae	Serratella spp. (teresa, tibialis, levis)	2	0	4	4	24	14	0	1	62	20
			Ephemerella (infrequens, inermis)	1	0	1	2	1	0	0	0	0	0
			Attenella delantala	3	0	0	1	2	0	0	0	0	0
			Drunella flavilinea	0	0	1	7	20	1	0	0	0	0
			Drunella grandis	0	0	1	1	1	0	0	0	0	0
			Drunella spinifera	0	0	0	0	0	1	0	0	0	0
			Timpanoga hecuba	7	0	0	2	0	0	0	0	0	0
		Heptageniidae	Cinygmula sp.	4	0	0	0	0	0	1	0	40	15
			Epeorus sp.	0	0	2	1	63	0	0	0	65	6
			Ironodes sp.	4	0	1	0	11	4	0	6	43	8
	Plecoptera	Nemouridae	Malenka sp.	2	407	215	247	89	92	1	11	1	3
			Zapada sp.	2	9	405	774	175	189	0	92	54	300
		Capniidae	Capnia /Paracapnia +mixed spp.	1	0	2	0	0	10	2	7	17	33
		Leuctridae	Despaxia augusta	0	2	0	0	0	0	0	5	0	0
		Chloroperlidae	Sweltsa sp.	1	4	2	4	6	2	0	3	6	4
			Suwallia	1	0	0	2	0	0	0	0	0	0
			Haploperla	1	0	0	0	2	0	0	0	0	0
		Peltoperlidae	Yoraperla sp.	2	0	0	2	0	0	0	0	3	1
		Perlodidae	Isoperla sp.	2	4	0	3	0	18	0	0	0	0
			Frisonia picticeps	2	0	2	0	1	0	0	0	0	0
			Kogotus / Rickera	2	0	0	0	0	0	0	0	1	0
			Skwala sp.	2	0	0	0	0	0	0	9	1	3
		Perlidae	Doroneuria baumanni	1	1	6	3	5	0	0	0	6	5
			Hesperoperla pacifica	1	0	0	1	2	0	0	0	0	1
	Trichoptera	Rhyacophilidae	Rhyacophila acropedes grp.	0	0	5	5	5	8	0	2	7	5

2003 Leviathan Mine Stream Invertebrate Monitoring: Taxa List and Count Sums (continued)					Spring						Fall		
Class	**Order**	**Family**	**Genus and species**	TVs	Lm	Bm	Bb	Mr	Al	La	Lm	Mr	Bb
			Rhyacophila angelita grp.	0	7	0	11	4	0	0	0	0	0
			Rhyacophila betteni grp.	0	0	0	0	5	0	0	0	3	0
			Rhyacophila sibirica grp.	0	0	0	0	0	1	0	0	1	6
		Hydroptilidae	Hydroptila sp.	6	0	7	0	0	0	0	1	0	2
			Ochrotrichia sp.	4	0	3	0	0	6	0	0	0	0
		Brachycentridae	Brachycentrus americanus	1	0	0	1	11	0	0	0	2	0
			Micrasema sp.	1	0	0	5	64	0	0	1	143	22
		Glossosomatidae	Agapetus sp.	0	0	0	3	5	0	0	0	16	9
			Anagapetus sp.	0	1	0	2	17	0	0	0	1	0
			Glossosoma sp.	0	0	0	7	0	0	0	0	5	0
		Arctopsychidae	Parapsyche almota	3	2	1	2	1	1	7	5	3	1
		Hydropsychidae	Ceratopsyche spp. (oslari, cockerelli)	4	10	18	15	71	17	0	774	346	675
		Lepidostomatidae	Lepidostoma sp.	1	0	2	5	1	1	0	6	67	54
			Lepidostoma cascadense	1	0	0	0	0	0	0	0	0	4
		Limnephilidae	Dicosmoecus sp.	2	2	4	1	0	4	0	0	0	0
			Amphicosmoecus sp.	1	2	0	0	0	0	0	0	0	0
			Onocosmoecus	2	0	2	1	0	0	0	0	0	0
			Psychoglypha sp.	2	2	2	2	0	3	2	0	0	0
		Uenoidae	Neophylax sp.	3	0	0	0	3	0	0	0	10	1
	Megaloptera	Sialidae	Sialis sp.	4	15	3	2	0	0	14	17	0	6
	Coleoptera	Psephenidae	Eubrianax edwardsi	4	0	0	0	0	0	0	15	10	14
		Elmidae	Lara avara	4	0	0	1	4	0	0	0	4	2
			Narpus concolor	4	0	6	10	2	1	0	1	14	0
			Cleptelmis addenda	4	0	0	0	1	0	0	0	0	0
			Optioservus quadrimaculatus	4	7	69	175	751	67	4	274	1593	290
			Optioservus divergens	4	0	6	0	179	7	1	9	265	18
			Zaitzevia parvula	4	0	0	0	1	0	0	19	3	11
		Dryopidae	Helichus sp.	4	0	0	1	0	0	0	1	0	0
		Hydraenidae	Hydraena sp.	5	0	0	0	0	1	0	0	0	0
			Ochthebius	5	0	0	0	0	2	0	1	0	0
		Hydrophilidae	Ametor scabrosus	5	0	0	0	0	2	0	0	0	0

2003 Leviathan Mine Stream Invertebrate Monitoring: Taxa List and Count Sums (continued)					Spring						Fall		
Class	**Order**	**Family**	**Genus and species**	TVs	Lm	Bm	Bb	Mr	Al	La	Lm	Mr	Bb
		Dytiscidae	Agabus sp.	5	1	0	0	0	0	4	0	0	0
			Stictotarsus striatellus	5	1	0	0	0	0	2	0	0	0
	Diptera	Tipulidae	Antocha monticola	3	0	0	0	0	0	0	0	5	0
			Dicranota sp.	3	6	10	7	4	15	9	1	7	9
			Limnophila sp.	6	0	0	0	0	0	0	0	1	1
			Tipula sp.	4	1	0	0	0	1	3	5	0	0
		Ptychopteridae	Ptychoptera	7	1	2	0	1	0	2	0	2	1
		Psychodidae	Pericoma sp.	4	0	0	0	0	0	0	0	95	50
			Maruina lanceolata	2	1	0	0	0	0	1	0	1	0
		Tabanidae	Tabanus sp.	8	0	0	0	3	0	0	0	2	1
		Simuliidae	Simulium spp. (argus-aureum-canadense++)	6	0	19	0	46	141	6	59	9	21
			Prosimulium	6	5	0	0	0	0	0	0	0	0
		Culicidae	Culex	8	0	0	0	0	0	4	0	0	0
		Dixidae	Dixa sp.	1	0	0	0	0	13	0	0	1	0
			Meringodixa	1	0	0	0	0	1	0	0	1	0
		Ceratopogonidae	Bezzia-Palpomyia sp.	6	43	5	9	5	10	9	37	14	19
			Culicoides sp.	6	3	0	2	1	3	0	1	0	2
			Forcipomyia sp.	6	1	0	0	0	2	0	0	0	0
			Ceratopogon sp.	6	18	7	1	0	7	2	4	0	0
			Monohelea sp.	6	0	0	0	0	0	9	4	0	0
		Muscidae	undetermined sp.	6	2	0	0	0	0	4	0	0	0
			Limnophora	6	0	0	0	1	0	8	0	0	0
		Empididae	Chelifera sp.	6	10	6	11	2	16	0	9	12	14
			Clinocera (Hydrodromia) sp.	6	0	0	0	1	1	0	0	0	0
		Ephydridae	Scatella	6	0	0	1	1	0	0	0	0	0
	Chironomidae	Diamesinae	Diamesa sp.	6	10	7	5	2	0	3	2	0	5
			Pseudodiamesa	6	0	0	0	0	0	1	0	0	0
			Pagastia sp.	1	405	111	151	87	47	12	3	1	5
		Prodiamesinae	Odontomesa sp.	6	0	0	6	0	0	0	0	0	1
		Tanypodinae	Apsectrotanypus sp.	6	2	3	0	0	1	0	0	1	0
			Larsia sp.	6	0	0	5	15	0	0	1	25	8

2003 Leviathan Mine Stream Invertebrate Monitoring: Taxa List and Count Sums (continued)					Spring						Fall		
Class	**Order**	**Family**	**Genus and species**	TVs	Lm	Bm	Bb	Mr	Al	La	Lm	Mr	Bb
			Pentaneura sp.	6	0	0	2	24	13	0	1	1	0
			Thienemannimyia grp.	6	5	32	14	14	0	0	15	0	6
			Zavrelimyia sp.	6	0	0	0	0	1	0	0	0	0
		Orthocladiinae	Brillia sp.	5	4	12	3	2	11	1	1	2	4
			Cricotopus-Orthocladius spp.	7	441	136	485	44	252	299	181	22	628
			Cricotopus trifascia grp.	7	0	3	0	0	0	0	0	0	0
			Corynoneura cf. lobata	6	6	6	0	11	9	10	31	24	7
			Eukiefferiella brehmi grp.	8	0	0	0	0	0	2	1	0	0
			Eukiefferiella gracei grp.	8	21	6	95	220	24	0	4	16	36
			Eukiefferiella claripennis grp.	8	179	2	0	4	35	12	216	3	25
			Eukiefferiella devonica grp.	8	0	0	0	1	0	0	0	0	0
			Heleniella sp.	6	7	0	2	12	1	0	0	4	0
			Krenosmittia sp.	6	0	0	1	0	0	0	0	0	0
			Limnophyes sp.	8	2	3	0	1	16	14	3	0	1
			Metriocnemus hygropetricus grp.	6	0	0	0	0	2	0	0	0	0
			Nanocladius parvulus grp.	3	0	0	0	2	0	1	0	0	0
			Parakiefferiella sp.	6	0	0	1	0	0	0	0	2	3
			Parametriocnemus sp.	6	0	5	0	3	32	7	4	9	6
			Paraphaenocladius sp.	6	0	0	0	1	0	0	0	0	0
			Parorthocladius	6	0	0	0	0	0	0	0	1	0
			Psectrocladius sordidellus grp.	8	0	0	0	0	0	15	0	0	0
			Pseudorthocladius sp.	6	3	0	0	0	0	7	1	0	0
			Pseudosmittia sp.	6	1	0	0	0	1	8	1	0	0
			Rheocricotopus sp.	6	0	6	0	0	0	0	0	27	0
			Smittia	6	0	0	0	0	0	1	0	0	0
			Thienemanniella cf. xena	6	0	3	0	25	36	0	6	57	65
			Tvetenia bavarica grp.	5	0	12	0	53	23	7	11	8	17
		Chironominae	Apedilum sp.	6	3	0	0	0	0	16	0	0	0
			Chironomus	10	0	0	0	0	1	6	0	0	0
			Cladotanytarsus vanderwulpi grp.	7	0	1	1	0	0	0	0	17	2
			Micropsectra sp.	7	10	447	42	78	108	66	54	69	92

2003 Leviathan Mine Stream Invertebrate Monitoring: Taxa List and Count Sums (continued)					Spring						Fall		
Class	**Order**	**Family**	**Genus and species**	TVs	Lm	Bm	Bb	Mr	Al	La	Lm	Mr	Bb
			Paracladopelma nereis	6	0	1	1	0	1	0	0	0	0
			Paratendipes	6	2	2	1	1	0	0	0	0	0
			Phaenopsectra sp.	7	4	61	0	0	0	1	0	1	1
			Polypedilum cf. laetum	6	3	0	0	0	3	1	0	0	0
			Polypedilum cf. scalaenum	6	3	6	3	0	0	0	0	2	1
			Pseudochironomus sp.	8	0	2	0	0	4	0	3	0	1
			Stempellinella sp.	4	0	15	10	25	0	0	0	0	0
			Rheotanytarsus	6	0	0	0	4	0	0	0	0	3
			Virgatanytarsus	6	0	0	0	1	0	0	8	20	25
OLIGOCHAETA	undetermined	undetermined	undetermined oligochaete spp.	4	66	84	65	66	18	8	27	81	9
TURBELLARIA	Tricladida	Planariidae	Dugesia tigrina	4	0	0	1	16	0	0	0	7	1
CRUSTACEA	Ostracoda	undetermined	undetermined ostracod spp.	8	0	40	7	5	29	0	5	10	2
BIVALVIA		Sphaeriidae	Pisidium sp.	8	0	0	1	9	0	0	0	37	0
GASTROPODA	Pulmonata	Lymnaeidae	Fossaria	8	0	0	0	0	0	0	0	0	2
	water mites		Cheiroseius	5	0	0	0	0	0	2	0	0	0
			Hydrozetes	5	0	0	0	1	0	1	0	0	0
HYDRACARINA			Atractides sp.	5	16	24	21	21	42	3	10	25	18
			Hygrobates	5	0	0	1	0	0	0	0	1	0
			Aturus sp.	5	1	7	11	19	1	0	1	32	17
			Feltria sp.	5	0	2	1	6	0	0	0	2	3
			Lebertia sp.	5	12	13	17	12	8	0	22	20	27
			Protzia sp.	5	0	0	0	0	0	0	1	0	1
			Sperchon sp.	5	35	1	24	11	37	1	18	13	15
			Wandesia	5	0	0	0	0	0	1	0	0	0
			Torrenticola	5	0	1	0	0	0	0	0	0	0
			Testudacarus sp.	5	0	0	6	19	0	0	2	35	27

TVs = tolerance values (0 = sensitive, 10 = tolerant)

Study Site Location Codes: Lm = Leviathan @/above Mountaineer, Al = Aspen above Leviathan, Mr = Mountaineer reference, Bb = Bryant below confluence, Bm = Bryant middle, and La = Leviathan above Aspen

WATER QUALITY STUDY REPORT FOR THE NATURAL RESOURCE DAMAGE ASSESSMENT OF SURFACE WATER BELOW THE LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA AND DOUGLAS COUNTY, NEVADA

(Markin and Yee, 2006)

Surface Water Results from the Project Database
Markin and Yee (2006)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
LEV	6/13/2002	Hg	0.4	ng/L	Total	MAR-006
Sta 25	6/13/2002	Alkalinity (Bicarbonate)	57	mg/L	Total	MAR-006
Sta 25	6/13/2002	Alkalinity (Bicarbonate)	56	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cl	1.05	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cl	1.08	mg/L	Total	MAR-006
Sta 25	6/13/2002	Carbon, Organic	0.8	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Carbon, Organic	0.8	mg/L	Dis	MAR-006
Sta 25	6/13/2002	pH	7.95	su	Lab	MAR-006
Sta 25	6/13/2002	pH	7.87	su	Lab	MAR-006
Sta 25	6/13/2002	SO4	104	mg/L	Total	MAR-006
Sta 25	6/13/2002	SO4	105	mg/L	Total	MAR-006
Sta 25	6/13/2002	Carbon, Organic	1.3	mg/L	Total	MAR-006
Sta 25	6/13/2002	Carbon, Organic	1.1	mg/L	Total	MAR-006
Sta 23	6/13/2002	Alkalinity (Bicarbonate)	3	mg/L	Total	MAR-006
Sta 23	6/13/2002	Alkalinity (Bicarbonate)	3	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cl	1.19	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cl	1.19	mg/L	Total	MAR-006
Sta 23	6/13/2002	Carbon, Organic	0.9	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Carbon, Organic	0.9	mg/L	Dis	MAR-006
Sta 23	6/13/2002	pH	6.13	su	Lab	MAR-006
Sta 23	6/13/2002	pH	6.11	su	Lab	MAR-006
Sta 23	6/13/2002	SO4	343	mg/L	Total	MAR-006
Sta 23	6/13/2002	SO4	339	mg/L	Total	MAR-006
Sta 23	6/13/2002	Carbon, Organic	1.3	mg/L	Total	MAR-006
Sta 23	6/13/2002	Carbon, Organic	1.3	mg/L	Total	MAR-006
BRY	6/13/2002	Alkalinity (Bicarbonate)	59	mg/L	Total	MAR-006
BRY	6/13/2002	Alkalinity (Bicarbonate)	59	mg/L	Total	MAR-006
BRY	6/13/2002	Cl	1.87	mg/L	Total	MAR-006
BRY	6/13/2002	Cl	1.86	mg/L	Total	MAR-006
BRY	6/13/2002	Carbon, Organic	1.1	mg/L	Dis	MAR-006
BRY	6/13/2002	Carbon, Organic	1.2	mg/L	Dis	MAR-006
BRY	6/13/2002	pH	8.04	su	Lab	MAR-006
BRY	6/13/2002	pH	8.04	su	Lab	MAR-006

Surface Water Results from the Project Database
Markin and Yee (2006)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
BRY	6/13/2002	SO4	102	mg/L	Total	MAR-006
BRY	6/13/2002	SO4	103	mg/L	Total	MAR-006
BRY	6/13/2002	Carbon, Organic	1.2	mg/L	Total	MAR-006
BRY	6/13/2002	Carbon, Organic	1.1	mg/L	Total	MAR-006
Sta 26	6/13/2002	Alkalinity (Bicarbonate)	86	mg/L	Total	MAR-006
Sta 26	6/13/2002	Alkalinity (Bicarbonate)	86	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cl	1.44	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cl	1.43	mg/L	Total	MAR-006
Sta 26	6/13/2002	Carbon, Organic	1	mg/L	Dis	MAR-006
Sta 26	6/13/2002	pH	8.25	su	Lab	MAR-006
Sta 26	6/13/2002	pH	8.3	su	Lab	MAR-006
Sta 26	6/13/2002	SO4	55.37	mg/L	Total	MAR-006
Sta 26	6/13/2002	SO4	55.5	mg/L	Total	MAR-006
Sta 26	6/13/2002	Carbon, Organic	1	mg/L	Total	MAR-006
Sta 26	6/13/2002	Carbon, Organic	1.4	mg/L	Total	MAR-006
Sta 26	6/13/2002	Carbon, Organic	1	mg/L	Total	MAR-006
Sta 15	6/13/2002	Alkalinity (Bicarbonate)	3	mg/L	Total	MAR-006
Sta 15	6/13/2002	Alkalinity (Bicarbonate)	3	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cl	1.45	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cl	1.43	mg/L	Total	MAR-006
Sta 15	6/13/2002	Carbon, Organic	1.1	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Carbon, Organic	1.1	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Hg	5.9	ng/L	Total	MAR-006
Sta 15	6/13/2002	Hg	0.4	ng/L	Total	MAR-006
Sta 15	6/13/2002	pH	4.74	su	Lab	MAR-006
Sta 15	6/13/2002	pH	4.77	su	Lab	MAR-006
Sta 15	6/13/2002	SO4	636	mg/L	Total	MAR-006
Sta 15	6/13/2002	SO4	749	mg/L	Total	MAR-006
Sta 15	6/13/2002	Carbon, Organic	1.6	mg/L	Total	MAR-006
Sta 15	6/13/2002	Carbon, Organic	1.5	mg/L	Total	MAR-006

Surface Water Results from the Project Database
Markin and Yee (2006)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
Sta 1	6/13/2002	Hg	2.1	ng/L	Total	MAR-006
Sta 1	6/13/2002	Hg	1.4	ng/L	Total	MAR-006
Sta 25	6/13/2002	Al	0.0288	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Al	0.0165	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Al	1.17	mg/L	Total	MAR-006
Sta 25	6/13/2002	Al	1.29	mg/L	Total	MAR-006
Sta 25	6/13/2002	As	0.0007	mg/L	Dis	MAR-006
Sta 25	6/13/2002	As	0.0007	mg/L	Dis	MAR-006
Sta 25	6/13/2002	As	0.0067	mg/L	Total	MAR-006
Sta 25	6/13/2002	As	0.0069	mg/L	Total	MAR-006
Sta 25	6/13/2002	B	0.0435	mg/L	Dis	MAR-006
Sta 25	6/13/2002	B	0.0275	mg/L	Dis	MAR-006
Sta 25	6/13/2002	B	0.023	mg/L	Total	MAR-006
Sta 25	6/13/2002	B	0.0452	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cd	0.00002	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cd	0.00002	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cd	0.00004	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cd	0.00005	mg/L	Total	MAR-006
Sta 25	6/13/2002	Ca	38.7	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Ca	37.9	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Ca	39.4	mg/L	Total	MAR-006
Sta 25	6/13/2002	Ca	40.6	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cr	0.00031	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cr	0.00035	mg/L	Total	MAR-006
Sta 25	6/13/2002	Co	0.0179	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Co	0.0179	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Co	0.0206	mg/L	Total	MAR-006
Sta 25	6/13/2002	Co	0.0203	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cu	0.0006	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cu	0.0005	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Cu	0.0025	mg/L	Total	MAR-006
Sta 25	6/13/2002	Cu	0.0026	mg/L	Total	MAR-006
Sta 25	6/13/2002	Fe	0.213	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Fe	0.19	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Fe	3.6	mg/L	Total	MAR-006
Sta 25	6/13/2002	Fe	0.0374	mg/L	Total	MAR-006
Sta 25	6/13/2002	Mn	0.641	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Mn	0.628	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Mn	0.694	mg/L	Total	MAR-006
Sta 25	6/13/2002	Mn	0.714	mg/L	Total	MAR-006
Sta 25	6/13/2002	Mg	11.2	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Mg	10.9	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Mg	11.4	mg/L	Total	MAR-006
Sta 25	6/13/2002	Mg	11.7	mg/L	Total	MAR-006
Sta 25	6/13/2002	Ni	0.0368	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Ni	0.0369	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Ni	0.0416	mg/L	Total	MAR-006

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Sta 25	6/13/2002	Ni	0.0425	mg/L	Total	MAR-006
Sta 25	6/13/2002	K	3.49	mg/L	Dis	MAR-006
Sta 25	6/13/2002	K	3.49	mg/L	Dis	MAR-006
Sta 25	6/13/2002	K	3.35	mg/L	Total	MAR-006
Sta 25	6/13/2002	K	3.77	mg/L	Total	MAR-006
Sta 25	6/13/2002	Se	0.0006	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Se	0.0007	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Se	0.0007	mg/L	Total	MAR-006
Sta 25	6/13/2002	Se	0.0007	mg/L	Total	MAR-006
Sta 25	6/13/2002	Na	10.3	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Na	10.1	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Na	10.3	mg/L	Total	MAR-006
Sta 25	6/13/2002	Na	10.6	mg/L	Total	MAR-006
Sta 25	6/13/2002	Sr	0.369	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Sr	0.362	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Sr	0.376	mg/L	Total	MAR-006
Sta 25	6/13/2002	Sr	0.387	mg/L	Total	MAR-006
Sta 25	6/13/2002	Tl	0.00092	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Tl	0.00094	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Tl	0.00101	mg/L	Total	MAR-006
Sta 25	6/13/2002	Tl	0.00104	mg/L	Total	MAR-006
Sta 25	6/13/2002	Zn	0.002	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Zn	0.0019	mg/L	Dis	MAR-006
Sta 25	6/13/2002	Zn	0.0085	mg/L	Total	MAR-006
Sta 25	6/13/2002	Zn	0.0089	mg/L	Total	MAR-006
Sta 23	6/13/2002	Al	0.0125	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Al	0.0165	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Al	0.0141	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Al	2.92	mg/L	Total	MAR-006
Sta 23	6/13/2002	Al	2.87	mg/L	Total	MAR-006
Sta 23	6/13/2002	As	0.0015	mg/L	Dis	MAR-006
Sta 23	6/13/2002	As	0.0007	mg/L	Dis	MAR-006
Sta 23	6/13/2002	As	0.0015	mg/L	Dis	MAR-006
Sta 23	6/13/2002	As	0.0198	mg/L	Total	MAR-006
Sta 23	6/13/2002	As	0.0199	mg/L	Total	MAR-006
Sta 23	6/13/2002	B	0.0503	mg/L	Dis	MAR-006
Sta 23	6/13/2002	B	0.0275	mg/L	Dis	MAR-006
Sta 23	6/13/2002	B	0.0476	mg/L	Dis	MAR-006
Sta 23	6/13/2002	B	0.0548	mg/L	Total	MAR-006
Sta 23	6/13/2002	B	0.0468	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cd	0.00012	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cd	0.00002	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cd	0.00012	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cd	0.00013	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cd	0.00014	mg/L	Total	MAR-006
Sta 23	6/13/2002	Ca	88.9	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ca	37.9	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ca	89.1	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ca	86.7	mg/L	Total	MAR-006

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Sta 23	6/13/2002	Ca	86.2	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cr	0.00081	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cr	0.00083	mg/L	Total	MAR-006
Sta 23	6/13/2002	Co	0.0691	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Co	0.0179	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Co	0.0684	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Co	0.0683	mg/L	Total	MAR-006
Sta 23	6/13/2002	Co	0.0666	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cu	0.0011	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cu	0.0005	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cu	0.0012	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Cu	0.0068	mg/L	Total	MAR-006
Sta 23	6/13/2002	Cu	0.0071	mg/L	Total	MAR-006
Sta 23	6/13/2002	Fe	5.53	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Fe	0.19	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Fe	5.51	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Fe	11.3	mg/L	Total	MAR-006
Sta 23	6/13/2002	Fe	11.3	mg/L	Total	MAR-006
Sta 23	6/13/2002	Mn	2.28	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mn	0.628	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mn	2.28	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mn	2.25	mg/L	Total	MAR-006
Sta 23	6/13/2002	Mn	2.23	mg/L	Total	MAR-006
Sta 23	6/13/2002	Mg	22.6	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mg	10.9	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mg	22.7	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Mg	22.1	mg/L	Total	MAR-006
Sta 23	6/13/2002	Mg	22	mg/L	Total	MAR-006
Sta 23	6/13/2002	Ni	0.14	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ni	0.0369	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ni	0.141	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Ni	0.137	mg/L	Total	MAR-006
Sta 23	6/13/2002	Ni	0.138	mg/L	Total	MAR-006
Sta 23	6/13/2002	K	5.04	mg/L	Dis	MAR-006
Sta 23	6/13/2002	K	3.49	mg/L	Dis	MAR-006
Sta 23	6/13/2002	K	4.7	mg/L	Dis	MAR-006
Sta 23	6/13/2002	K	4.72	mg/L	Total	MAR-006
Sta 23	6/13/2002	K	4.2	mg/L	Total	MAR-006
Sta 23	6/13/2002	Se	0.0018	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Se	0.0007	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Se	0.0017	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Se	0.0019	mg/L	Total	MAR-006
Sta 23	6/13/2002	Se	0.002	mg/L	Total	MAR-006
Sta 23	6/13/2002	Na	15.6	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Na	10.1	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Na	15.5	mg/L	Dis	MAR-006

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Sta 23	6/13/2002	Na	15.2	mg/L	Total	MAR-006
Sta 23	6/13/2002	Na	15	mg/L	Total	MAR-006
Sta 23	6/13/2002	Sr	0.677	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Sr	0.362	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Sr	0.678	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Sr	0.661	mg/L	Total	MAR-006
Sta 23	6/13/2002	Sr	0.654	mg/L	Total	MAR-006
Sta 23	6/13/2002	Tl	0.00307	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Tl	0.00094	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Tl	0.00313	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Tl	3.25	mg/L	Total	MAR-006
Sta 23	6/13/2002	Tl	0.00324	mg/L	Total	MAR-006
Sta 23	6/13/2002	Zn	0.0211	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Zn	0.0019	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Zn	0.0213	mg/L	Dis	MAR-006
Sta 23	6/13/2002	Zn	0.0258	mg/L	Total	MAR-006
Sta 23	6/13/2002	Zn	0.0263	mg/L	Total	MAR-006
BRY	6/13/2002	Al	0.218	mg/L	Dis	MAR-006
BRY	6/13/2002	Al	0.194	mg/L	Dis	MAR-006
BRY	6/13/2002	Al	0.355	mg/L	Total	MAR-006
BRY	6/13/2002	Al	0.38	mg/L	Total	MAR-006
BRY	6/13/2002	As	0.0041	mg/L	Dis	MAR-006
BRY	6/13/2002	As	0.0042	mg/L	Dis	MAR-006
BRY	6/13/2002	As	0.0048	mg/L	Total	MAR-006
BRY	6/13/2002	As	0.0048	mg/L	Total	MAR-006
BRY	6/13/2002	B	0.0551	mg/L	Dis	MAR-006
BRY	6/13/2002	B	0.0311	mg/L	Dis	MAR-006
BRY	6/13/2002	B	0.0407	mg/L	Total	MAR-006
BRY	6/13/2002	B	0.0363	mg/L	Total	MAR-006
BRY	6/13/2002	Cd	0.00001	mg/L	Dis	MAR-006
BRY	6/13/2002	Cd	0.00002	mg/L	Dis	MAR-006
BRY	6/13/2002	Cd	0.00001	mg/L	Total	MAR-006
BRY	6/13/2002	Cd	0.00002	mg/L	Total	MAR-006
BRY	6/13/2002	Ca	34.6	mg/L	Dis	MAR-006
BRY	6/13/2002	Ca	33.4	mg/L	Dis	MAR-006
BRY	6/13/2002	Ca	34.4	mg/L	Total	MAR-006
BRY	6/13/2002	Ca	34.1	mg/L	Total	MAR-006
BRY	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
BRY	6/13/2002	Cr	0.00004	mg/L	Dis	MAR-006
BRY	6/13/2002	Cr	0.00009	mg/L	Total	MAR-006
BRY	6/13/2002	Cr	0.00007	mg/L	Total	MAR-006
BRY	6/13/2002	Co	0.00032	mg/L	Dis	MAR-006
BRY	6/13/2002	Co	0.00032	mg/L	Dis	MAR-006
BRY	6/13/2002	Co	0.00056	mg/L	Total	MAR-006
BRY	6/13/2002	Co	0.00058	mg/L	Total	MAR-006
BRY	6/13/2002	Cu	0.0008	mg/L	Dis	MAR-006
BRY	6/13/2002	Cu	0.0008	mg/L	Dis	MAR-006
BRY	6/13/2002	Cu	0.001	mg/L	Total	MAR-006
BRY	6/13/2002	Cu	0.001	mg/L	Total	MAR-006

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BRY	6/13/2002	Fe	0.132	mg/L	Dis	MAR-006
BRY	6/13/2002	Fe	0.127	mg/L	Dis	MAR-006
BRY	6/13/2002	Fe	0.332	mg/L	Total	MAR-006
BRY	6/13/2002	Fe	0.351	mg/L	Total	MAR-006
BRY	6/13/2002	Mn	0.0241	mg/L	Dis	MAR-006
BRY	6/13/2002	Mn	0.023	mg/L	Dis	MAR-006
BRY	6/13/2002	Mn	0.0362	mg/L	Total	MAR-006
BRY	6/13/2002	Mn	0.0378	mg/L	Total	MAR-006
BRY	6/13/2002	Mg	11.7	mg/L	Dis	MAR-006
BRY	6/13/2002	Mg	11.3	mg/L	Dis	MAR-006
BRY	6/13/2002	Mg	11.7	mg/L	Total	MAR-006
BRY	6/13/2002	Mg	11.6	mg/L	Total	MAR-006
BRY	6/13/2002	Ni	0.00428	mg/L	Dis	MAR-006
BRY	6/13/2002	Ni	0.00423	mg/L	Dis	MAR-006
BRY	6/13/2002	Ni	0.00486	mg/L	Total	MAR-006
BRY	6/13/2002	Ni	0.00476	mg/L	Total	MAR-006
BRY	6/13/2002	K	5.28	mg/L	Dis	MAR-006
BRY	6/13/2002	K	5.09	mg/L	Dis	MAR-006
BRY	6/13/2002	K	5.38	mg/L	Total	MAR-006
BRY	6/13/2002	K	5.62	mg/L	Total	MAR-006
BRY	6/13/2002	Se	0.0005	mg/L	Dis	MAR-006
BRY	6/13/2002	Se	0.0005	mg/L	Dis	MAR-006
BRY	6/13/2002	Se	0.0005	mg/L	Total	MAR-006
BRY	6/13/2002	Se	0.0005	mg/L	Total	MAR-006
BRY	6/13/2002	Na	16.8	mg/L	Dis	MAR-006
BRY	6/13/2002	Na	16.1	mg/L	Dis	MAR-006
BRY	6/13/2002	Na	16.7	mg/L	Total	MAR-006
BRY	6/13/2002	Na	16.4	mg/L	Total	MAR-006
BRY	6/13/2002	Sr	0.319	mg/L	Dis	MAR-006
BRY	6/13/2002	Sr	0.307	mg/L	Dis	MAR-006
BRY	6/13/2002	Sr	0.318	mg/L	Total	MAR-006
BRY	6/13/2002	Sr	0.314	mg/L	Total	MAR-006
BRY	6/13/2002	Tl	0.00043	mg/L	Dis	MAR-006
BRY	6/13/2002	Tl	0.00045	mg/L	Dis	MAR-006
BRY	6/13/2002	Tl	0.00043	mg/L	Total	MAR-006
BRY	6/13/2002	Tl	0.00045	mg/L	Total	MAR-006
BRY	6/13/2002	Zn	0.0013	mg/L	Dis	MAR-006
BRY	6/13/2002	Zn	0.0032	mg/L	Dis	MAR-006
BRY	6/13/2002	Zn	0.0021	mg/L	Total	MAR-006
BRY	6/13/2002	Zn	0.0022	mg/L	Total	MAR-006
Sta 26	6/13/2002	Al	0.0181	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Al	0.0193	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Al	0.233	mg/L	Total	MAR-006
Sta 26	6/13/2002	Al	0.352	mg/L	Total	MAR-006
Sta 26	6/13/2002	As	0.004	mg/L	Dis	MAR-006
Sta 26	6/13/2002	As	0.0039	mg/L	Dis	MAR-006
Sta 26	6/13/2002	As	0.0056	mg/L	Total	MAR-006
Sta 26	6/13/2002	As	0.0055	mg/L	Total	MAR-006
Sta 26	6/13/2002	B	0.0268	mg/L	Dis	MAR-006

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Sta 26	6/13/2002	B	0.0304	mg/L	Dis	MAR-006
Sta 26	6/13/2002	B	0.0309	mg/L	Total	MAR-006
Sta 26	6/13/2002	B	0.03	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cd	0.00001	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cd	0.00001	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cd	0.00002	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cd	0.00002	mg/L	Total	MAR-006
Sta 26	6/13/2002	Ca	29.8	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Ca	29.6	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Ca	29.9	mg/L	Total	MAR-006
Sta 26	6/13/2002	Ca	29.6	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cr	0.00014	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cr	0.00013	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cr	0.00029	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cr	0.00027	mg/L	Total	MAR-006
Sta 26	6/13/2002	Co	0.00027	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Co	0.00026	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Co	0.00151	mg/L	Total	MAR-006
Sta 26	6/13/2002	Co	0.00146	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cu	0.0007	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cu	0.0007	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Cu	0.0014	mg/L	Total	MAR-006
Sta 26	6/13/2002	Cu	0.0014	mg/L	Total	MAR-006
Sta 26	6/13/2002	Fe	0.033	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Fe	0.0362	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Fe	0.776	mg/L	Total	MAR-006
Sta 26	6/13/2002	Fe	0.773	mg/L	Total	MAR-006
Sta 26	6/13/2002	Mn	0.0131	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Mn	0.013	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Mn	0.0747	mg/L	Total	MAR-006
Sta 26	6/13/2002	Mn	0.0726	mg/L	Total	MAR-006
Sta 26	6/13/2002	Mg	10.9	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Mg	0.109	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Mg	11	mg/L	Total	MAR-006
Sta 26	6/13/2002	Mg	10.8	mg/L	Total	MAR-006
Sta 26	6/13/2002	Ni	0.00311	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Ni	0.00306	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Ni	0.00571	mg/L	Total	MAR-006
Sta 26	6/13/2002	Ni	0.00546	mg/L	Total	MAR-006
Sta 26	6/13/2002	K	2.75	mg/L	Dis	MAR-006
Sta 26	6/13/2002	K	0.0479	mg/L	Dis	MAR-006
Sta 26	6/13/2002	K	4.5	mg/L	Total	MAR-006
Sta 26	6/13/2002	K	4.64	mg/L	Total	MAR-006
Sta 26	6/13/2002	Se	0.0005	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Se	0.0005	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Se	0.0004	mg/L	Total	MAR-006
Sta 26	6/13/2002	Se	0.0004	mg/L	Total	MAR-006
Sta 26	6/13/2002	Na	11.1	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Na	11.1	mg/L	Dis	MAR-006

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Sta 26	6/13/2002	Na	11.1	mg/L	Total	MAR-006
Sta 26	6/13/2002	Na	11.1	mg/L	Total	MAR-006
Sta 26	6/13/2002	Sr	0.29	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Sr	0.289	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Sr	0.293	mg/L	Total	MAR-006
Sta 26	6/13/2002	Sr	0.289	mg/L	Total	MAR-006
Sta 26	6/13/2002	Tl	0.00043	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Tl	0.00043	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Tl	0.00048	mg/L	Total	MAR-006
Sta 26	6/13/2002	Tl	0.00047	mg/L	Total	MAR-006
Sta 26	6/13/2002	Zn	0.0003	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Zn	0.0004	mg/L	Dis	MAR-006
Sta 26	6/13/2002	Zn	0.0018	mg/L	Total	MAR-006
Sta 26	6/13/2002	Zn	0.0018	mg/L	Total	MAR-006
Sta 15	6/13/2002	Al	3.35	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Al	3.33	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Al	8.46	mg/L	Total	MAR-006
Sta 15	6/13/2002	Al	8.12	mg/L	Total	MAR-006
Sta 15	6/13/2002	As	0.0313	mg/L	Dis	MAR-006
Sta 15	6/13/2002	As	0.0314	mg/L	Dis	MAR-006
Sta 15	6/13/2002	As	0.0605	mg/L	Total	MAR-006
Sta 15	6/13/2002	As	0.0602	mg/L	Total	MAR-006
Sta 15	6/13/2002	B	0.0791	mg/L	Dis	MAR-006
Sta 15	6/13/2002	B	0.0683	mg/L	Dis	MAR-006
Sta 15	6/13/2002	B	0.0857	mg/L	Total	MAR-006
Sta 15	6/13/2002	B	0.0727	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cd	0.00018	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cd	0.00018	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cd	0.00019	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cd	0.00018	mg/L	Total	MAR-006
Sta 15	6/13/2002	Ca	118	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Ca	115	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Ca	121	mg/L	Total	MAR-006
Sta 15	6/13/2002	Ca	116	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cr	0.00043	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cr	0.00045	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cr	0.00242	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cr	0.00242	mg/L	Total	MAR-006
Sta 15	6/13/2002	Co	0.175	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Co	0.173	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Co	0.182	mg/L	Total	MAR-006
Sta 15	6/13/2002	Co	0.174	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cu	0.0068	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cu	0.0068	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Cu	0.0077	mg/L	Total	MAR-006
Sta 15	6/13/2002	Cu	0.0078	mg/L	Total	MAR-006
Sta 15	6/13/2002	Fe	45.1	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Fe	43.9	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Fe	47.5	mg/L	Total	MAR-006

Surface Water Results from the Project Database
Markin and Yee (2006)
Leviathan Mine Site
Alpine County, California

Surface Water Station	Sample Date	Parameter	Value	Units	Basis	SourceCode
Sta 15	6/13/2002	Fe	45.6	mg/L	Total	MAR-006
Sta 15	6/13/2002	Mn	5.14	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Mn	5.02	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Mn	5.28	mg/L	Total	MAR-006
Sta 15	6/13/2002	Mn	5.07	mg/L	Total	MAR-006
Sta 15	6/13/2002	Mg	32	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Mg	31.3	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Mg	32.7	mg/L	Total	MAR-006
Sta 15	6/13/2002	Mg	31.6	mg/L	Total	MAR-006
Sta 15	6/13/2002	Ni	0.403	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Ni	0.392	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Ni	0.403	mg/L	Total	MAR-006
Sta 15	6/13/2002	Ni	0.397	mg/L	Total	MAR-006
Sta 15	6/13/2002	K	6.48	mg/L	Dis	MAR-006
Sta 15	6/13/2002	K	5.87	mg/L	Dis	MAR-006
Sta 15	6/13/2002	K	6.23	mg/L	Total	MAR-006
Sta 15	6/13/2002	K	6.76	mg/L	Total	MAR-006
Sta 15	6/13/2002	Se	0.0013	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Se	0.0013	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Se	0.0012	mg/L	Total	MAR-006
Sta 15	6/13/2002	Se	0.0013	mg/L	Total	MAR-006
Sta 15	6/13/2002	Na	17	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Na	16.6	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Na	17.4	mg/L	Total	MAR-006
Sta 15	6/13/2002	Na	16.8	mg/L	Total	MAR-006
Sta 15	6/13/2002	Sr	0.828	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Sr	0.811	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Sr	0.852	mg/L	Total	MAR-006
Sta 15	6/13/2002	Sr	0.816	mg/L	Total	MAR-006
Sta 15	6/13/2002	Tl	0.00684	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Tl	0.00683	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Tl	0.00688	mg/L	Total	MAR-006
Sta 15	6/13/2002	Tl	0.00701	mg/L	Total	MAR-006
Sta 15	6/13/2002	Zn	0.0595	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Zn	0.0596	mg/L	Dis	MAR-006
Sta 15	6/13/2002	Zn	0.0598	mg/L	Total	MAR-006
Sta 15	6/13/2002	Zn	0.0607	mg/L	Total	MAR-006

Notes:

Informaton obtained from database source code MAR-006 within the project database. The original source was from *Water Quality Study Report for the Natural Resource Damage Assessment of Surface Water Below the Leviathan Mine Alpine County, California and Douglas County, Nevada*. Markine and Yee (2006)

As = Arsenic, B = Boron, Ca = Calcium, Cl = Chlorine, Cu = Copper, Fe = Iron, Mg = Magnesium, Mn = Manganese, Na = Sodium, NO3 = Nitrate, PO4 = Phosphate, SO4 = Sulfate, TDS = Total Dissolved Solids, Zn = Zinc, HCO3 = bicarbonate, Dis = dissolved, SpC = specific conductivity, uS/cm = microseimens per centimeter, ppm = parts per million, su = standard units, mg/L = milligrams per liter

SUMMARY OF MATERIAL TESTING AND OBSERVATION SERVICES, GEOTECHNICAL SLOPE STABILITY, LEVIATHAN MINE DELTA AREA WASTE PILE, ALPINE COUNTY, CALIFORNIA

(Kleinfelder, 2006)

KLEINFELDER
An employee owned company

February 9, 2006
File: 57840.01

California Department of General Services
Design Services Section
Real Estate Services-Professional Services Branch
707-3rd Street, Suite 4-105
West Sacramento, California 95605

Attention: Mr. John Feeney, P.E.

SUBJECT: Summary of Material Testing and Observation Services
Geotechnical Slope Stability
Leviathan Mine Delta Area Waste Pile
Alpine County, California

References: Plans and Specifications prepared by California Department of General Services titled *Engineering and Slope Work, W.O. Number 113660, Leviathon Mine, Alpine County, California.*

Geotechnical Investigation Report, Phase I Preliminary Slope Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California, by Kleinfelder, Inc., dated March 16, 2001, File: 30-2867-01.

Geotechnical Investigation Report, Phase II Preliminary Slope Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California, Kleinfelder, Inc. Report, dated April 30, 2002, File: 30-2867-02.

Geotechnical Slope Stability Evaluation, Leviathan Mine Delta Area Waste Pile, Alpine County, California, by Kleinfelder, Inc., dated July 30, 2003, File: 29398.01.

Proposal to Perform Construction Observations and Engineering Oversight for Slope Stability Mitigation, Leviathan Mine Delta Area Waste Pile, Alpine County, California, by Kleinfelder, Inc., dated March 21, 2005, File: 30-YP5-A51

Dear Mr. Feeney:

This final report will serve to document that Kleinfelder personnel provided full-time design-build consultation, observation, and material testing services from June 7, 2005 to August 10, 2005 for the Delta Slope Landslide Stability project at the Leviathon Mine

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in Alpine County, California. Based on our observation and testing, it is our opinion that the landslide was graded to the general requirements of the construction documents and our recommendations. Any deviations from the construction plans and specifications regarding earthwork were performed with concurrence with California Department of General Services (DGS) personnel. The following paragraphs summarize the project construction activities and our observations and conclusions.

DESCRIPTION OF LANDSLIDE

The project site is an inactive sulfur mine located in steeply sloping terrain at an elevation of approximately 7,000 feet. The subject landslide occurred in a portion of the Delta Slope area waste pile in the northwest area of the mine. The area of instability was approximately 250 feet in length in a north-south direction, and a maximum width of 120 feet in an east-west direction, and located on the steep, northwest limit of the waste pile, adjacent to Leviathan Creek. Leviathon Creek currently flows along the western portion of the slope. Based on a review of pre-mine topography, up to 65 feet of mine waste material was placed into the drainage of Leviathon Creek during mining operations and Leviathon Creek was reportedly displaced around the waste pile.

The landslide consisted of an upper-rotational slide and a lower debris flow or planar slide. A well defined but erosion-modified scarp, several feet in height, had formed near the top of the slope with evidence of toe bulging and movement at the toe of the slope. This primary scarp extended for over 200 feet along the top of the slope. A second smaller scarp was present below the primary scarp. Evidence of previous slope movement has been reported with areas near the crest of the slope exhibiting several feet of subsidence.

A lower less-defined scarp was present at the base of the rotational portion of the landslide. The lower debris flow or planar portion of the landslide was below this lower scarp and had exhibited evidence of saturation, springs, and more moisture than the upper rotational portion of the slide. Small trees on the lower slope face also showed signs of creep-type movement in their curved trunks.

An unpaved road provided access to the site from the north and continued south of the treatment ponds and the mining area. A road from the main access road extended onto the Delta Slope area mine waste material. A culvert underlies the main access road near this junction and also collects surface water from the unlined drainage ditch along the eastern side of the main access road. The downslope outlet of the culvert directs surface water into the toe of the waste pile slope and had caused erosion along the edge of the waste material and the landslide.

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PROJECT DESCRIPTION

The landslide stabilization operations included grading the existing slope to a 2.5:1 to 3.5:1 (horizontal to vertical) inclination, constructing benches at regular intervals along the slope, installing trench drains to a depth of 10½ feet on the benches, and constructing a toe-buttress. The width of the benches are approximately 20 feet wide, with the exception of the first bench which is approximately 30 feet wide. The benches were graded to a 3% minimum slope and cobble-lined drainage swales constructed at the back of each bench with a minimum slope of 3%. Trench drains for subsurface drainage were constructed along the centerline of the benches, and connected to a main subsurface drain pipe placed along the northern side of the landslide.

CONSTRUCTION OBSERVATION

Kleinfelder personnel performed full-time observation and testing of the following activities:

- Earthwork and construction of slopes and roadway;
- Construction of horizontal and lateral trench and storm drains;
- Rock buttress construction; and
- Soil placement and compaction.

The following paragraphs summarize the general construction activities that were performed as part of the project. An as-built drawing showing approximate final grades and surface and subsurface drainage features installed as part of the project is attached as Plate 3 in Appendix A. Daily Field Reports (DFR's) and selected photographs are included in Appendix B and E, respectively. Additional site photographs (approximately 600) taken during construction were presented separately in electronic format on computer discs.

Mass grading of the Delta Slope waste pile was initiated by cutting a haul road along the western flank of the landslide to the area of Bench 1. Rough grading for the 30-foot wide bench was then performed as well as excavation of trenches for drainage of encountered groundwater. Next, the 3.5:1 slope to Bench 2 was cut. Due to extremely soft and saturated soil conditions encountered at the east end of Bench 2, grading operations were shifted to the top of the slope and the 2.5:1 slope between Benches 2 and 3. Rough grading was then performed over the remainder of the slope to establish all slopes and grades. During these activities the main haul road (labeled as New Road on as-built drawings) was rerouted away from the top of the slide towards the south. The last slopes to be cut were the 2:1 and 3:1 slopes from the rerouted haul road towards the Delta slope.

Once the majority of the rough grading was complete, the trench drains were constructed, beginning with Bench 3 then working down slope. The trench drains were excavated with a minimum 3-foot width along the centerline of each bench to a depth of

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approximately 10½ feet below ground surface. Each trench drain was lined with filter-fabric and approximately 6 inches of 3-inch minus drain rock was placed as pipe bedding for 6-inch perforated HDPE flex pipe that was then covered with a minimum of 6 feet of 3-inch minus drain rock. After the trench drains were filled with drain rock, the filter-fabric ends were folded over each other and backfilled with native material. Compaction of the backfilled on-site soils was documented through visual observation, soil probing, and direct nuclear testing (ASTM Method D2922). Pre-fabricated concrete manholes were placed at the east end of each bench, with the perforated pipe inserted a minimum of 18 inches into the manhole.

Trench "finger" drains were installed between benches to intercept seeps observed on the slope face between benches. The finger drains were connected to the lateral drains on the benches, and constructed in the same manner as the trench drains. For the finger drains constructed between Benches 1 and 2, a minimal amount of 6-inch diameter perforated pipe was utilized due to the limited quantity of encountered groundwater and to conserve drainpipe. It is our opinion that since the 3-inch minus drain rock has a relatively high hydraulic conductivity, these finger drains will readily convey these minor volumes of water to the drain located on Bench 1.

Drainage swales were constructed at the back of the benches and along the redirected segment of the main access road at a minimum slope of 3%. The swales were approximately 2 feet deep with 1.5:1 (H:V) side slopes. The V-ditch was lined with 10 mil visqueen and the 3-inch minus rock hand-placed into the swale over the visqueen. A larger rock lined swale was constructed on the east side of the upper level to capture runoff and to prevent erosion of the eastern boundary of the Delta Slope.

The toe buttress was constructed using approximately 18-inch plus boulders unearthed during grading operations. The largest boulders (approximately 6 feet in diameter) were placed at the bottom, perimeter of the buttress and were keyed into the native soils. The buttress was constructed at an approximate inclination of 2:1 (H:V). Smaller cobbles were used to fill in (chink) the voids between the larger boulders and create additional points of contact. Smaller boulders and cobbles were also placed on the soil at the top of the buttress for erosion protection.

After final grades were established, storm-water surface drains were constructed to minimize storm-water infiltration into the Delta Slope area, and to control surface runoff. Drop inlets were installed and connected to the storm drain pipe at the east end of each bench. Storm drains were placed to approximately five feet below ground surface. Approximately 0.4 feet of 7/8-inch (Type II) aggregate base material was used as pipe bedding underneath the 24- and 15-inch diameter solid HDPE pipe (diameter location based on design drawings). HDPE pipe was inserted into the drop inlets approximately 18 inches to allow for possible future movement of the HDPE pipe. Aggregate base material was placed around and above the pipe to approximately 4 inches over the top

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of the pipe. All aggregate base material was compacted using a jumping jack hand compactor. A minimum of 2 feet of native material was placed as trench backfill over the pipe, and compacted by wheel rolling with a loader, or a compaction wheel attached to an excavator. Visual observation, soil probing, and the use of the direct nuclear transmission testing (ASTM Method D2922) were used to confirm compaction of the backfill.

A shallow storm drain diversion pipe was installed approximately 15 feet to the east of the "New Road" running to the west at 1.5% grade towards Leviathon Creek (see as-built drawing). This diversion pipe was installed similar to other storm drain pipes using 15-inch diameter solid HDPE pipe. This diversion drain is intended to channel most of the storm water from the runoff drainages to the south of the Delta Slope and away from the Delta Slope.

The main access road was graded with a minimum road width of 14 feet, and verified to be a minimum of 90% relative compaction through visual observation and the direct nuclear transmission method (test results provided in Appendix C). Compaction tests were performed on approximate 500-foot centers beginning at the California gate and ending at the Nevada gate, a distance of approximately 1 mile. Approximately 0.4 feet of 3-inch minus drain rock was placed on the main access road, overlain by approximately 0.1 feet of 7/8-inch Type II aggregate base material, and compacted with a vibratory smooth-drum roller.

Throughout earthwork operations, groundwater levels were periodically measured in three remaining monitoring wells (MW) not destroyed during grading (as shown on the as-built drawing). Two of the monitoring wells were renamed in the field as JR1 (B-4), and JR2 (B-3) as referenced in the Daily Field Reports. On June 30, 2005, groundwater levels in monitoring wells B-4 and B-3 were measured to be 6.46 and 18.40 feet below ground surface, respectively. By August 10, 2005, water levels had decreased to 13.75 and 19.55 feet below ground surface, respectively (the last day of construction). This represents a lowered groundwater table of 7.29 feet and 1.15 feet for B-4 and B-3, respectively. Groundwater level was measured in monitoring well B-8 on June 7, 2005 at 7.30 feet below ground surface and again on August 10, 2005 at 7.95 feet below ground surface. Monitoring well B-8 was located at the top of Delta Slope and was covered by stockpiled rock during most of construction activities. New monuments were placed around these remaining monitoring wells because the upper portion of the monitoring well casing was removed during grading operations.

LABORATORY AND FIELD TESTING

Twining Laboratories, Inc. performed the majority of the laboratory tests for on-site materials used during construction:

- Particle Size Gradation;

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- Plasticity Index;
- Direct Shear Strength; and
- Moisture-Density Relationship.

In addition, Kleinfelder, Inc. also performed the following laboratory tests:

- Particle Size Gradation;
- LA Abrasion;
- Specific Gravity;
- Moistures; and
- Moisture-Density Relationship.

The contractor was able to mine and process a highly competent dark gray andesite rock outcropping to the immediate east of the project site. This rock was processed on-site to 7/8-inch minus and 3-inch minus materials, respectively. The 7/8-inch minus material was tested and met requirements for use as Type II aggregate base material and was placed around storm drain pipes and as cover for the road. The 3-inch minus material was used as drain rock in all of the acid drain trenches and as the base rock for the road.

Individual laboratory test results performed by Twining Laboratories, Inc., and Kleinfelder are provided in Appendix D. It should be noted numerous discrepancies were found within Twining Laboratory's test results, which were never resolved. As a result, Kleinfelder relied primarily on laboratory test results performed during our previous investigations in stability analyses and field modifications.

Field density tests using the direct nuclear transmission testing method (ASTM Method D2992) were taken throughout construction activities to document relative compaction of fill soils placed at the deposit areas, as trench backfill and for road construction. The results of these tests are presented in Appendix C of this report. It should be noted that due to the high moisture contents of the site soils, 90% relative compaction could not be achieved. The materials were compacted as much as practical to be firm and unyielding and deemed adequate for their intended function.

POST-CONSTRUCTION MONITORING AND MAINTENANCE

A routine maintenance program will be crucial for the long-term global stability of the Delta Slope area. Such a program should consist of visual observations for signs of instability and maintenance and should include the following:

- Signs of instability such as tension cracks, settlement, and slope movement;
- Ponding of surface water and immediate correction;
- Groundwater seeps;

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- Separation of drainage pipe from manholes and drop inlets and immediate repairs;
- Routine cleaning of debris and sediment from storm drain swales, drop inlets, and manholes;
- Recording water levels from nearby monitoring wells.

In the event high groundwater conditions occur that could potentially affect the stability of the landslide, additional drainage measures should be taken which may include surface water controls, additional trench drains, and possible horizontal and vertical drains or wells.

Due to saturated material at the toe of the landslide, some additional slow movement (creep) should be anticipated. This movement is expected to be very slow and should not pose a threat to the global stability of the landslide or threaten blockage of Leviathan Creek. In the event continued movement occurs, debris fences or similar mitigations could potentially be used to help limit the extent the materials move towards the creek.

Based on a site visit in October, 2005 the remaining drain rock was still stockpiled at the top of the Delta Slope area, on Bench 3. In addition, Bench 3 had an approximately 5-foot abrupt, grade drop due to prior removals for temporary haul roads. The stockpile should be removed at the earliest possible opportunity and the top of the bench leveled to create a smooth grade transition as shown on the as-built drawings. It should be noted, the additional load on the top of the slope from the stockpile creates a moderate risk of potential instability. This was conveyed to DGS and CARWQB staff through phone conversations after the site visit.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, based on our observation and testing, it is our opinion that all work was performed in accordance with project specifications and Kleinfelder requirements. Slope stability analyses of the final slope geometry were performed to assess overall global stability. Based on our analyses it is our opinion that global stability increased to the intended levels of our report. A regular inspection program should be initiated and routine maintenance performed as required.

LIMITATIONS

Please recognize that construction monitoring is a technique employed to reduce the risk of problems arising during construction. These services have been performed in accordance with generally accepted geotechnical engineering practices that exist in the area at this time. Provisions of construction observation and testing by the engineer are not insurance, nor do they constitute a warranty or guarantee of any type. Even with

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diligent construction observation testing, some latent construction defects may be missed. In all cases, the Contractor shall retain responsibility for the quality of their work, for adhering to plans and specifications, and for repairing defects regardless of when they are found.

We appreciate this opportunity to be of service to you and look forward to future endeavors. If you have any questions about this report or need additional information, please contact either of the undersigned in our Reno office.

Sincerely,

KLEINFELDER, INC.

Bart Wills, P.G.
Staff Geologist

for Jesse Ruzicka, E.I.
Staff Professional

Mike Klein, P.E., G.E., C.E.G.
Geotechnical Department Manager

BW:JR:MK:am

Appendices:

- A – As-Built Site Plan
- B – Daily Field Reports (DFRs)
- C – Nuclear Density Test Results
- D – Laboratory Test Results
- E – Site Photographs

Distribution: (Addressee, 6 Originals)

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APPENDIX A

As-Built Site Plan

```
ERROR: undefinedresource
OFFENDING COMMAND: findresource

STACK:

/DefaultColorRendering
/ColorRendering
/DefaultColorRendering
```

PRECIPITATION DATA CONTAINED IN THE DATA QUALITY OBJECTIVE REPORT: REMEDIAL INVESTIGATION AND FEASIBILITY STUDY, LEVIATHAN MINE, ALPINE COUNTY

(Atlantic Richfield, 2008c)

2.4.2.2 Precipitation

Precipitation falling both within the watersheds above the Site and directly on the Site provide the source of all water flowing at the Site. A meteorological station was developed on site and has been producing data since 2003. However, the data set is not complete in terms of daily precipitation totals, with data missing during 22 of the 42 months for which data are available. Because of the short period of record for on-site data and the significant amount of missing data within the period of record, other regional data sources and estimates were used to estimate potential precipitation at the Site during the scoping evaluation.

Brown and Caldwell (1983) developed isohyets of precipitation measured at various regional meteorological stations to develop an estimate of approximately 14.4 inches for mean annual precipitation at the Leviathan Mine Site. Monthly average precipitation was developed based on an assumed relationship between Leviathan and Woodfords, California. MWH did not update this analysis, but noted that the State's meteorological station was in the process of installation.

A review of the map of mean annual precipitation for California developed by Rantz (1969), based on precipitation measured between 1900 and 1960, shows the Leviathan Mine Site is falling between the 22.5 and 27.0 inches per year contours, suggesting a much higher mean annual precipitation than that estimated by Brown and Caldwell. This is likely due to the fact that simple interpolation methods such as the isohyetal method are not considered accurate for mountainous terrain because they do not account for the effects of topography, or the angle or direction of various facing slopes on precipitation (e.g, higher elevations within the watershed may receive significantly more precipitation, Phillips et al., 1992).

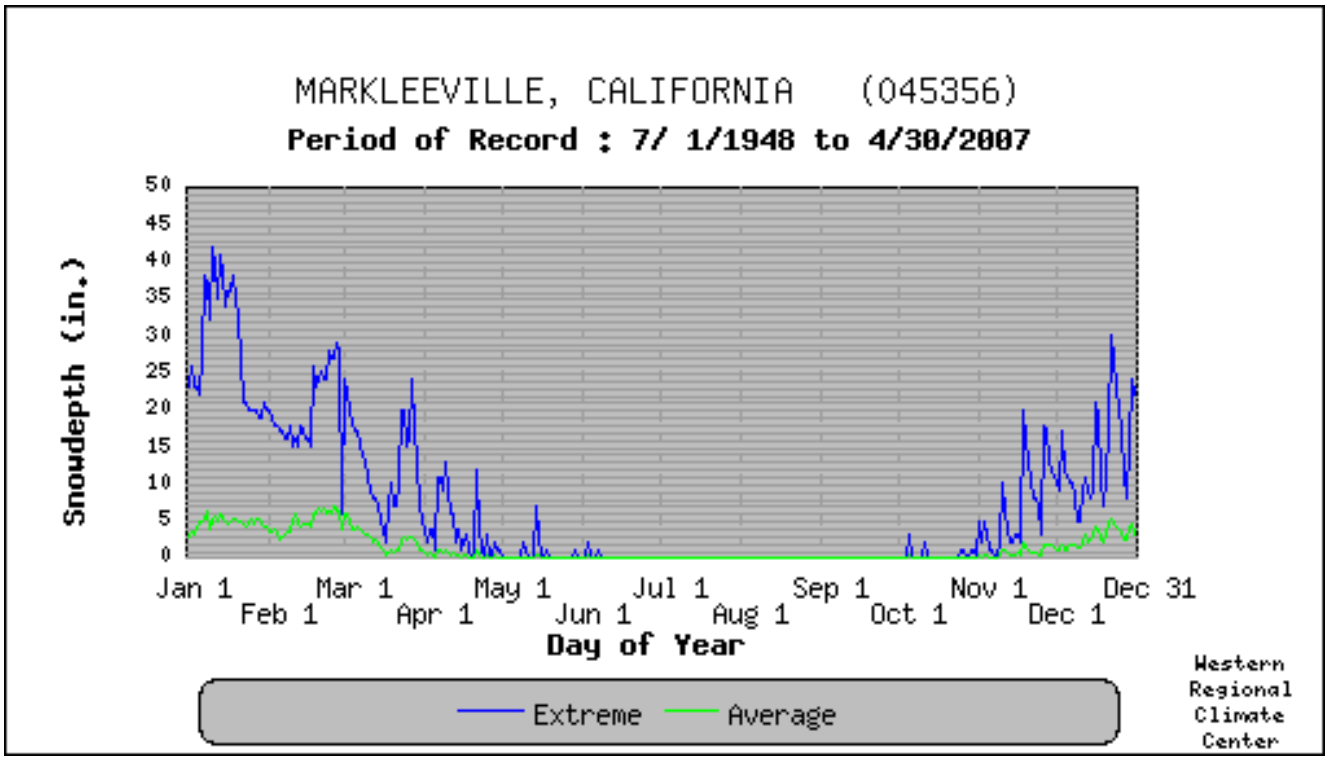
Techniques are available that attempt to account for variations in topography and other variables on climatic parameters. One widely used method is the PRISM (Parameter-Elevation Regressions on Independent Slopes Model) climate mapping system, developed by Dr. Christopher Daly (http://prism.oregonstate.edu/). PRISM is a unique knowledge-based system that uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event-based climatic parameters. The PRISM model is continuously updated to incorporate point data, a digital elevation model, and expert knowledge of complex climatic extremes, including rain shadows, coastal effects, and temperature inversions.

PRISM produced precipitation estimates are available for any location in the United States, and come as data points on an 800-meter (30-arcsecond) grid of the United States. Annual precipitation estimates developed using the PRISM model were downloaded for the Leviathan Mine Site by entering the latitude and longitude of the current on-site meteorological station.

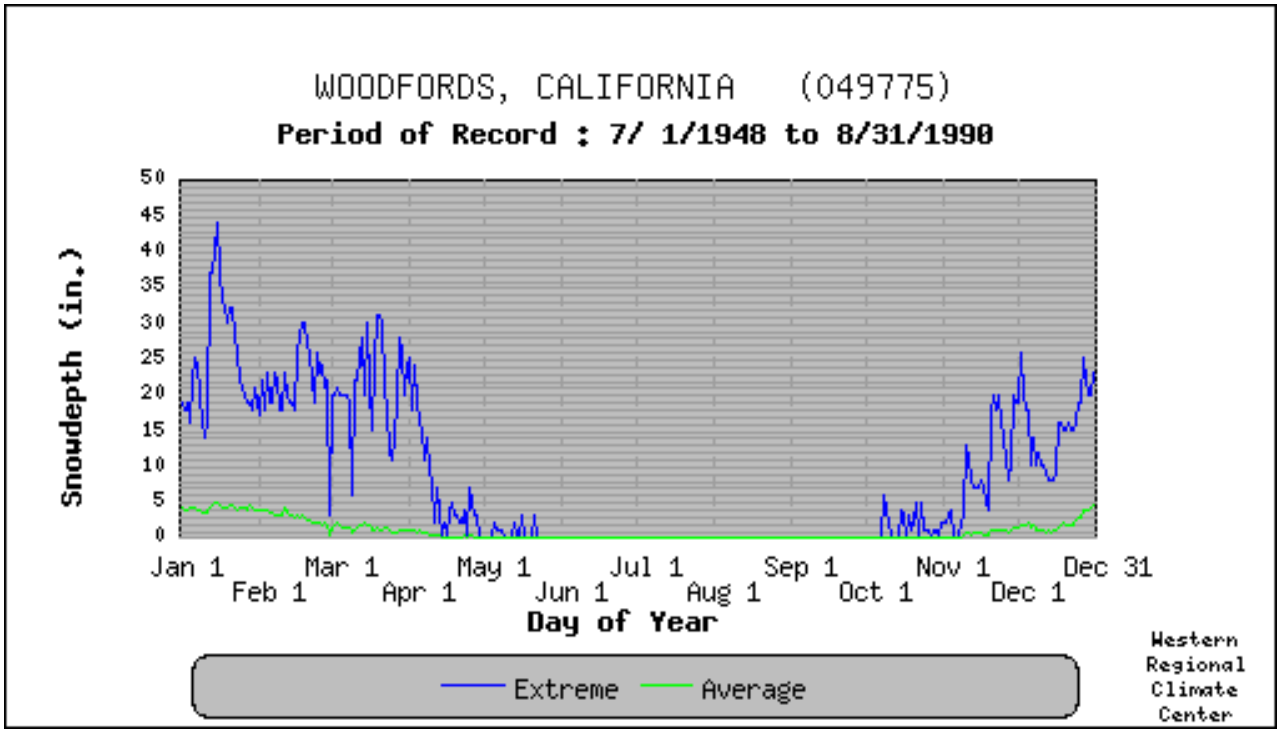
Mean monthly and annual precipitation estimates based on data from 1971 through 2000 (e.g., 30-year normals) are presented in Table 2. Contours of PRISM estimated mean annual precipitations within the broader watersheds are shown on Figure 6.

As shown in Table 2, the majority of precipitation in the watershed occurs in winter months from October through March (25 inches or 79.4 percent of the average annual precipitation). Precipitation during these months falls as snow, producing significant snow pack which routinely restricts access to the on-site property due to deep snow conditions followed by peak runoff periods in April and May.

In addition to the PRISM estimates for the Site, nearby meteorological stations with long periods of record were reviewed. The graph below shows the average and extreme snow depths measured at Markleeville, California. Under average conditions, snow stays on the ground until the end of April, and snow pack begins to develop again in early November. In extreme years, the snow pack has extended into late June and developed in early October. Snow depths of over 40 inches are evident in the period of record (snow depths are greater at Monitor Pass).



The graph below shows snow data from Woodfords, another nearby meteorological station. This data shows a very similar pattern of snow pack, with snow continuing into May and beginning again in October.



The estimated long-term mean annual precipitation for Leviathan was estimated by the PRISM model at 31.5 inches per year. This is slightly higher than the estimate by Rantz, 1969 and more than double the estimate developed by Brown and Caldwell. This illustrates the general uncertainty in understanding the actual amount of available water at the Site and within the broader Leviathan Creek watershed.

As noted, data from the meteorological station installed on-site are complete for only 20 months between 2003 and 2006. A comparison between precipitation measured during these months and estimates from the PRISM model is presented in Table 3. This comparison indicates that on average, PRISM estimates are approximately 59 percent higher than Site measurements.

With the limited available record at the Site, it is difficult to evaluate if Site measurements are significantly more accurate than regional estimates based on climate modeling. For the purposes of estimating the Site water balance, the higher (and potentially more conservative) PRISM estimates were used in the analysis.

2.4.2.3 Short-Term Precipitation Events

Another important consideration in understanding the Site water balance in relation to ongoing Site activities is the potential for short-term storm-related precipitation events and their impact on surface water flows. Twenty-four-hour precipitation return periods have been estimated for California by the National Oceanographic and Atmospheric Administration (NOAA) (NOAA Atlas 2, Precipitation Frequency Atlas of the Western United States, 1973). Maps containing (http://www.weather.gov/oh/hdsc/currentpf.htm) estimates of 24-hour precipitation return periods for the Leviathan Mine Site were reviewed. The Site and the broader watershed area were generally near several precipitation contours on the map, as shown on Figure 7, resulting in some uncertainty in accurately reading the maps for the Site. Therefore, estimates were made based on both observing which contour most closely crossed the general Site area, and on an estimate of the area-weighted average of contours within the Station 23 watershed. Results are presented in Table 4.

The 100-year 24-hour precipitation for the Site is estimated to range from 7.0 to 7.5 inches based on this method. The maximum daily precipitation total measured at the on-site meteorological station during 2003 through 2006 is 1.5 inches, which is significantly lower than the estimated 3.0 inches for the 2-year return period. As before, measurement error and biases make interpreting the short period of Site data difficult, and use of the 24-hour precipitation estimates from the NOAA Atlas is considered conservative.

The PMP is generally the maximum depth of precipitation that is physically possible for a particular geographic region, and has been estimated for the Site based on procedures described in Hydrometeorological Reports No. 58 and 59 (HMR 58 and 59, PMP for California, NWS, 1999). All-season 24-hour PMP maps for California were downloaded in Geographic Information System (GIS) format from the NOAA National Weather Service Hydrometeorological Design Studies Center Web page (http://www.weather.gov/oh/hdsc/studies/pmp.html). These PMP maps represent estimates for watersheds of 10 square miles or greater. The watershed estimated above USGS gauging station 23 is estimated at approximately 10 square miles, and was thus used in the calculation.

Estimates of the all-season PMP for various storm durations were developed for the Leviathan Mine Site based on procedures outlined in HMR 58, and are summarized in Table 5.

As shown on Table 5, the 24-hour all-season PMP for the Site is estimated at approximately 12.6 inches.

For the Site, peak stream flows are generally observed during snow melt occurring in spring. Therefore, the maximum available water for a peak event may not be the all-season PMP, but

may be derived from a rain-on-snow event during the spring. Estimates of the maximum rain-on-snow event were developed based on procedures outlined in U.S. Army Corps of Engineers Guidance EM-1110-2-1406, Runoff from Snowmelt. The method uses the 100-year 24-hour precipitation, an assumption of unlimited snow available for runoff, and temperature and wind speed parameters for the Site. Using 7.5 inches for the 24-hour precipitation, an average wind speed of 5 miles/hour (from Site data), and an assumed temperature of 60 degrees for the storm, the maximum snowmelt for the 24-hour storm was estimated at 3.3 inches. This results in a total available water of 10.8 inches for the maximum rain-on-snow event, which is below the all-season PMP of 12.6 inches. Therefore, the estimated all-season PMP of 12.6 inches is considered the maximum potential short-term event for the Site.

2.4.2.4 Stream Flow

A key component of the Site water balance is surface water flow entering the Site. The USGS established some short-term daily measurement stations in 1981 and 82, and established a number of permanent continuous monitoring stations in 1998. These stations are shown on Figure 7. Key stations near the Site that have had generally continuous monitoring since 1998 include Station 1 (Leviathan Creek above the Mine), Station 15 (Leviathan Creek above Aspen Creek) and Station 23 (Leviathan Creek above Mountaineer Creek). In addition, daily flow data have been collected at 4L Creek above Leviathan Creek and Station 22 (Aspen Creek above the Site) since October 2003. Monthly average flow rates measured at these stations are summarized in Table 6; monthly average stream flows are shown on Figure 8.

In addition to continuous monitoring stations at and near the Site, several one-time or short-term stream flow measurements have been made at the Site. These data are useful to provide a framework for assessing general Site conditions, but generally can not be used directly to develop Site water balance estimates.

While general average conditions may be estimated from the limited stream flow data set from continuous monitoring at the Site, the period of record is not extensive enough to accurately estimate extreme conditions. Extreme stream flow and flood conditions are important to understand to support remedial design activities and to understand changes in the Site water balance during extreme events. Rough estimates of flood frequency flows from the gauged locations were developed using regression techniques outlined in *Nationwide Summary of USGS Regional Regression Equations for Estimating Magnitude and Frequency of Floods for Ungaged Sites, 1993* (USGS, 1994). The Leviathan Mine Site falls within an area that has two different regression techniques; (1) the Sierra Region of the California Statewide Rural zones, and (2) the Eastern Sierra Region 5 of the Southwestern United States zone (USGS, 1994). Regression equations for various stream flow return periods are provided based on drainage

TABLE 40
PROJECT DATABASE CONTENTS AS OF OCTOBER 2008
Leviathan Mine Site
Alpine County, California

Date	Database Source Code	Author	Title	Surface Water Quality	Sediment Quality	Soil Quality	Ground-water Quality	Bio-assessment Data	Climate Data	Flow Data	Summary
1952	WHI-001	W. White, Nevada Department of Health	Letter regarding water samples collected from Aspen and Leviathan Creeks (pre-mine)	2	0	0	0	0	0	1	Documents pre-open pit mining surface water quality based on two samples. One sample was collected from Aspen Creek above the Site and one was collected from Leviathan Creek at the bridge downstream of the Site. One flow measurement collected.
1955	NCR-002	Nevada Dept of Conservation and Natural Resources (NDCNR), Division of Wildlife	Nevada Division of Wildlife Stream Survey - Bryant Creek	0	0	0	0	1	0	0	Includes a downstream survey of the Bryant and Barney Riley Creeks in July and September of 1955. Qualitative measurements made of stream quality. Data collected on the number of fish which were shocked during a fish shocking test. No fish were shocked along any of the five sections during the test.
1958	COL-001	S.J. Coli	Report Leviathan Creek Bioassay	0	0	0	0	25	0	0	A bioassay was conducted in 1958 to investigate the toxicity of Leviathan Creek on rainbow trout. Four tests were performed on Leviathan Creek and two control tests performed on Mountaineer and Dowd Creeks. All 32 fish tested in Leviathan Creek died after 170 minutes. All 16 fish at the control sites survived after 48 hours.
1958	REI-001	E Reinke, CA Dept of Public Health	Transmittal to RWQCB: Leviathan Creek water quality sample results	104	0	0	0	0	0	0	Five surface water samples were collected on Leviathan Creek to investigate the water quality above the mine, at the mine, and downstream of the mine. Samples collected on Sept 27,1957. Water samples were analyzed for general chemistry and metals.
1968	RWQ-001	RWQCB	Report on Pollution of Leviathan Creek Caused by Leviathan Mine	17	0	0	0	0	0	0	Includes a detailed mining history and information on pollution at the Site. Five surface water samples were collected from a culvert downstream of the Site in 1963. Water samples were analyzed for pH, total iron, and sulphate. Results supported the issuance of Resolution 64-3, a Cease and Desist Order for the Site.
1969	LEG-004	John Leggett, RWQCB	Letter: Transmit RWQCB meeting minutes; Fish and Game Report (Sterling P. Davis, 1969)	138	0	0	0	16	0	0	Surface water quality and bioassays were collected from six sampling stations. The six sample stations included water from the adit, an area of "mine drainage from springs" and from the present day USGS surface water Stations 1, 23, 24, and 31. The surface water quality included an analysis of general chemistry and metals. The bioassessment included a survey of bottom organisms (fish food) and an evaluation of Leviathan Creek toxicity on rainbow trout. Report evaluates the length of stream affected by mining activities (7.8 miles) and the estimated number of fish lost (227 pounds per year).
1969	NEL-002	Nelson Laboratories for RWQCB	Investigation of Soil and Irrigation Water Conditions on the Brooks Park - River Ranch	42	0	378	0	0	0	0	Two surface water samples (named BCDD and CCDD) were analyzed for general chemistry and metals. Soil samples from 6 locations (A through F) were collected within the top foot of the surface and analyzed for metals, nutrients, and the percentage of sand, clay, and organic material. All samples were collected on November 11, 1969. Limited details were available for review. [1]
1970	YOU-001	Ralph Young, Agricultural Consultant	An Appraisal of the Effects of Contaminants in Irrigation Water Derived from Bryant Creek on the Agricultural Potential of River Ranch	14	0	68	0	0	0	0	One surface water sample (named BCDD) was collected and analyzed for general chemistry and metals Four soil sample locations (1C, 2C, 2L, 1L) were collected from the top four inches of the surface. All samples were collected on on September 7, 1970 and analyzed for pH and metals. Limited details were available for review. [1]
1975	RWQ-002	RWQCB	Report on Pollution of Leviathan Creek, Bryant Creek and the East Fork Carson River caused by the Leviathan Sulphur Mine	158	0	0	0	0	0	0	Investigation conducted on Leviathan Creek, Bryant Creek, and the East Fork Carson River. Provides background history of the mine, and presented new surface water quality data. Water samples were analyzed for general chemistry and metals from five surface water locations (named LEV-ds, Mine Drainage [1], Mine Drainage [2], and in the present day locations of USGS Stations 1 and 31). Samples were collected in December 1968, June and September 1969, and in July and December 1974. Results indicate that the surface water quality did not improve between 1968 through 1974 and remained at concentrations that violated the discharge requirements.
1977	BUT-001	Richard Butterfield, UNR	The Revegetation Potential of the Leviathan Mine Spoils, MS Thesis Univ Nevada Reno	0	0	159	0	0	0	0	Samples were collected from surface soil and analyzed for general chemistry, nutrients, metals, and percent sand, silt, and clay. Details of the sample date, location, or methods were not available for review. [1]
1985	HAM-001	D. P. Hammermeister, S.J. Walmsley, USGS	Hydrologic Data for Leviathan Mine and Vicinity Alpine County, California, 1981-83	3,297	57	0	1,375	39	0	109	Surface water field data included one or more measurements of pH, flow, water temperature, and specific conductance at 45 locations in and adjacent to the mine area. Stream sediment samples were collected at three surface water stations in May 1983. These sediment samples were analyzed for metals, total carbon, and moisture content. Subsurface lithology was recorded in 71 vertical borings. Although not included within the database, the borehole geophysical data provided information on moisture content, porosity, density, natural gamma, and temperature logs. Selected samples were analyzed for mineralogic content. The borings were converted to piezometers, many of which were clustered and screened at different depths. Groundwater field data were collected from the 71 piezometers between August 1982 through April 1983. Field measurements included the depth to water, hydraulic conductivity, and temperature. Groundwater samples were analyzed for metals and general chemistry.
1989	BAL-001	James W. Ball, D. Kirk Nordstrom, USGS	Final Revised Analyses of Major and Trace Elements from Acid Mine Waters in the Leviathan Mine Drainage Basin, California and Nevada, October 1981 to Oct 1982	2,412	0	0	0	0	0	64	Revised surface water analytical results of the dataset from the 1981-1983 USGS investigation were presented. This dataset was reanalyzed using a more precise method for quantifying trace metals in surface water that can heavily alter surface water tracer studies. 67 surface water samples from 45 locations were re-analyzed.
1997	CLA-002	Vic Claassen and Michael Hogan - Univ CA, Davis	Partial Soil Remediation and Revegetation of the Leviathan Mine	0	0	773	0	0	0	0	Surface soil samples were collected from 31 sampling locations and analyzed for metals, nutrients, conductivity, pH, and percent of organic material. Samples were collected sometime between 1985/1986. Limited details were available for review. [1]
1998	LAW-001	Stephen J. Lawrence, USGS	Trace-Element Enrichment in Streambed Sediment and Crayfish, Carson and Truckee Rivers, Nevada and California, September 1992	0	28	0	0	29	0	0	11 streambed sediment samples were collected from the Carson and Truckee Rivers and analyzed for metals. Results were compared to bioassays conducted on crayfish.

TABLE 40
PROJECT DATABASE CONTENTS AS OF OCTOBER 2008
Leviathan Mine Site
Alpine County, California

Date	Database Source Code	Author	Title	Surface Water Quality	Sediment Quality	Soil Quality	Ground-water Quality	Bio-assessment Data	Climate Data	Flow Data	Summary
1998	SRK-002	SRK Consulting	Leviathan Mine Spring 1998 Stream Monitoring Program	2,842	0	0	0	0	0	37	Surface water samples were collected at 9 stream locations during six sampling events conducted between June and July of 1998. Stream locations included stations EFC1, EFC2, and selected USGS surface water sampling stations. Field measurements of flow, temperature, pH, were collected at each stream location. Water samples were analyzed for nutrients, hardness, TDS, total alkalinity, and metals.
1999	ENS-001	ENSR Environmental Toxicology Services for ARCO Environmental Remediation, LLC	Data Report for the Leviathan Mine Study Area Water and Sediment Toxicity Testing and Benthic Community Data September 1998 Assessment	498	734	0	0	79	0	0	Surface water samples were collected from 18 locations between September 1998 and October 1999. Locations included selected USGS stations and from discharge points at the Site. The analyses performed on the surface water samples included measuring the pH, total dissolved solids, dissolved oxygen, dissolved organic carbon, and metals. Stream sediment samples were collected from 18 locations with the surface water samples and analyzed for total organic carbon, grain size, and metals. Bioassessments were performed at 14 locations which included selected USGS stations and from discharge points at the Site. Measurements of %C, EPT, HBVI, mean density, total taxa, and a water toxicity test were performed. Limited details were available for review. [1]
1999	SRK-003	SRK Consulting	1998-1999 Data Summary Report Administrative Order on Consent Leviathan Mine, Alpine County, California	3,205	0	398	1,293	0	24	46	Surface water samples were collected at 19 stream locations during 10 sampling events between September and November of 1998. The sampling locations included discharge points from the Site (e.g., Adit, seeps, CUD, etc) and selected USGS surface water sampling locations. Field measurements of flow, temperature, and pH were collected at each sampling location. Water samples were analyzed for nutrients, hardness, TDS, and metals. 200 surface soil samples were collected and analyzed for pH and conductivity. 15 borings were advanced to observe the subsurface lithology and install monitoring wells (MW-1 through MW-12). Paired/clustered wells were completed in MW-2, MW-5, and MW-10) to compare vertical differences in groundwater quality. Groundwater samples were collected from the 15 newly installed monitoring wells and from two of the remaining piezometers (PZ-25 and PZ-33) (17 wells total). Groundwater samples were collected on 23 separate events between August 1998 through September 1999. Groundwater parameters (pH, temperature, conductivity, TDS) were measured in the field and samples were analyzed for metals. Climate data was recorded from a light duty weather station in June 1998 through September 1999. Temperature, precipitation, and wind speed
1999	THO-002	Larry Thompson, Dan Welsh, USFW for Atlantic Richfield and LMC	Assessments of Injuries to Aquatic Natural Resources near the Leviathan Mine, Alpine County, California. Phase 1 Data Report: Concentrations of Metals and Trace Elements in Aquatic Insects and Fish	572	0	0	0	442	0	0	The purpose of this study was to determine the concentrations of metals and trace elements in whole aquatic insects, and the muscle and liver tissues of fish, collected in surfafce waters downstream from the Leviathan Mine. Four surface water samples were collected at 12 stream locations on April 5, 1999. The sample stations included EFC-Ruhen and selected USGS sample stations. Four water samples were collected at each station and analyzed for metals, acidity, alkalinity, and nutrients. In September 1998, aquatic insects were collected in 11 stream locations, seven that are downstream of the Site. In October 1998, fish were collected in creeks downstream of the Site. Samples were analyzed for metal concentrations.
2000	HOF-001	Ray J. Hoffman, Karen A. Thomas, USGS	Methylmercury in Water and Bottom Sediment Along the Carson River System, Nevada and California, September 1998	12	4	0	0	0	0	2	Surface water samples were collected from two locations (EFC-Ruhen and EFC-upstr) in September 1998. Surface water samples were analyzed for flow, pH, temperature, mercury, methyl-mercury, and total organic carbon. Stream sediments were analyzed at these locations and analyzed for mercury and methyl-mercury. Details not provided. [1]
2000	LEH-001	Stafford K. Lehr, CDFG	Leviathan Mine Natural Resources Damage Assessment Phase I Fisheries Assessment	0	0	0	0	253	0	0	Documents the status of fisheries populations in the Leviathan-Bryant Creek watershed in October 1998. A bioassessment was conducted at 11 locations and included information on the population of fish in each sections of the watershed.
2000	THO-001	Karen A. Thomas, Michael S. Lico, USGS	Data on Stream-Water and Bed-Sediment Quality in the Vicinity of Leviathan Mine, Alpine County, California, and Douglas County, Nevada; September 1998	982	2031	0	0	0	0	14	Conducted a chemical assessment of streams in the area of Leviathan Mine in September 1998. Measurements of stream flow, pH, dissolved oxygen, temperature, specific conductance, and at most sites alkalinity, bicarbonate, and carbonate at 14 locations. Surface water samples were analyzed for nutrients, major ions, trace elements, and organic carbon. Streambed sediments were collected at the same locations and analyzed for major and trace elements, total carbon, inorganic carbon, and organic carbon.
2001	HIG-006	Damian K. Higgins	Preliminary Assessment of Fish Community Dynamics and Trace-Element Exposures to Aquatic Invertebrates and Salmonids, Lower Bryant Creek and East Fork Carson River, Douglas County, Nevada, 2001	0	0	0	0	1,026	0	0	Bioassessment of metals in 38 fish tissue samples collected at four locations (BRY, EFC 1, EFC2, EFC-Ruhen) in October 2001. Limited details were available for review. [1]

TABLE 40
PROJECT DATABASE CONTENTS AS OF OCTOBER 2008
Leviathan Mine Site
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2001	MIL-001	Glenn C Miller, Timothy K Tsukamoto, UNR	Operation and Monitoring of Bioreactors at the Leviathan Mine	131	0	0	0	0	0	0	Water samples were collected through various parts of the Aspen Seep bioreactor to optimize and evaluate effectiveness of the system modifications. Samples were collected on 15 different sampling events between January and July of 2001. Water samples were analyzed for pH, TDS, total alkalinity, and metals.
2002	BRO-004	Brown & Caldwell Consultants	Leviathan Mine 2001 Early Response Action, Channel Underdrain Treatment Completion Report (with Appendices A through F)	232	0	0	0	0	0	0	A treatability study was performed to achieve short-term water quality improvements in Leviathan Creek, to demonstrate continuous lime treatment, and to assist in managing solids generated by CUD treatment. The technology tested included the use of a continuous treatment lagoon system using calcium hydroxide (lime) designed for metal hydroxide and metal oxy-hydroxide preciptiation. Seven surface water sampling events were conducted between August and September of 2001 to monitor the effectiveness of the treatment technology. Field parameters (e.g., pH, temperature) were recorded and water samples were collected from the influent, effluent, and surface of Pond 4 for laboratory analysis. Water samples were analyzed for total alkalinity, acidity, TDS, sulfate, hardness, and metals.
2002	FIS-002	Peter Fischer & Mae Gustin, UNR	Influence of Natural Sources on Mercury in Water, Sediment and Aquatic Biota in Seven Tributary Streams of the East Fork of the Upper Carson River, California	0	18	0	0	19	0	0	Seven tributaries were sampled between June and September 1999 to measure the concentration of mercury and methyl-mercury in stream sediments and aquatic biota. Limited details were available for review. [1]
2002	KLE-002	Kleinfelder, Inc., Reno, NV	Geotechnical Investigation Report: Phase II Slope Stability Investigation, Leviathan Mine Delta Area Waste Pile, Alpine County, California	0	0	0	45	0	0	0	Geotechnical investigation on the slope stability of the Delta Area waste pile. Groundwater elevations were collected from borings B-1 through B-9, MW-8, and MW-12 during five events between September and November of 2001.
2006	MAR-006	Melanie J. Markin, USFWS; Julie Yee, USGS	Water Quality Study Report for the Natural Resource Damage Assessment of Surface Water Below the Leviathan Mine, Alpine County, California and Douglas County, Nevada	443	0	0	0	0	0	0	Seven surface water stations (BRY, LEV, Sta 1, 15, 23, 25, and 26) were monitored on June 13, 2002 and analyzed for pH, alkalinity, organic carbon, nutrients, and metals. Limited details were available for review. [1]
1995-2003	HER-EDR	Dr. David Herbst, RWQCB and EPA	Electronic Data Report (EDR) - Semi-Annual Bioassessment Data	0	0	0	0	981	0	0	Provides (1) semi-annual benthic macroinvertabrate and sediment data, and (2) Field Evaluation and Technical Support (FEATS) data. Data provided between June 1995 through September 2003.
1998-2002	USG-EDR	USGS	Electronic Data Report - Periodic Flow Measurements	69	0	0	0	0	0	69	USGS surface water flow data collected from Sta 16 and Sta 24 during 40 sampling events between October 1998 through August 2002.
2002-2005	EPA-EDT	EPA	Electronic Data Transfer (EDT) - Field Evaluation and Technical Support (Feats) Data	4,404	813	0	0	0	0	0	RWQCB Mono- and Bi-phasic water quality. Data provided from June 2002 through Septemeber 2005.
2003-2005	UNR-EDT	UNR, for Atlantic Richfield Company	Electronic Data Transfer - Aspen Seep Bioreactor Data	2,864	0	0	0	0	0	83	Atlantic Richfield ERA influent and effluent water quality data from Aspen Seep Bioreactors from April 2003 through February 2005.
ONGOING	ACE-EDT	US Army Corps of Engineers	Oversight Summaries	771	0	0	0	0	0	0	Measurements of pH, specific conductance, and temperature of surface water from 17 surface waster stations. Data provided since June 2007.
ONGOING	ARC-EDT	Atlantic Richfield Company	Electronic Data Transfer (EDT) - ERA Treatment Data	24,665	0	0	0	0	0	549	Provides (1) influent and effluent water quality and sludge data from the Pond 4 CUD/DS Treatment System and (2) influent and effluent water quality and sludge data from the Aspen Seep Bioreactors Treatment System. Data provided since 9/13/2001
ONGOING	NDE-EDT	Nevada Dept of Environmental Protection	Electronic Data Transfer - Surface Water Quality Data	9,525	0	0	0	0	0	136	Ongoing data collection. Surface water sampling along the East Fork Carson River and Sta 26. Data provided since January 1977.
ONGOING	USG-PUB	USGS	Published Flow Data	5	0	0	0	0	0	42,106	USGS flow data collected between April 1994 through the present.
ONGOING	RWQ-EDT	RWQCB	Electronic Data Transfer - Surface Water Quality, ERA Treatment, and Climate Data	46,101	293	0	73	0	432	378	Ongoing data collection. Provides (1) comprehensive surface water quality monitoring data (monthly and semi-annual), (2) influent and effluent water quality and sludge data from the Biphasic Treatment System of Adit and Pit Underdrain (PUD) flows, (3) Site climate data, and (4) groundwater quality monitoring data (MW-3). Data provided since August 1984.

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A HISTORY OF THE LEVIATHAN MINE POLLUTION ABATEMENT PROJECT ALPINE COUNTY, CALIFORNIA

Eric J. Taxer
Associate Water Resource Control Engineer

Jason J. Churchill
Public Health Chemist II

and

Dr. Ranjit S. Gill
Environmental Specialist IV

California Regional Water Quality Control Board
Lahontan Region
2092 Lake Tahoe Boulevard
Suite Number 2
South Lake Tahoe, California 96150
United States of America
(916) 544-3481

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ABSTRACT

The Leviathan Mine is an abandoned open-pit sulfur mine, located on the eastern slope of the Sierra Nevada Mountains at an elevation of 7,000 feet in Alpine County, California. The entire mine site is over 500 acres. Disposal of mine tailings in the area surface waters and the generation of Acid Mine Drainage (AMD) degraded downstream water quality and destroyed downstream beneficial uses.

The California State Water Resources Control Board (State Board) obtained over six million dollars to remediate the pollution. The constructed project, designed to control approximately 75 percent of the pollution, was completed in 1985. The project consisted of relocating and regrading one million yards of tailings, constructing 11.4 acres of evaporation ponds, channelizing streams to prevent contact with mine tailings constructing 17,000 feet of drainage ditches to prevent stormwater infiltration and revegetating the site.

Moderate improvements to water quality have been documented. However, AMD seeps, pond overflows, and sedimentation/erosion continue to impair water quality. Adequate success with revegetation was not achieved, resulting in erosion of the mine tailings.

The State is currently exploring the feasibility of improving water quality through the treatment/control of AMD discharges, construction of non-point source controls, and through additional efforts at revegetation.

Keywords: abandoned open-pit mine reclamation, tailings, acid mine drainage (AMD), non-point source, pH, sulfur, iron, arsenic, nickel, total dissolved solids (TDS), aluminum, Alpine County, California

INTRODUCTION AND BACKGROUND

The Leviathan Mine is an abandoned open-pit mine on the eastern slope of the Sierra Nevada Mountains at an elevation of 7000 feet in Alpine County. A location map is shown on Figure 1. The site is drained by Leviathan and Aspen Creeks which are tributary to Bryant Creek and, eventually, to the East Fork Carson River. The East Fork Carson River is a major western Nevada water supply source which is relied on heavily for agricultural irrigation supply, for fish and wildlife habitats, and for recreational benefits (rafting).

The mine was initially developed in 1863 as a source of copper sulfate for the processing of silver ore at the Comstock Mines in Virginia City, Nevada. By 1872, work on the property came to a standstill due to lack of copper and an over-abundance of sulfur. When abandoned, the mine consisted of two adits connected by a vertical raise, the lower adit being 1000 feet in length located 200 feet below the upper adit. During this period, Leviathan Creek just below the mine area showed slight discoloration due to seepage of water from the canyon walls. The water from the mine area contained high concentrations of sulfur and iron, but the quantities of pollutants were not such as to significantly affect water quality. Bryant Creek at this time was a natural unpolluted stream which supported a natural fresh water flora and fauna and a healthy trout population.

The mine was reopened from 1935 to 1941 to develop the sulfur body by the Calpine Corporation of Los Angeles through a sublease from Texas Gulf Sulfur Company. An extensive system of tunnels, drifts, and rises was constructed. In 1941, the Calpine Corporation gave up its sublease and the property reverted to Texas Gulf Sulfur Company. No degradation of Bryant Creek occurred during this period.

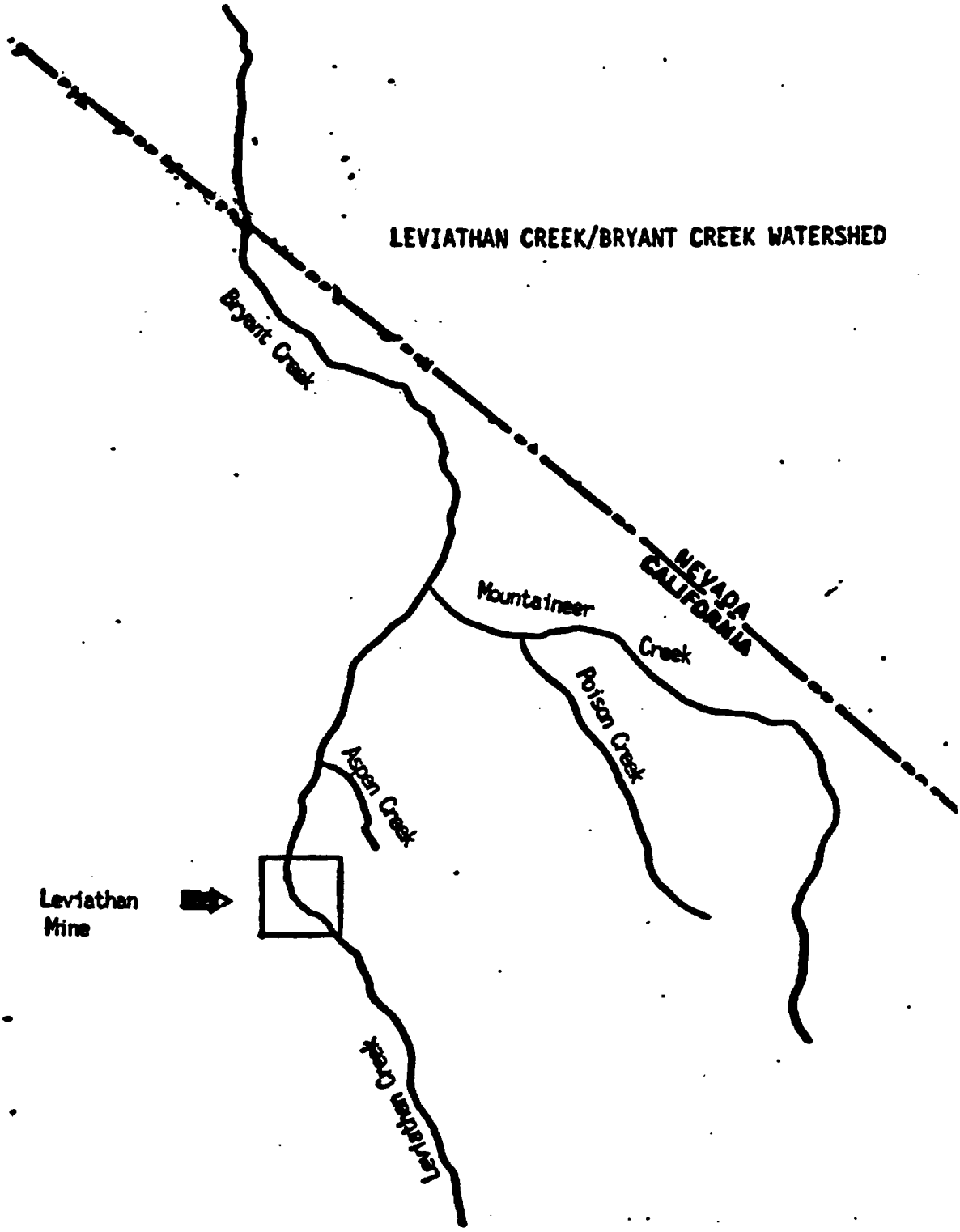


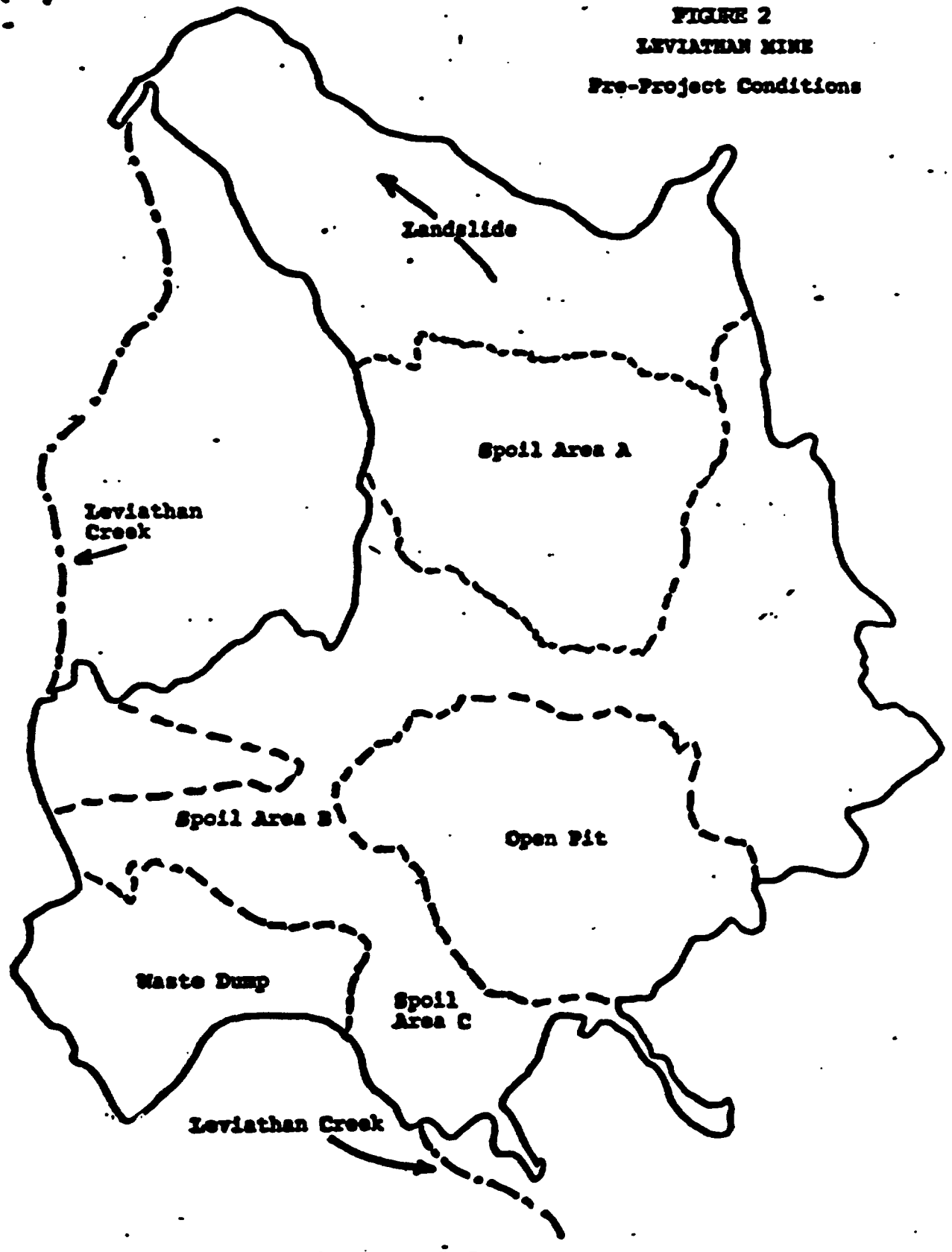
FIGURE 1. Leviathan Mine Location Map

Extensive degradation of the site and of the surface waters resulted from operations that occurred from 1951 through 1962 under the ownership of the Anaconda Copper Company (which has since become a wholly-owned subsidiary of the ARCO Products Company) for the mining of sulfur used to process copper ore at its Yerington, Nevada, facility. The first fish kill occurred in the Carson River and Bryant Creek in 1952 when an old mine shaft was opened, discharging a large quantity of highly acid and toxic waste into Leviathan Creek. In 1954, Anaconda began operation of the mine as an open pit without developing a comprehensive plan for disposing of the mine tailings or for reclaiming the site. Many of the old mine workings were removed, and the overburden material (high in sulfur content) was hauled to the nearest location. At first, this meant hauling the material immediately north of the open pit, but eventually the disposal extended into the Leviathan Creek channel. Figure 2 shows the locations of the disposal and mining areas. The overburden placement eventually dammed the creek and caused the water to seep through the overburden pile. Surface runoff from snowmelt and precipitation became contaminated by contact with over twenty two million tons of low-grade sulfur ore. This runoff became acidic and leached toxic quantities of heavy metals from the ore.

The pollution problem became progressively worse, and in 1959 a second fish kill occurred along 10 miles of the Carson River below the confluence of Bryant Creek. An estimated 10,000 to 20,000 non-game fish were reported killed; however, only a few dead trout were found, implying that the trout had been driven from Bryant Creek and a 10 mile stretch of the Carson River by toxic substances discharged continually from the mine from 1953 to 1959.

The fish kill prompted Anaconda to proceed with some corrective measures.

FIGURE 2
LEVIATHAN MINE
Pre-Project Conditions



These included installing a diversion pipe to carry Leviathan Creek around the overburden pile and detaining a portion of the seepage from the mine and tailings in ponds for release during periods of high flows. However, when the California Regional Water Quality Control Board - Lahontan Region (Regional Board) requested Anaconda to apply for a permit, the Anaconda Company sold the mine and removed the treatment and disposal facilities. Anaconda left behind a 245-acre site covered with spoil material, which included a 50-acre open pit (up to 350 feet of overburden had been removed), a 26-acre waste dump over 130 feet deep, and a 100-acre active landslide. The landslide was attributed to super-saturated undisturbed (by mining) material which constantly received an influx of infiltrating water from the ungraded spoil area of the Leviathan Mine. The pollution problem became steadily worse. The water quality data from this period are discussed below. It has been suspected that the pollution from the mine resulted in below-average crop growth and higher livestock mortality on downstream agricultural lands in Nevada. (Historical data from the Regional Board's "Report on Pollution of Leviathan Creek, Bryant Creek, and the East Fork Carson River Caused by the Leviathan Sulphur Mine".)

CONSTRUCTION OVERVIEW

Pre-Project Work

In 1978, California voters passed the Clean Water and Water Conservation Bond Act (State Assistance Program, SAP), and the Regional Board later obtained $3.76 million from this bond act to address the Leviathan Mine problem. In April, 1983, the Regional Board voted to file suit against ARCO under the Federal CERCLA legislation (Comprehensive Environmental Response, Compensation, and Liability Act). Negotiations, in-lieu of litigation, proceeded, and ARCO agreed to a $2.337 million settlement in July, 1983.

The Regional Board contracted with the consulting firm of Skelly and Loy in 1979 to develop a feasibility study for the abatement of pollution from the Leviathan Mine. The report identified five discrete problem areas at the mine: (1) the open pit and spoil areas, (2) the mine tunnels, (3) the waste dump, (4) site drainage, and (5) the landslide area (see Figure 2). The open pit and spoil areas prohibited adequate site drainage and promoted precipitation and snow melt infiltration into the spoils. Water infiltrating the spoils of the inadequately drained pit floor entered the workings of the mining tunnel, flowed through the tunnel, became degraded by tunnel materials, and seeped though spoils covering the tunnel mouth. The waste dump was eroded by the adjacent Leviathan Creek. Creek waters infiltrated the tailings where the two were in direct contact, percolated though the tailings, leached toxic materials, and discharged on the downstream side of the dump. Leviathan and Aspen Creeks both eroded and infiltrated the site spoil materials. The landslide area was also continually eroded by both streams.

The report recommended regrading the open pit and diverting runoff from the open pit, sealing the opening of the mine tunnel, reconstructing Leviathan and Aspen Creek channels in place (versus relocating the channels), removing the waste dump and placing the material in a clay-lined open pit, and removing the landslide material to cover the pit, spoil, and mine tailings.

The Regional Board then contracted the U.S. Geological Survey (USGS) to do a complete hydrogeotechnical investigation of the mine site. The objectives of the USGS investigation were to characterize the surface-water quantities at the mine site and in the Leviathan Creek and Bryant Creek drainages, to characterize the surface-water quality at the mine and in the area surface waters, to characterize the shallow ground water system at the

mine, to define the major geochemical processes producing acid mine discharge, and to aid in the determination of pollution source areas.

Project Selection

The Regional Board hired Brown and Caldwell Consulting Engineers to design a pollution abatement project. The Regional Board's goal was to restore water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity, within the limitations of available funding. The Regional Board also requested that the project be designed to be as maintenance-free as possible.

Brown and Caldwell developed a "Recommended Project" within the limits of available funds (which at the time consisted only of the $3.76 million SAP grant), and a "Maximum Feasible Pollution Abatement Project" not constrained by funding. Major elements of the recommended project were:

1. Channelizing Leviathan Creek. Realignment of 1900 linear feet of the creek channel would redirect the creek and prevent its contamination by passage through mine waste materials. The use of a sealed channel would prevent acid groundwater seepage from entering the channel through the sides and bottom.
2. Filling and regrading the open pit. Construction of compacted terraced surfaces and sealed surface drainage channels would increase the quantity and improve the quality of surface drainage from the pit. Open channels would be constructed to carry runoff rapidly to the bottom of the pit. A pipeline would be installed to carry surface drainage from the pit to Leviathan Creek. Approximately 380,000 cubic yards of fill would be required.
3. Constructing on-site evaporation ponds. Evaporation ponds would

be constructed on-site to receive subsurface drainage collected by a mine pit and adit underdrain system. Ponds would be lined with heavy and durable plastic membranes to prevent groundwater degradation. A total of 15 acres of ponds would be constructed on-site. The evaporation pond area would not be sufficient to dispose of all the subsurface drainage; therefore, discharge of contaminated water would occur in the early- to mid-spring period of average water years.

4. Excavating and regrading the waste dump. The waste dump would be regraded to eliminate erosion and infiltration. Excavated materials would be used as fill for earthwork planned for the mine pit and other areas. Approximately 472,000 cubic yards of material would be removed.

5. Regrading Spoil Area A and drainage work. (See Figure 2.) This would involve regrading surface depressions and constructing surface drainage channels to improve drainage. Improved surface drainage would reduce infiltration.

The recommended project was expected to reduce the annual mean Total Dissolved Solids (TDS) load from the mine site by an estimated 79 percent. The construction bid price for the project was estimated at $2.8 million in 1983, with an average annual cost for project maintenance of $10,500 for the first five years.

The maximum feasible project included an additional 2.7-acre evaporation pond to completely contain all AMD; replacement of the deep limestone underdrain system in the mine pit with a shallower rock underdrain at the mouth of the pit (because of unknown groundwater flow and soil characteristics

beneath the pit); extreme regrading and filling of the pit to reduce subsurface flow; and construction of open drainage channels on fill slopes and pit floor in lieu of pipeline transport to further reduce AMD generation. The maximum feasible pollution abatement project was expected to reduce the annual mean TDS load from the mine site by 85 to 90 percent. The estimated construction cost was $5.8 million, with an average annual cost of $92,000 for the first five years (the design included extensive revegetation work).

Brown and Caldwell evaluated a number of other project alternatives that fell into two categories - pollution source control and pollution discharge control. The pollution source control alternatives included upgradient interception of the groundwater, interception of adit flow before contamination, clay or soil-cement seals and synthetic liners to prevent infiltration of contaminated or uncontaminated water into the ground, and biochemical or chemical deoxygenation of groundwater upgradient of the site to inhibit the formation of sulfuric acid during water contact with ore-bearing spoil materials. Pollution discharge control alternatives included sealing the adit, on-site chemical treatment of AMD, and exportation of AMD offsite to evaporation/holding ponds in Nevada.

The Regional Board initially chose the maximum feasible project, since they would be pursuing recovery of funds from ARCO under the Federal Superfund Legislation. However, in April 1983, the Regional Board selected the recommended project for several reasons: there was no guarantee of additional funds as a result of the ARCO suit, SAP grant funds might be disencumbered if not used, and delaying the project would escalate costs further. The Regional Board supported doing as much work as resources would allow at the site rather than allowing continued pollution.

Project Construction

In August, 1983, project construction began. Site conditions were much worse than anticipated. Acidic seeps and springs were found in many locations throughout the construction area. The channelization of Leviathan Creek had to be redesigned and elevated due to these seeps. The seeps below the channel were collected in a gravel underdrain and discharged directly to the creek. Site constraints made it impossible to allow discharge to an evaporation pond. Rainfall made the site unworkable due to the heavy mud produced from the tailings. The construction season had to end by November 15th for the two years of construction.

The settlement with ARCO allowed for many improvements to the original design. 17,000 feet of drainage ditches were changed to concrete from soil-cement. A fifth evaporation pond was added (but only a total of 11.4 acres of ponds could be built due to limited stable areas at the site). Additional AMD seeps were captured and routed to the evaporation ponds. Additional funds were available to install an intensive revegetation project. Project construction was completed in 1985 at a cost of $4,172,000. Figure 3 shows a schematic of the completed project.

POST-PROJECT CONDITIONS

Current Water Quality Conditions

The Regional Board has conducted routine monitoring at Leviathan Mine since project completion in order to evaluate the effectiveness of the control measures, and to determine the overall quality of the Leviathan Creek watershed. Monitoring is conducted for pH, total dissolved solids, sulfate, aluminum, arsenic, iron, and nickel. Some of the data collected through this monitoring program are compared with pre-project data in Figure 4. Results

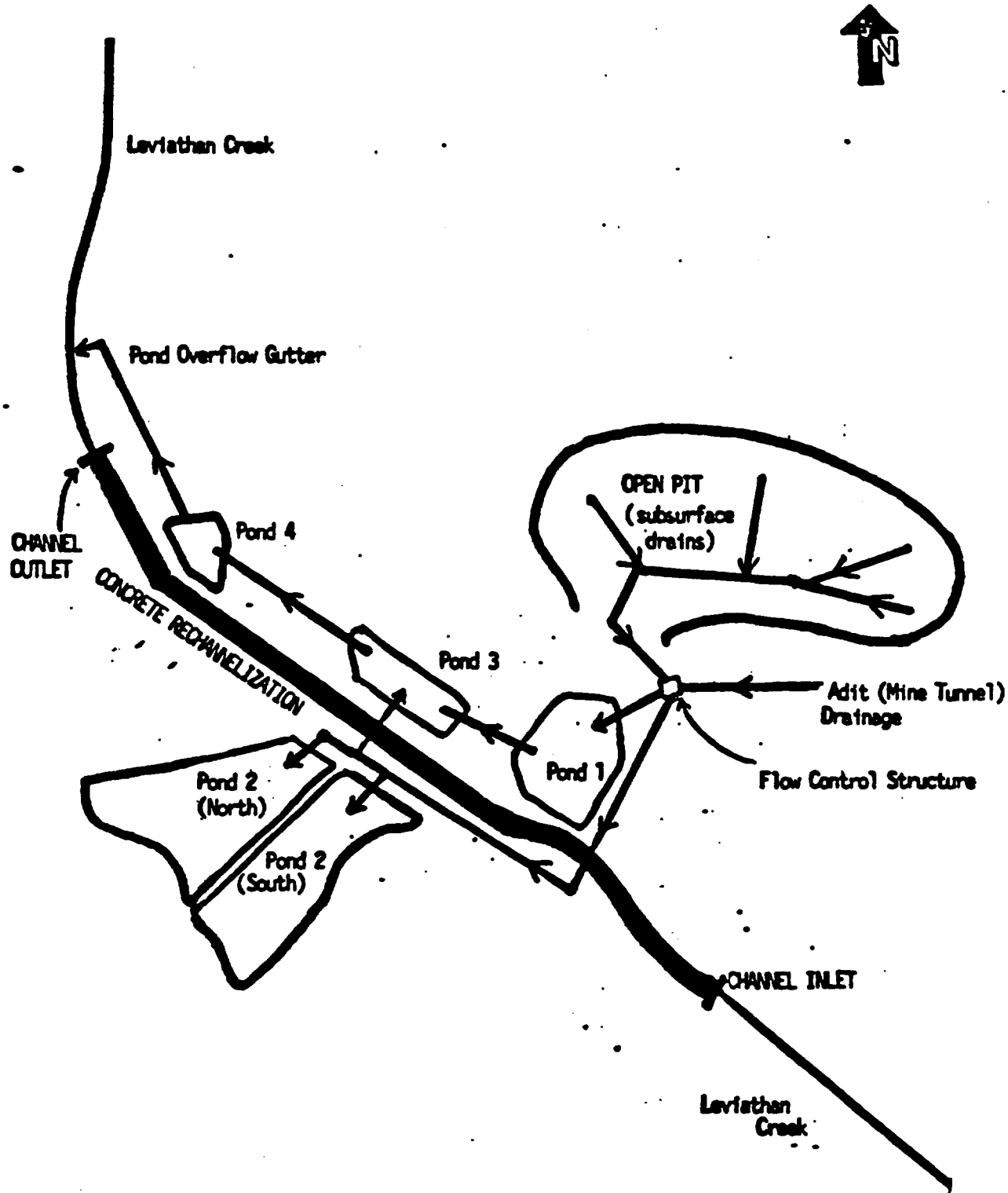


FIGURE 3. Leviathan Mine Post-Project Conditions

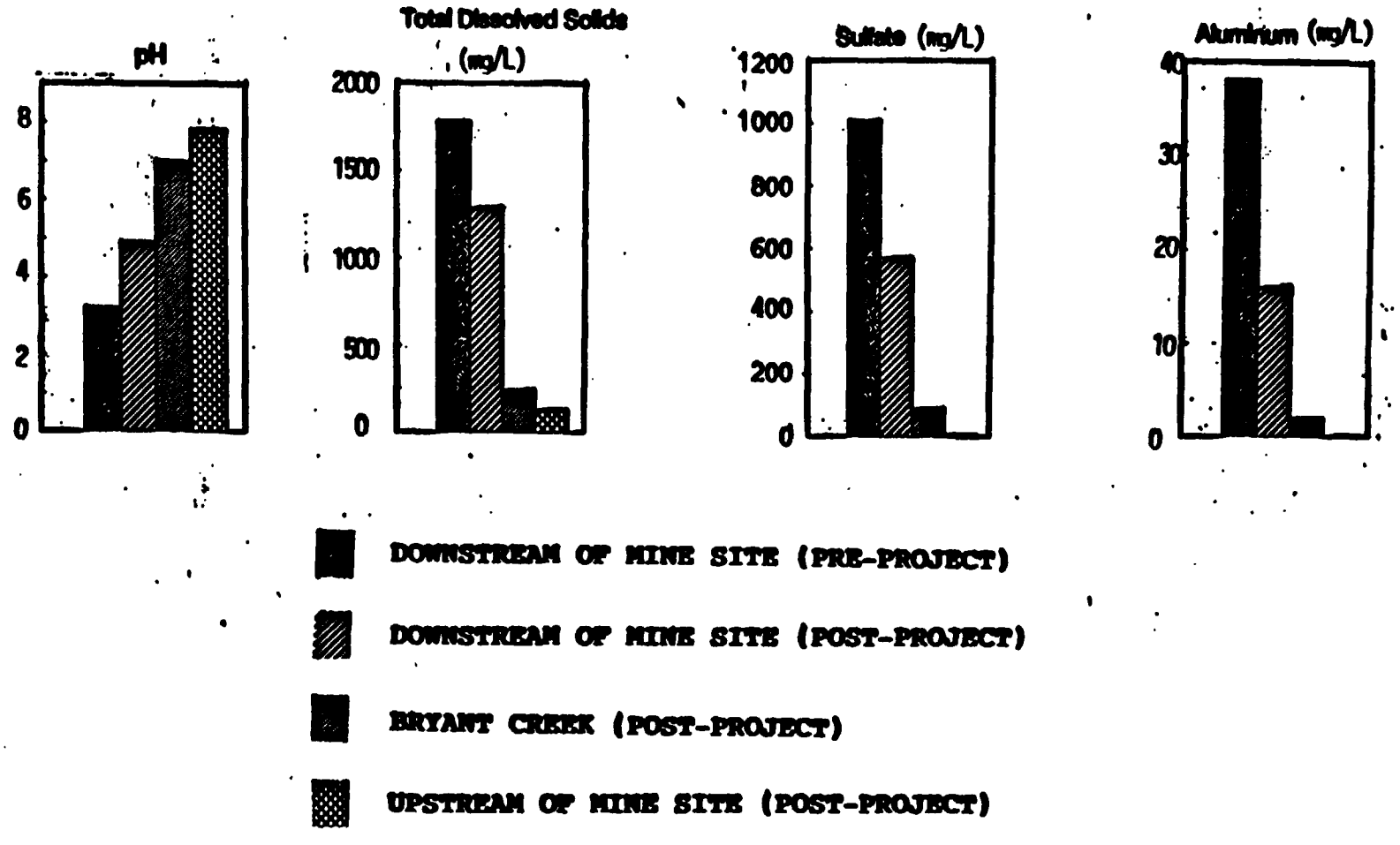


FIGURE 4. LEVIATHAN MINE -- MEDIAN CONCENTRATIONS (pH, TDS, sulfate, and aluminum)

of monitoring at Bryant Creek represent the water quality leaving the watershed after dilution of Leviathan Creek by Aspen and Mountaineer Creeks, which are relatively uncontaminated.

Because of the inaccessibility of the site, most monitoring has been conducted in summer or early fall. Very little information has been gathered during the winter or spring runoff periods (when the evaporation ponds are known to overflow). For this reason, the post-project data represent baseline or "normal" conditions for Leviathan Creek and do not reflect the seasonal influence of evaporation pond overflows. Comparisons of pre- versus post-project conditions are limited because of the relative scarcity of pre-project data. Finally, drought conditions have persisted in California during most of the post-project monitoring program, and the effect of the drought on the monitoring results is unknown.

Despite these limitations, the data suggest a moderate improvement in the water quality of the Leviathan Creek watershed. Although Leviathan Creek remains degraded, Bryant Creek generally meets the recommended standards for supporting a variety of uses. Table 1 presents a comparison of post-project monitoring results for Leviathan and Bryant Creeks, with a variety of recommended water quality criteria (recommended criteria are collated in the 1983 Brown and Caldwell report).

Sources of Ongoing Water Quality Problems

Ongoing water quality problems are from three sources: 1) uncontrolled springs and seeps; 2) evaporation pond overflows; and 3) erosion of tailings into the creek channel. Limited monitoring data indicate that the underdrain seep may be the greatest pollution source to the creek, and additional seeps

TABLE 1.
WATER QUALITY COMPARED TO RECOMMENDED CRITERIA FOR LEVIATHAN AND BRYANT CREEKS

	pH	Total Dissolved Solids (mg/l)	Sulfate (mg/l)	Aluminum (mg/l)	Arsenic (mg/l)	Iron (mg/l)	Nickel (mg/l)
Leviathan Creek (Post-project Median)	4.9	1,287	570	16	0.054	122	0.74
Bryant Creek (Post-project Median)	7.0	242	89	2	0.005	4.9	0.10
Recommended Water Quality Criteria--Cold Fresh Water Habitat (Chronic)	6.5-9.0	2,000			0.04		0.056
Recommended Water Quality Criteria--Cold Fresh Water Habitat (Acute)	6.5-9.0	2,000			0.44	1.0	1.1
Recommended Water Quality Criteria--Agricultural Supply Irrigation	4.5-9.0	700	200	5.0	0.10	5.0	0.20
Recommended Water Quality Criteria--Agricultural Supply Livestock Watering	4.5-9.0	2,500	500		0.20		

occur along Leviathan Creek downstream of the channel. Of the 8.1 million gallons of AMD that is estimated to be generated every year, approximately 3 million gallons of partially concentrated AMD is flushed from the evaporation ponds into the Leviathan Creek during the spring runoff period of an average water year. (However, increased seasonal flows of the creek help to dilute the discharge.) Finally, the lack of vegetation at the site (discussed below) increases the erosion of the mine tailings into both Leviathan and Aspen Creeks.

Assessing the relative contributions of seeps, overflows, and erosion to the ongoing problems at the mine has been difficult because of the inaccessibility of the site during winter and spring and because of the lack of needed data. Regular chemical analysis of pond overflows and visible seeps, over a sufficient time period, is still needed. Flow measurements which are critical to a careful analysis of the situation are needed, but they are often difficult to obtain at the site.

Non-Point Source Control

At the completion of the construction, an intensive revegetation effort was conducted at the mine in order to dewater the mine spoils and to help stabilize the slopes. A contracted study [Leiser] concluded that the prospects for successful revegetation of the Leviathan Mine were good. The study analyzed the typical precipitation patterns of the site, and the water holding capacity and the acidic and toxic contents of the mine spoils. All conditions were adequate to support vegetation. The consultant studied twenty-five woody species immediately adjacent to the mine site as potential revegetation candidates. Test plots with several of these species indicated that a 69 to 92 percent survival rate could be expected. The report also

stated that experience with grass species had been poor, and any revegetation attempt with grasses would require an on-going fertilization program.

The Regional Board entered into a tentative agreement with the U.S. Forest Service (USFS) whereby the USFS would take over the site once it became stabilized. The USFS Range and Experiment Station in Utah designed a revegetation effort that emphasized grasses, against the recommendation of State revegetation experts. However, woody species were also included in the design. The Regional Board allowed the USFS to proceed with the designed revegetation effort, assuming that the USFS would assume title to the land. The grasses subsequently failed to survive, but woody species showed promise for future revegetative efforts. The USFS has since declined to take over the site.

The lack of adequate vegetative cover at the Leviathan Mine has left acres of eroding slopes which threaten to choke the mine's pollution abatement facilities with sediment, jeopardizing their function as well as undermining their structural stability. The road system at the site has little drainage control and is contributing to the erosion and sedimentation problem. The eroding slopes and resulting contaminated sediment loads also endanger the restoration of beneficial uses of the Leviathan Creek system. Revegetation consultants to the Regional Board believe that a successfully implemented revegetation project would greatly reduce the threat to pollution abatement structures, avert treatment failure, and further reduce pollutant loading to the Leviathan Creek system from the sediments. A successful revegetation project would also lessen the percolation of precipitation through the tailings, reducing the generation of AMD seeps and enhancing the restoration of the beneficial uses in the Leviathan Creek system.

Federal Requirements

The U.S. Environmental Protection Agency (EPA) has recently placed the Leviathan Mine on the Federal Clean Water Act Section 304(l)(1)(b) Short List. The EPA will assume permitting authority for the Leviathan Mine and will issue an Individual Control Strategy (ICS) for the mine. The permit will require compliance with effluent limits, based on State water quality standards, for arsenic and nickel within three years. Regional Board staff will coordinate with the EPA and other interested agencies in development of the ICS.

PROPOSALS

The Leviathan Mine is one of the highest priority water-quality problems now facing the Regional Board. The Regional Board recognizes the severity of water quality impacts that still emanate from the mine and is committed to reducing them. Potential projects that are currently being considered by the Regional Board to control existing sources of pollution are:

1. Control Eroding Slopes and Mine Tailings.

   Implement a comprehensive slope stabilization and revegetation program using plants tolerant to on-site acidic soil and low water conditions.

2. Control Roadside Drainage and Erosion.

   Regrade roads for proper drainage and install drainage control and treatment structures. The integrity of the roads will be maintained while erosion and sediment transport to streams will be reduced.

3. Control Excess AMD.

   The Regional Board is currently seeking expertise for methods to control AMD. Options include artificial wetlands to reduce the

pollution loading to area surface waters; an additional holding pond to contain AMD overflow from the existing evaporation ponds; and/or a wastewater treatment system to treat AMD overflows from the existing evaporation ponds to Leviathan Creek.

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LEVIATHAN MINE 5-YEAR WORKPLAN

California Regional Water Quality Control Board
Lahontan Region

Prepared by: Catherine Schoen, Water Resource Control Engineer
Dr. Bruce Warden, Environmental Specialist II
Diana Henrioulle-Henry, Associate Water Resource Control Engineer

Reviewed by: Dr. Ranjit Gill, Environmental Specialist IV
Harold J. Singer, Executive Officer

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I. Introduction

This report describes a five year workplan that the Regional Water Quality Control Board, Lahontan Region (Regional Board) believes will best address the water quality problems remaining at Leviathan Mine. The workplan defines positive steps toward achieving the Regional Board's overall goal: the restoration of all beneficial uses to Bryant Creek, with significant improvements to Leviathan and Aspen Creeks. Future regulatory action for Leviathan Mine should incorporate this workplan.

The five year workplan also serves as a site management plan that outlines maintenance, inspections, and monitoring requirements. Erosion, vandalism, project aging, and acid mine drainage discharges create these constant needs. This document establishes a baseline program for maintenance, site inspections, and monitoring required to protect the project improvements and comply with the requirements of the Toxic Pit Cleanup Act Exemption granted to the SWRCB by the Regional Board (Resolution No. 89-204).

In addition to the proposed workplan, this report contains descriptions of the Leviathan Mine site, mining operations, early monitoring efforts, the design and construction of the Regional Board's Leviathan Mine Pollution Abatement Project, and post-project water quality. Substantial background information has been included in this workplan to establish a common understanding of the site. Though direct inspection of Leviathan Mine offers valuable insight, true appreciation requires knowledge of information buried in the voluminous project files, and recollections of staff who observed the site before and during construction of the pollution abatement project. Most would agree that Leviathan Mine is an impressive site with many facets that do not lend themselves to simple or complete solutions.

II. Site Description

Leviathan Mine lies within the Bryant Creek (interstate) watershed, at an elevation of 7,000 feet (Figure II.1). Leviathan Creek flows north across a southwestern portion of the disturbed mine site and Aspen Creek flows northwest along the northeast border of the overburden piles and landslide. Both receive surface runoff, and subsurface flows from the site, while only Leviathan Creek receives continuous underdrain discharge and seasonal pond overflows. Aspen Creek flows into Leviathan Creek downstream of all mining related impacts to land. Approximately two miles north and downstream of the mine, Leviathan Creek meets with Mountaineer Creek to form the headwaters of Bryant Creek. Bryant Creek flows north across the California-Nevada state line which is three miles downstream from the end of Leviathan Creek, and continues another three miles northwest before it enters the East Fork Carson River. Leviathan Mine, Leviathan Creek and Bryant Creek can be located on the USGS Heenan Lake Quadrangle 7.5 minute series topographic map. The nearest population, Dresslerville, Nevada, is approximately 20 miles downstream from the mine site.

Leviathan Mine is located east of Markleeville in Alpine County, California (Figure II.2). The site is accessed by two dirt roads that connect to California State Route 89 over Monitor Pass (3 miles), and to Interstate Highway 395 in the Double Spring Flat area between Gardnerville and Topaz Lake (10 miles). In normal years, vehicle access is limited to late spring through fall. Spring rain and winter snow storms make the dirt roads virtually impassable. Vehicle travel is discouraged during wet conditions because tire ruts accelerate erosion damage. In winter, Regional Board staff travel into the site on skis and snowshoes after driving in as far as possible from the more arid Nevada side. The majority of annual precipitation occurs in the winter in the form of snow.

The site is in a remote area of the eastern slopes of the Sierra Nevada where utility services are unavailable. Evidence of vandalism is readily apparent at the site, and has often required costly repairs. The area is also seismically active. Recent earthquakes with magnitudes greater than 4.0 were centered in Double Spring Flat (September 1994) and Markleeville (February 1995). Open pit mining operations created site instability evidenced by several landslides, one of which is over 100 acres in aerial extent.

The site stands out as barren and eroding in comparison to the surrounding eastern Sierra Nevada forest. The pollution abatement project resulted in extensive areas of deep compaction which may be preventing revegetation. Winter frost heave loosens the top ground layer each year making the slopes susceptible to rill and gully erosion. Slope erosion contributes to sedimentation of the surface drainage structures constructed within the pit, around the evaporation ponds, and on the slopes below the ponds. Each year maintenance work is required to clear the surface drainage structures of sediment and to regrade and repair the dirt access roads.

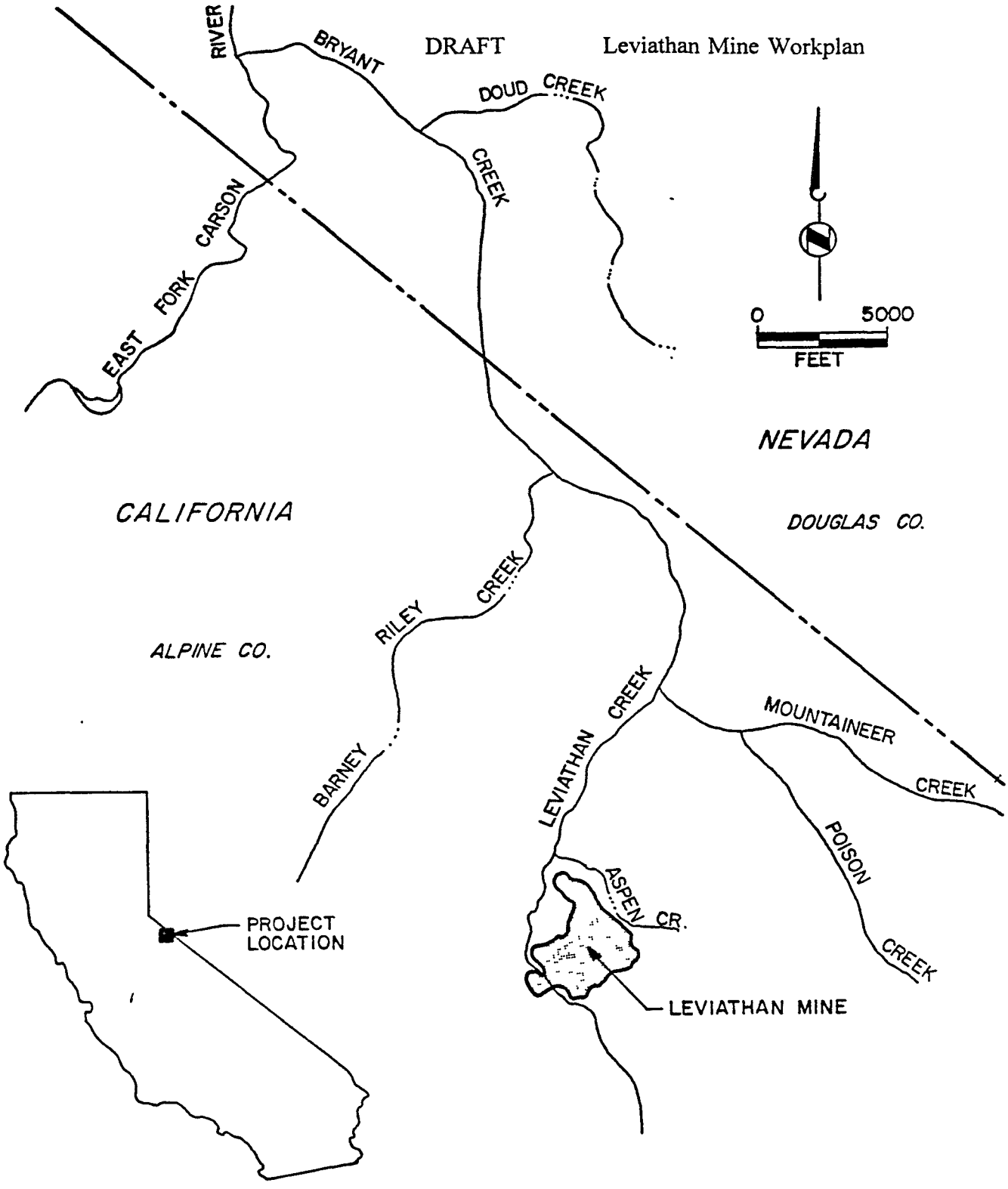
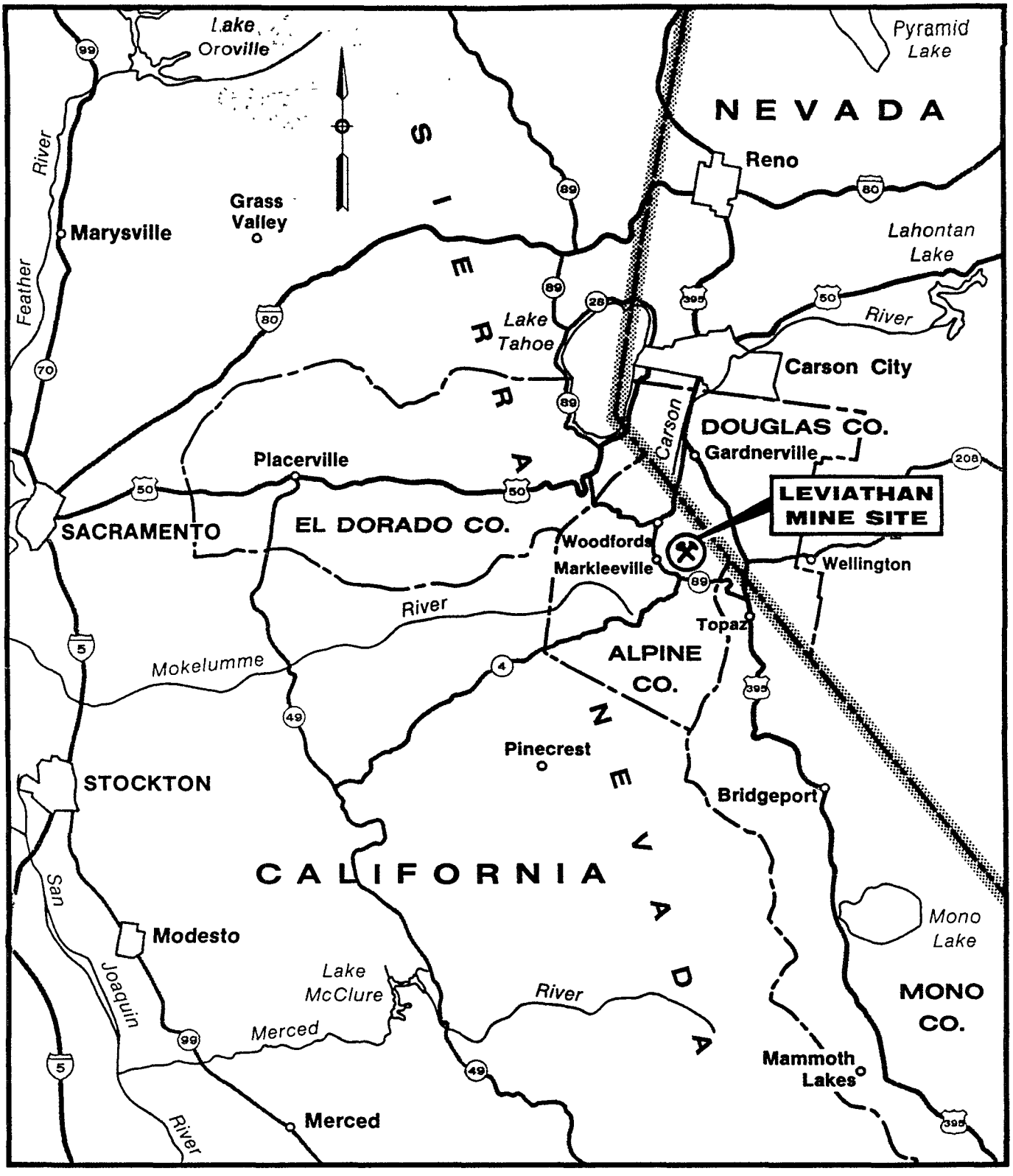


Figure II.1: Bryant Creek watershed



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SCALE IN MILES

Figure II.2: Location of Leviathan Mine

III. Mining Operations

The Regional Board's files contain scant information on the history of mining operations at Leviathan Mine. Extracting minerals needed for processing more valuable ore mined in Nevada was a reoccurring theme. The mine had several owners and produced copper and sulfur.

A. Subsurface

Initial mining efforts at Leviathan were underground. Mining work during this period resulted in several adits (horizontal tunnels into a mountain) with drifts, raises and stopes, that were connected by winzes. During subsurface operations Leviathan was mined for copper sulfate, copper, and sulfur, respectively.

1. Copper sulfate

Comstock Lode miners discovered Leviathan Mine and developed the first workings in 1863. An adit was driven 400 feet in search of copper sulfate for processing silver sulfide ore in Virginia City, Nevada. Copper sulfate was found, but not in sufficient quantities.

2. Copper

By 1869, miners became interested in the showing of primary copper minerals. A second adit of 700 to 1000 feet in length was driven 200 feet below the first adit. The two adits were connected by a vertical rise. By 1870 miners extracted 500 tons of 30 to 50 percent copper ore from the two adits. During this time it was noted that the mine was "bottoming" in an immense sulfur deposit.

3. Sulfur

In 1935 Calpine Corporation, of Los Angeles began subsurface sulfur mining. An extensive system of underground workings was constructed. The main adit, Tunnel No. 3, was 3000 feet long and at the top of the sulfur body. Tunnel No. 5 was driven 75 feet below Tunnel No. 3. About 5,000 long tons of sulfur were produced from the underground workings. This operation was noted as being extremely hazardous because of the highly flammable nature of sulfur. In 1941 Calpine Corporation gave up its sublease.

B. Open-pit

Anaconda Copper Mining Company purchased Leviathan Mine in 1951 for sulfur mining by open-pit methods. The sulfur was needed for processing copper ore at Anaconda's Weed Heights mine near Yerington, Nevada. Isabell Construction Company began stripping overburden from the sulfur orebody in 1952, and continued removing overburden adjacent to open pit mining operations of sulfur ore which began in 1953. Anaconda stopped mining operations in late 1962 and sold Leviathan Mine to Chris Mann, the Alpine County Clerk in January 1963. Figure III.1 shows the pit, spoil areas, waste dump, surface features, and boundary of mining impacts that resulted from Anaconda's operations. About 500,000 long tons of sulfur with an estimated value of $14.5 million were produce between 1953 to 1962. U. S. Borax declined an option to buy Leviathan Mine in 1968. Besides exploratory drilling by U. S. Borax, no mining activities occurred after Anaconda's operations.

Approximately 22 million tons of overburden containing large quantities of low grade sulfur ore were spread over more that 200 acres without any classification, separation, or original ground surface preparation. Overburden was dumped in spoil areas A, B, and C, as labeled on Figure III.1. Anaconda created a 26-acre waste dump more than 130 feet in depth by disposing waste rock, consisting of low grade ore from mining operations, in the Leviathan Creek canyon. Leviathan Creek flowed around and seeped through the waste dump. The final mined 50-acre pit was roughly 2000 feet long, 1000 feet wide and a maximum of 400 feet deep. Much of the underground mine workings were excavated, with the exception of portions of Tunnel Nos. 1, 2, 3, and all of Tunnel No. 5 which lay some 20 feet below the bottom of the pit. Figures III.2, III.3, and III.4 show the pit and approximate locations of excavated and remaining underground workings.

Anaconda made various attempts to decrease water pollution during the open pit mining operation. These attempts consisted of diverting Leviathan Creek around the waste dump in an impervious ditch and an eight inch plastic pipe, capturing acid mine drainage in a large pond and treating it with lime to raise pH and precipitate iron before discharge, disposing of acid mine drainage in injection wells near Leviathan Creek, sealing Adit No. 5 with an eight inch thick concrete bulkhead installed 40 feet from the portal opening, and various grading efforts to cover the exposed ore body and to redirect Leviathan Creek. Unfortunately, the ditch and pipeline diversions washed out during high flows, the pond dike broke and released millions of gallons of acid mine drainage causing a fish kill that extended ten miles down the East Fork of the Carson River, the injection wells clogged, and the adit seal failed.

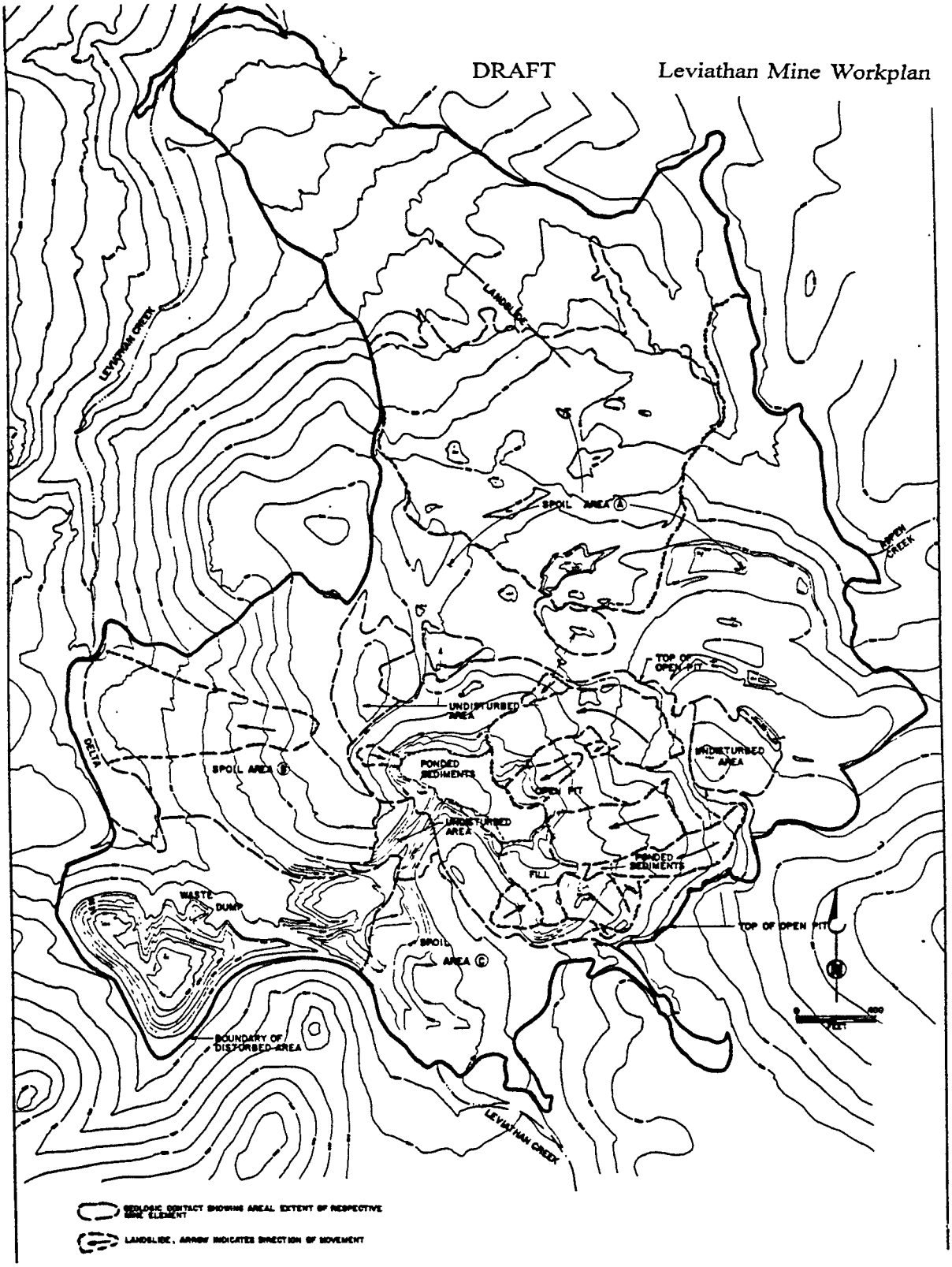


Figure III.1: Mining impacts

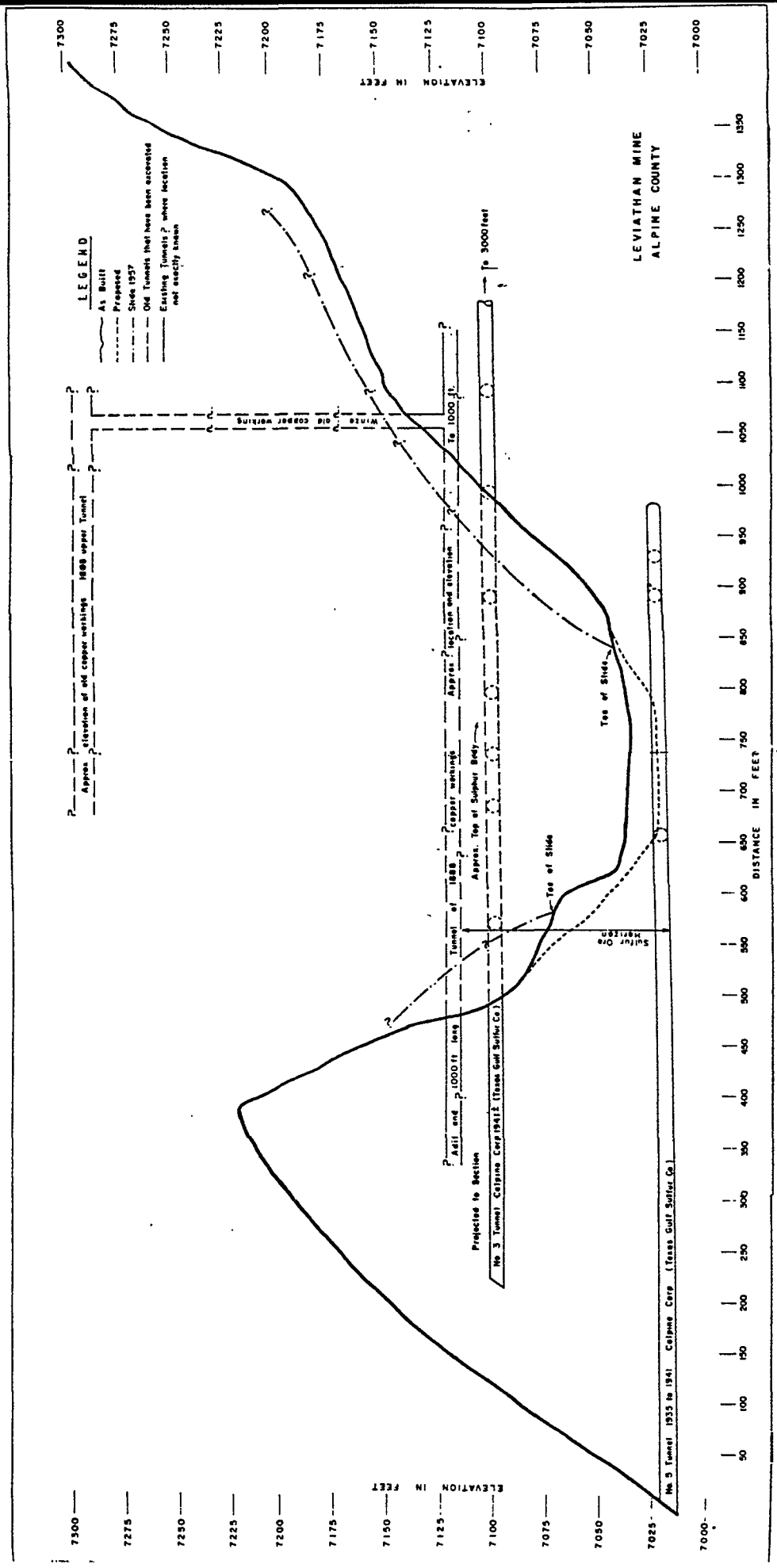


Figure III.2: Profile view of pit and underground working

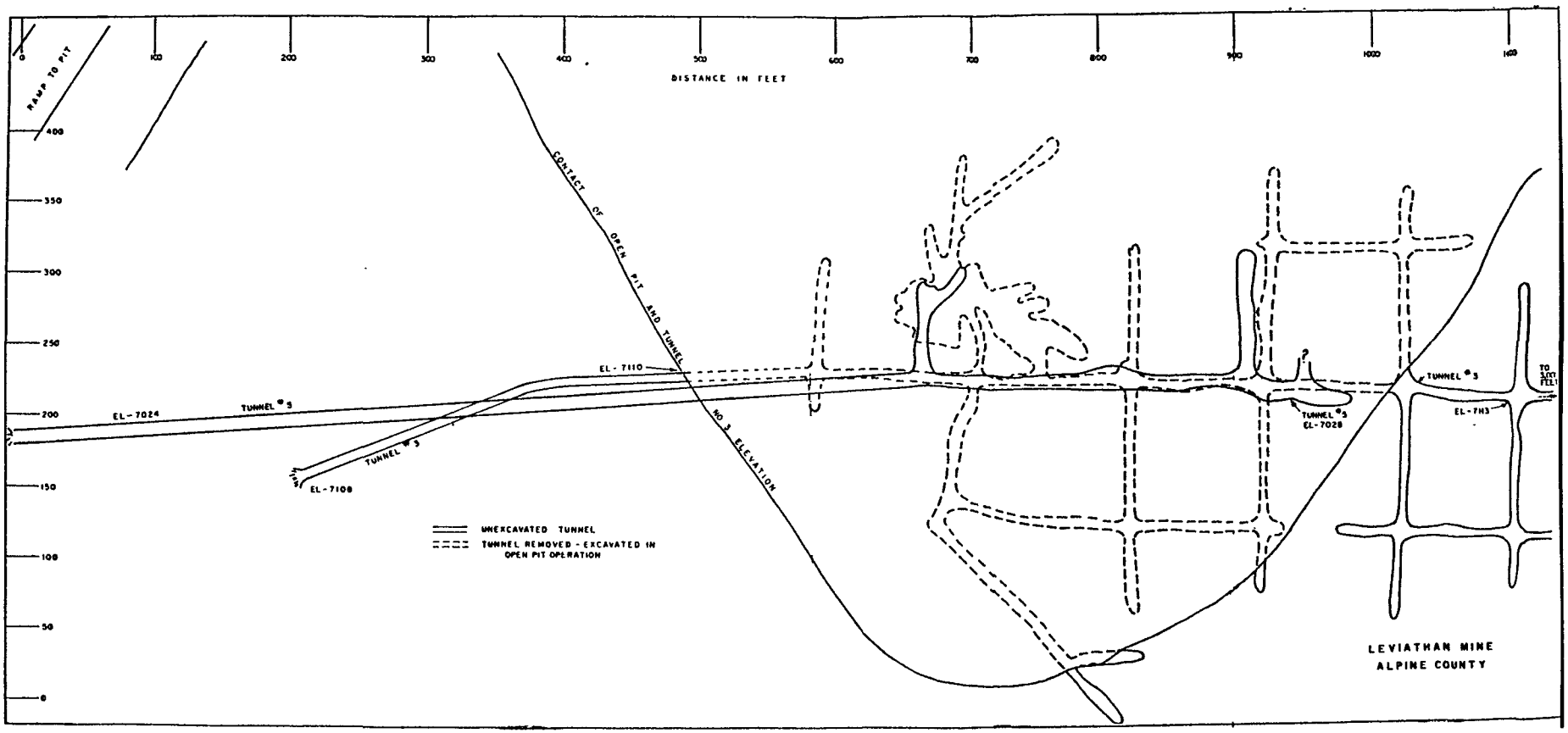
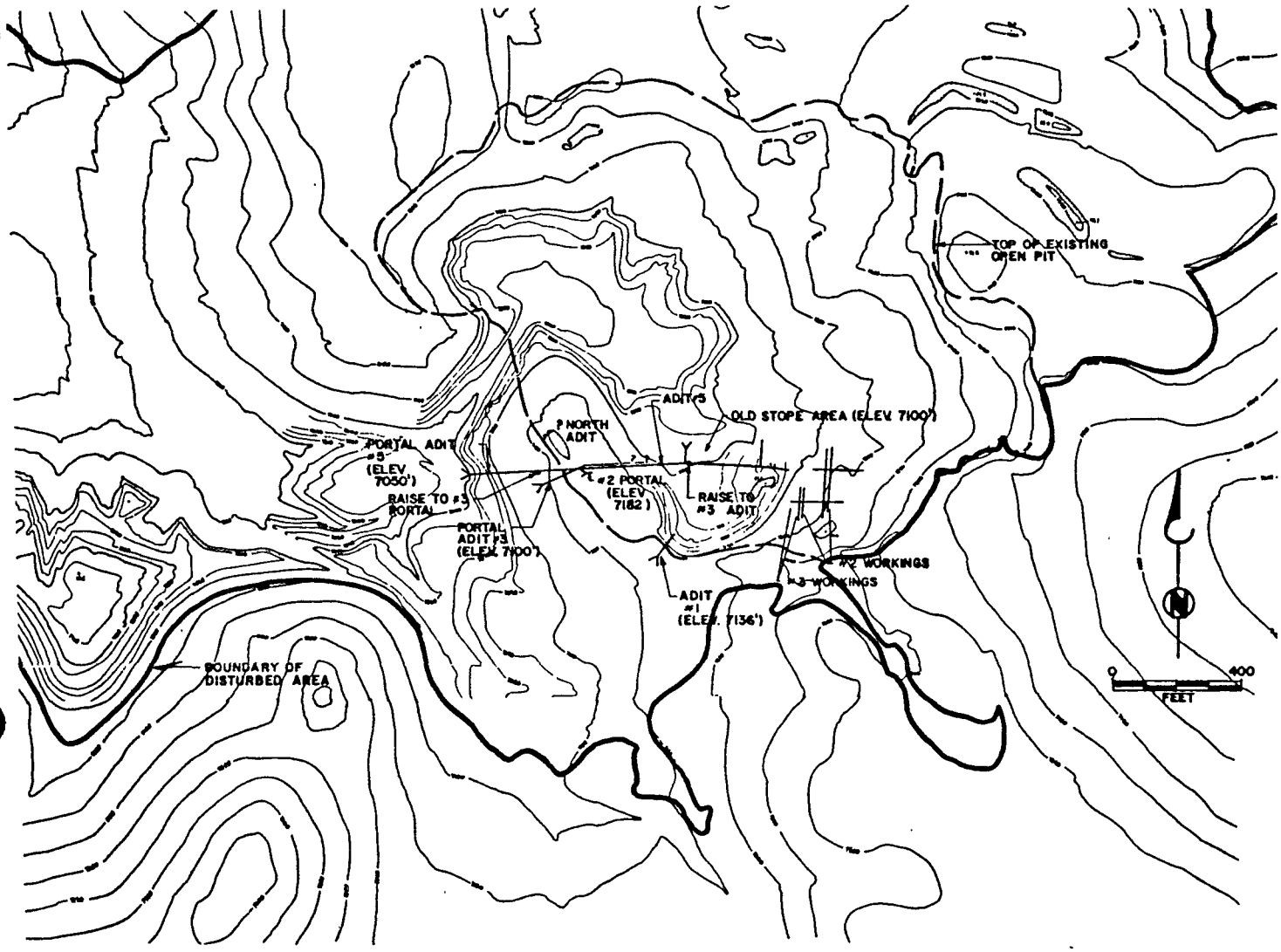


Figure III.3: Plan view of pit and underground workings



LEGEND

ADIT (ELEV. 7136') — NUMBER, APPROXIMATE LOCATION, AND APPROXIMATE ALIGNMENT OF ORIGINAL MINE WORKING WHICH IS STILL PROBABLY IN EXISTENCE. ELEVATIONS SHOWN ARE ADAPTED FROM EXISTING MINE MAPS AND MAY NOT CORRESPOND TO PRESENT ELEVATION DATUM

NOTE: PORTAL ELEVATIONS FOR ADIT NOS. 1 AND 2 ARE SHOWN RELATIVE TO THE ASSUMED ELEVATION GIVEN FOR ADIT NO. 1 ON EXISTING MINE MAPS. ADIT NO 3 IS REPORTEDLY APPROXIMATELY 84 FEET ABOVE ADIT NO. 5. ONLY THE ELEVATION SHOWN FOR ADIT NO. 5 PORTAL IS CONSIDERED REASONABLY ACCURATE.

Figure III.4: Brown and Caldwell map of probable remaining underground mine workings

IV. Pre-project conditions

Very sketchy details exist about the water quality of Leviathan and Bryant Creeks prior to the beginning of Anaconda's mining operations. In a 1957 letter, California Department of Fish and Game Warden Artie G. Brown stated that Leviathan Creek was always polluted downstream of the mine as evidenced by yellow colored water and yellow sediment deposited on the bottom of the stream bed. Conversely, fish were reportedly caught in Bryant Creek as late as May 1953. Fisheries could have existed in Bryant Creek and not Leviathan Creek if the flow rate of Mountaineer Creek provided enough dilution to mitigate the early impacts to Leviathan Creek. Water diverted from Bryant Creek just below Doud creek was used for pasture irrigation and stock watering by Parks Cattle Ranch.

Shortly after the open-pit mining operation began it was apparent that Bryant Creek, and the East Fork Carson River were being degraded by discharges from Leviathan Mine. The first of two fish kills occurred in April 1954 when overburden removal operations collapsed an old mining tunnel and released a slug of acid mine drainage. The second fish kill occurred in November 1959 and extended ten miles below Bryant Creek in the East Fork Carson River. A breach in Anaconda's containment pond dike released approximately five million gallons of acid mine drainage. The absence of trout among the fish killed in Bryant Creek and in East Fork Carson River immediately downstream from Bryant Creek indicated that continuous discharges from mining operations had eliminated the more sensitive trout fisheries that existed prior to open-pit operations. A rancher with downstream water rights noticed poor crop growth in fields irrigated with water diverted from Bryant Creek, and an increase in cattle mortality. Communities in Nevada were concerned about pollution in the East Fork Carson River and what effect it would have on future plans to create a reservoir for municipal and domestic supplies.

The August 1970 Water Quality Control Plan for the Bryant Creek Basin listed agricultural water supply as the only existing beneficial use for Leviathan and Bryant Creeks below the Leviathan Mine. At that time the quality of Bryant Creek water was only marginal for irrigation. The plan also listed three potential uses: livestock and wildlife watering, fish and aquatic life habitat, and recreation and aesthetic enjoyment. The plan states that the potential uses were in effect before mine discharges occurred.

A. Early studies and data collections

Many and various efforts were made to characterize the impacts of Leviathan Mine on water quality at and below the site during and after open-pit mining operations. Attachment A contains 10 abstracts of early studies and data collections ranging from 1954 to 1975. These sources, listed in Table IV.A.1,

document water quality impairment in Leviathan and Bryant Creeks.

Table IV.A.1: Abstracts contained in Attachment A

No.	Date	WQ data
1	1954 to 1962	constituent concentrations
2	1955 to 1974	constituent concentrations
3	Jan and July 1958	bioassay
4	1961	USPHS investigation
5	Oct 1968 Jan 1969	loading rates
6	Dec 1968	constituent concentrations
7	Jan and Dec 1969	bioassay, invertebrate and fish surveys
8	May to Sept 1969	water balance
9	Nov 1969	irrigated soil
10	Sept 1970	irrigated soil

Monitoring data demonstrated significant mining impacts to water quality in the form of high metal and sulfate concentrations, and low pH and dissolved oxygen concentrations in Leviathan and Bryant Creeks. Iron and arsenic concentrations exceeded USPHS 1962 Drinking Water Standards seven miles downstream from the mine. No fish were found in Leviathan or Bryant Creeks between the mine and East Fork Carson River. A bioassay study demonstrated toxicity nine miles downstream of the site at the mouth of Bryant Creek. Stream bottom studies revealed that no invertebrates existed in Leviathan or Bryant Creeks from the mine to East Fork Carson River, and that the benthic environment of East Fork Carson River did not fully recover until two miles downstream from Bryant Creek. Soil studies of areas irrigated with Bryant Creek water exhibited low soil pH that could lead to metal toxicity and nutrient deficiency with continued use.

B. 1970 Regional Board staff report

The January 1970 Regional Board staff report titled "Report on Pollution of Leviathan Creek, Bryant Creek, and East Fork Carson River caused by the Leviathan Sulphur Mine" was the most comprehensive report prepared at the time it was written. All available water quality data was collected and

compared to receiving water standards to show violation of waste discharge requirements. The report contains a brief discussion of the condition of beneficial uses (agricultural supply, wildlife sustenance, and recreation) for each segment of surface water in the watershed and a very specific discussion of the impacts to irrigation, stock and wildlife watering, and fish propagation below the mine site. The report also contains descriptions of the watershed, the mine site, mining operations, pollution sources, discharge and regulation history, regional geology, and site hydrology. The 1973 and 1975 revisions of this report contain new descriptions of specific corrective measures with cost estimates and alternative Regional Board actions.

Table IV.B.1 summarizes the worst water quality conditions measured in Leviathan Creek below the mine and in Bryant Creek at the ranch diversion (seven miles downstream from the mine, or two miles beyond the California border) from three sample collections between December 1968 and September 1969. There is no indication whether the metal concentrations are for total or dissolved metals. The table also contains information from the report concerning water quality standards necessary to protect the beneficial uses listed. Current U.S. EPA arsenic criteria is 0.1 milligrams per liter (mg/l) for irrigation and 0.19 mg/l for protection of freshwater aquatic life.

Table IV.B.1: Worst 1968 and 1969 water quality measured in Leviathan and Bryant Creeks

Parameter (mg/l)	Leviathan Cr. below mine	Bryant Cr. at ranch diversion	Irrigation	Stock and wildlife watering	Fish and Aquatic life habitat
pH	2.8	3.2	optimum soil pH 5.5 to 8.5	low pH's increase toxic metal solubility	optimum range 6.5 to 8.5, ≤4.0 toxic
Acidity (as $CaCO_3$)	1600	33			
Alkalinity (as $CaCO_3$)	0.0	0.0			≥20 mg/l to protect carbonate system
Sulfates	1425	344	≤200 excellent ≥500 hazardous	≤500 acceptable 2100 to 3590 toxic	≤100 for healthy trout population
Total dissolved solids	5430	404	≤175 excellent 175 to 525 good	≤2500 acceptable	≤400 good fisheries, fish cannot survive sudden increases
Boron	3.5	2.4	<0.5 acceptable		
Aluminum	38	6.7	1.0 dissolved reduces crop yield		5.0 kills trout in 5 minutes

Table IV.B.1: Worst 1968 and 1969 water quality measured in Leviathan and Bryant Creeks (Continued)

Parameter (mg/l)	Leviathan Cr. below mine	Bryant Cr. at ranch diversion	Irrigation	Stock and wildlife watering	Fish and Aquatic life habitat
Copper	2.0	0.11	0.1 to 1.0 toxic depending on plant		Toxicity threshold limit = 0.02
Iron	342	92		iron taste prohibits cattle from drinking sufficient amounts	toxicity pH dependent, 1.0 toxic in Bryant Cr.
Manganese	13	0.61	≥0.50 may be harmful		1.0 maximum recommended
Arsenic	1.2	0.2	1.0 maximum recommended	1.0 may be toxic	1.0 may be toxic

From this table it can be seen that the low pH and high sulfate, boron, aluminum, copper, and manganese concentrations in irrigation waters drawn from Bryant Creek most likely produced soil acidity, and decreased crop productivity observed at River Ranch. Leviathan Creek was harmful if not toxic when used for wildlife and stock watering, while Bryant Creek water ranged from harmful to acceptable. The pH, alkalinity, sulfate, total dissolved solids, aluminum, copper, iron, manganese, or arsenic alone would have eliminated the cold freshwater habitat throughout Leviathan and Bryant Creeks.

V. Pollution abatement project design

The Regional Board took on the challenge of Leviathan Mine after efforts to get the new owners or Alpine County to shoulder the burden failed. Minor temporary improvements were made at the site by the new owners and Anaconda between 1963 and 1975, but both Alpine Mining Enterprises and Alpine County lacked the financial means to address the pollution at Leviathan Mine and Anaconda had no recognized legal liability. Outrage from Brooks Park, owner of Parks Cattle Company, and concern from public agencies such as the Departments of Fish and Game in both Nevada and California, Alpine County Health Department, California Department of Health, and the Carson River Council of Governments, provided the initial impetus and support for the Regional Board to assume the role of lead agency.

The problems at Leviathan Mine were more obvious than the solutions. Federal grants

required specific project plans and assurance of site access and continued project operation. The Regional Board began working to obtain a project feasibility report and site ownership. With Clean Water Act 208 Water Quality Planning funds the Regional Board implemented the Leviathan Mine Pollution Abatement Project Management Strategy by organizing a Political Advisory Committee (PAC) of local elected officials and reactivating an existing Technical Advisory Committee (TAC) of concerned individuals with technical expertise from State and Federal agencies. Staff sought direction from both the TAC and PAC in developing each step of the project: feasibility study, project design, construction and long-term ownership.

A feasibility study prepared in 1979 by Skelly and Loy estimated that cleanup of the mine site would cost approximately $2.1 million. In 1978, the voters in California passed a $50 million bond issue to provide funding for the correction of water pollution problems and for water conservation projects throughout the state. These funds were administered through the State Water Resources Control Board. In 1979, Regional Board staff used the feasibility study cost estimate and added funds for a hydrogeotechnical investigation, engineering design, construction management, and inflation to arrive at an estimated project cost of $3.76 million. An application was made to the State Water Resources Control Board, and in 1980 the application was approved.

In June 1982, the Regional Board contracted the consultant firm of Brown and Caldwell to design the Leviathan Mine Pollution Abatement Project. Brown and Caldwell performed a series of identification, evaluation and elimination steps to develop the design of the recommended project. A preliminary cost estimate showed that the recommended project could be constructed at the site within the project budget. The Regional Board accepted the recommended project and instructed Brown and Caldwell to prepare final plans and specifications. As the final design considerations were included in the project, the engineer's estimate had climbed to approximately $3.5 million. The amount of funding remaining in the Regional Board's grant was approximately $2.9 million. Suggestions to cut costs by eliminating project components were rejected to maintain acceptable safety margins and project effectiveness. The Regional Board decided to proceed with the bid process because of the poor economic climate in the construction industry in 1983, and with the hope that the engineer's estimate was conservative.

A. Skelly and Loy feasibility report

Lack of funding prevented the Regional Board from addressing the Leviathan Mine problem until 1978, when a feasibility study was contracted using Clean Water Act 208 Water Quality Planning funds. Skelly and Loy, a consultant firm from Harrisburg, Pennsylvania, prepared the "Feasibility Study for

Abatement of Pollution from the Leviathan Mine, Alpine County, California." The June 1979 feasibility study contained a clear problem statement, additional data collection needs, alternative pollution abatement techniques, and a cost estimate for design and construction.

The Skelly and Loy report, based on all available data, concluded that the five major problems areas to be addressed were: open pit and spoil area, mine tunnels, waste dump, site drainage, and slide area. The report presented the following recommendations: 1) create more reliable and useful data base with photogrammetric mapping, consistent water quality monitoring program, and investigation of surface and subsurface site conditions including the landslide; and 2) implement a five component abatement scheme addressing the problem areas identified that should be re-evaluated once better understanding was gained from the first recommendation.

B. Gathering additional data

Once funding was secured, the Regional Board immediately began implementing Skelly and Loy's first recommendation by gathering crucial design information about the site.

1. Photographic Mapping

The Regional Board contracted with the U.S. Forest Service for the preparation of photographic mapping of Leviathan Mine. Ortho-photo reproductions were prepared at scales of 1" = 100' and 1" = 200' with topographic contours at 2' intervals.

2. Geology of the Leviathan Sulfur Mine and Vicinity, by Herbst and Sciacca, SWRCB, October 1982

A field study of the geology of the Leviathan Mine area was undertaken by Charlene Herbst and John Sciacca of the State Water Resources Control Board at the request of the Regional Board. A geologic map of the site was constructed on 1" = 100' scale orthophoto map to help answer questions about the surface and subsurface hydrology and provide information for the design of engineering works. The study also produced a 22 page report that details the geologic units, geologic structures including faults, and ground water hydrology.

In addition, John Sciacca wrote a masters thesis titled the "Historical and Environmental Geologic Study of the Leviathan Creek Basin

Landslide." This report is an investigation of the large landslide (over 100 acres in aerial extent) north of the pit that was activated by the placement of overburden.

3. Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, California, 1981-1983, U. S. Geological survey, Open-File Report 85-160

The most rigorous study of water quality at Leviathan Mine was performed by USGS. Extensive hydrologic data was gathered for water years 1981 and 1982, including surface water quality and flow rates, stream bottom and benthic invertebrate analysis, and ground water quality and elevations for more than 30 wells. Figures V.B.1, V.B.2, and V.B.3 show the locations of tests holes and surface water sampling sites. Besides creating a much needed data base for the design of a pollution abatement project, this data also serves as a characterization of the pre-project conditions for measuring project effectiveness.

The Leviathan files contain several other reports USGS produced from the data collected for this study, including:

Shallow Ground Water Flow in the Vicinity of the Open Pit at Leviathan Mine - draft report (Prudic and Hammermeister),

Major and Trace Element Analysis of Acid Mine Waters in the Leviathan Mine Drainage Basin, California/Nevada - October 1981 to October 1982, Water-Resource Investigations Report 85-4169 - draft report (Ball and Nordstrom),

Data From a Solute Transport Experiment in the Leviathan Mine Drainage, Alpine County, California, October 1982, Open-File Report 85-85 - final report (Flint, Bencala, Zellwaeger, and Hammermeister),

Final Revised Analysis of Major and Trace Elements from Acid Mine Waters in the Leviathan Mine Drainage Basin, California and Nevada - October 1981 to October 1982, Water-Resource Investigations Report 89-4138 - final report (Ball and Nordstrom),

Transport and Natural Attenuation of Cu, Zn, As, and Fe in the Acid Mine Drainage of Leviathan and Bryant Creeks - draft

report (Webster, Nordstrom, and Smith)

C. Brown and Caldwell Design Report and Draft EIR

On February 3, 1982, the Regional Board mailed out proposal requests for an engineering design of the Leviathan Mine Pollution Abatement Project. The end result of a competitive proposal and interview process was the selection of Brown and Caldwell Engineers of Sacramento. The engineering firm was requested to review the data generated by USGS, and data in Leviathan files (including 1982 geology report, 1980 photographic mapping by USFS, and aerial photographs from 1940, 1954, 1968, 1969, and 1975), identify the major sources of acid mine drainage at the site, evaluate various alternatives for improving downstream water quality, design the selected alternative, prepare construction plans and specifications, develop revegetation plan, prepare environmental documents, and provide construction management.

An intensive review of all the available data and engineering information by Brown and Caldwell and their geotechnical subcontractor led to the conclusion that **the majority of the acid mine drainage being generated at Leviathan came from: a) an abandoned adit, b) the open pit, and c) the contact of Leviathan Creek with the overburden materials as the creek traversed the mine workings**. The water sources generating acid mine drainage in the adit and pit were regional ground water and percolating rainfall and snow melt. Brown and Caldwell believed that as the regional ground water flowed north into the mined area it became immediately and grossly contaminated and was later discharged from the adit and pit as well as numerous smaller seeps and springs.

Brown and Caldwell performed a series of identification, evaluation and elimination steps to develop the design of the recommended project. These design steps are summarized in Attachment B.

The **recommended project** consisted of five major elements:

1) Leviathan Creek channelization,
2) mine pit filling and regrading,
3) waste dump excavation and regrading,
4) on-site evaporation ponds, and
5) spoil area A regrading and drainage work.

Figure V.C.1 is a schematic of the recommended project showing the locations of the five major elements.

The Leviathan Creek channel proposed in the recommended project consists of an open rectangular, wire mesh reinforced concrete channel 1900 feet in length extending from a point just south of the waste dump northerly to a point just beyond the delta. The channel alignment was slightly east of the creek alignment at that time. The slope of the channel was expected to range from 0.005 to 0.2 depending on localized conditions. Unnamed tributaries that terminated in the waste dump would be reconnected with Leviathan Creek with soil cement channels. In the delta area, the channel was to be elevated 10 feet above the existing creek alignment to prevent seepage of acid groundwater from entering the channel through the sides or bottom.

The recommended project design specified the pit to be filled with 380,000 cubic yards of mine waste excavated from the waste dump in the Leviathan Creek canyon to raise the bottom elevation from 7060 to 7160 feet. The compacted pit fill slope would be graded with two to four terraces. Each terrace would have an earthen drainage ditch sealed with soil cement. The ditches were designed to drain to open channels that collect in the bottom of the pit, and are drained by a pipe to Leviathan Creek. A pit underdrain was to be constructed across the mouth of the pit in the shape of a "T" and with a bottom elevation of 7054 feet. A concrete barrier wall installed down gradient and across the pit throat would assist in collecting the underdrain flow. A perforated pipe would extend from the wall into the pit and a solid pipe would continue from the wall to the flow control structure near the adit.

The recommended project called for the excavation of 472,000 cubic yards from the top of the waste dump to create a large flat area for 9.3 acres of evaporation ponds (ponds 2N and 2S). The existing waste dump elevation of 7117 feet would be dropped down to 7045 feet. Excavated material would be used for filling and regrading the pit and areas adjacent to the waste dump.

The recommended project proposed five evaporation ponds with a total of 15.1 acres of surface area. Figure V.C.2 shows the locations and surface areas of the proposed ponds. The pond dikes would be trapezoidal with a maximum height of 6 feet, and constructed of compacted material obtained from the site. The tops of the dikes were specified to be 12 feet wide with a 3:1 slope on the water side and a 2:1 slope on the land side. The pond bottoms would be constructed of engineering fill and lined with 36 mil acid resistant liner protected with a minimum 12 inch earth cover. The bottoms were to be mildly sloped for maintenance drainage. The ponds would receive acid mine drainage from the flow control structure which combined the adit and pit underdrain flows. Piping was designed so that all or any combination of the top two ponds, each with two cells, could be bypassed. Weirs in the flow control

structure could be adjusted to discharge acid mine drainage into the pipeline carrying pit runoff to Leviathan Creek channel.

The recommended project also indicated minimum regrading of spoil pile A to provide positive surface drainage to Aspen Creek. Channels from surface depressions would be graded to slopes of 2 to 3 percent, and channels on slopes with velocities exceeding 2.5 feet per second would be lined with 4-inch-diameter rock.

The estimated cost of the recommended project was $2.8 million, with maintenance costs estimated at $52,600 for the first five years, and $30,000 for the second five years. The recommended project was expected to remove 79 percent of the total dissolved solid (TDS) load and return the beneficial uses of agricultural irrigation in Bryant Creek above Doud Creek and stock watering below Aspen Creek confluence with Leviathan Creek. Calculated iron and nickel concentrations from the mine to the East Fork of the Carson River exceeded domestic water supply criteria. The recommended project 's water quality was also predicted to exceed cold freshwater habitat criteria for iron, copper, cadmium, chromium, nickel and lead at all points below the mine to the East Fork of the Carson River. Receiving water TDS and metal concentrations were estimated for the recommended project based upon expected pH increases and reduced metals emissions. Table V.C.1 presents the estimated constituent concentrations in Leviathan Creek below the confluence with Aspen Creek and in Bryant Creek below the confluence of Leviathan and Mountaineer Creeks.

Table V.C.1: Recommended project water quality

Parameter	TDS	Iron	Copper	Cadmium	Chromium	Zinc	Arsenic	Nickel	Lead
Unit	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Leviathan below Aspen	346	20100	72	10	50	55	73	182	3
Bryant	150-155	5600	52	4	17	34	26	72	1

Brown and Caldwell developed three "maximum feasible pollution abatement projects" based on the objective of restoring water quality of the Bryant Creek watershed as nearly as possible to its pre-mining conditions. The three alternatives contain more intense application of the pollution abatement concepts employed in the recommended project. One variation included substantial additional regrading and filling of the mine pit from spoil area A to further reduce infiltration and promote surface runoff. Another variation incorporated extensive site revegetation to control drainage from all areas of

the site including the pit. And the third version of the maximum feasible project combined the first two variations. The recommended project compared well to all three variations of the maximum feasible project. The costs of the maximum feasible projects ranged from $4.3 million to $5.8 million, with the first five years of maintenance ranging from $124 thousand to nearly half a million dollars. While the maximum feasible projects may have significantly reduced the concentrations of total dissolved solids and toxic metals, the beneficial uses restored by the maximum feasible projects were estimated to be the same as those for the recommended project but with a greater level of protection.

Project changes were made in developing the final design plans and specifications, such as eliminating the pond in the delta area, and piping a section of the Leviathan Creek Channel. Brown and Caldwell completed the final design for the recommended project during the Spring of 1983. On June 9, 1983, the Regional Board certified the final Environmental Impact Report (EIR) for the Leviathan Mine Pollution Abatement Project was completed in compliance with the California Environmental Quality Act and State Guidelines (Resolution No. 83-6). The final EIR consists of the April 1983 draft and a supplemental document titled "Leviathan Mine Pollution abatement Project, Final Environmental Impact Report, May 1983" which contains responses to comments made on the preliminary and draft EIR's. Response to late comments received from Anaconda are also included as Attachment A..

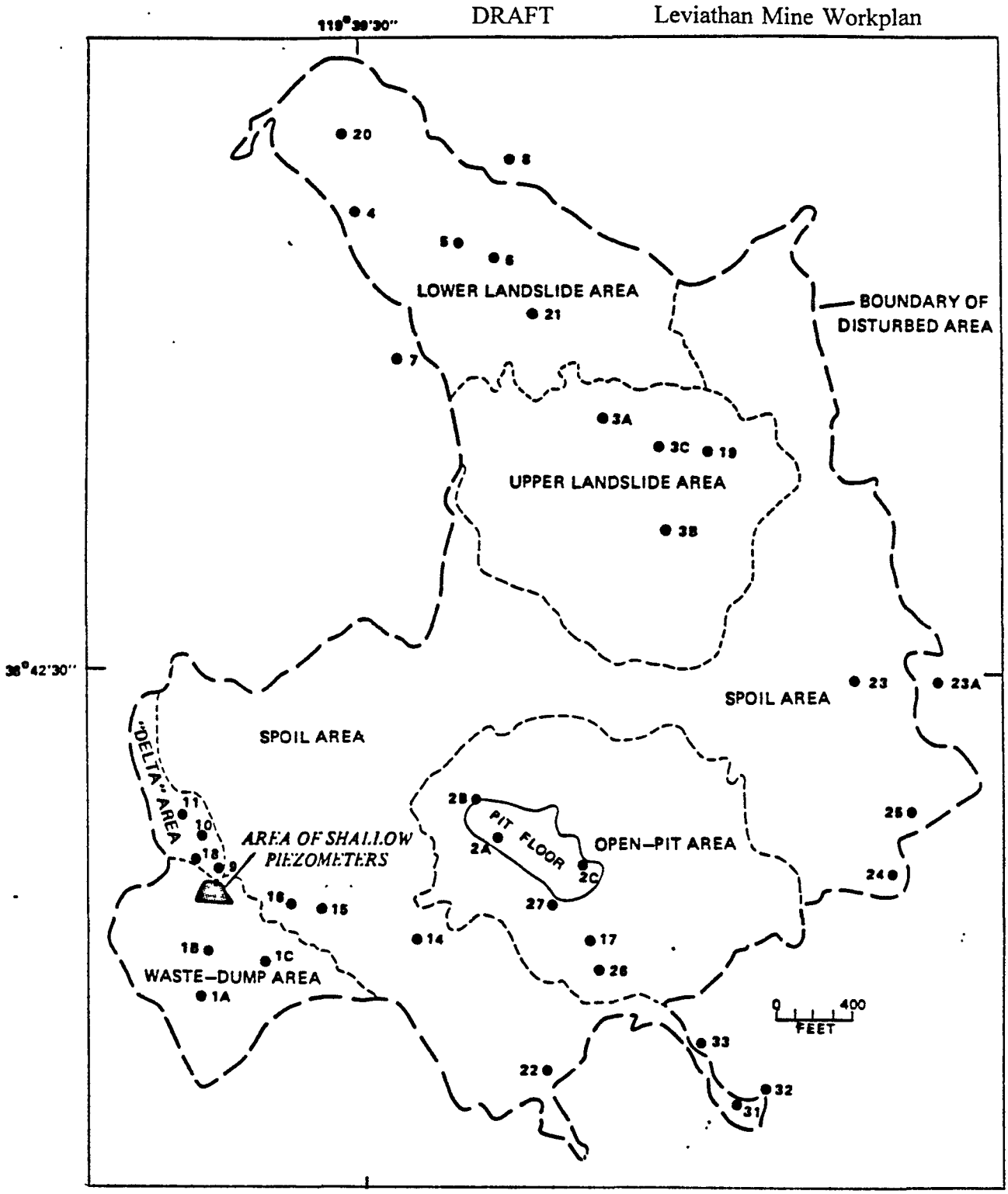


Figure V.B.1: Test holes and shallow piezometers location map

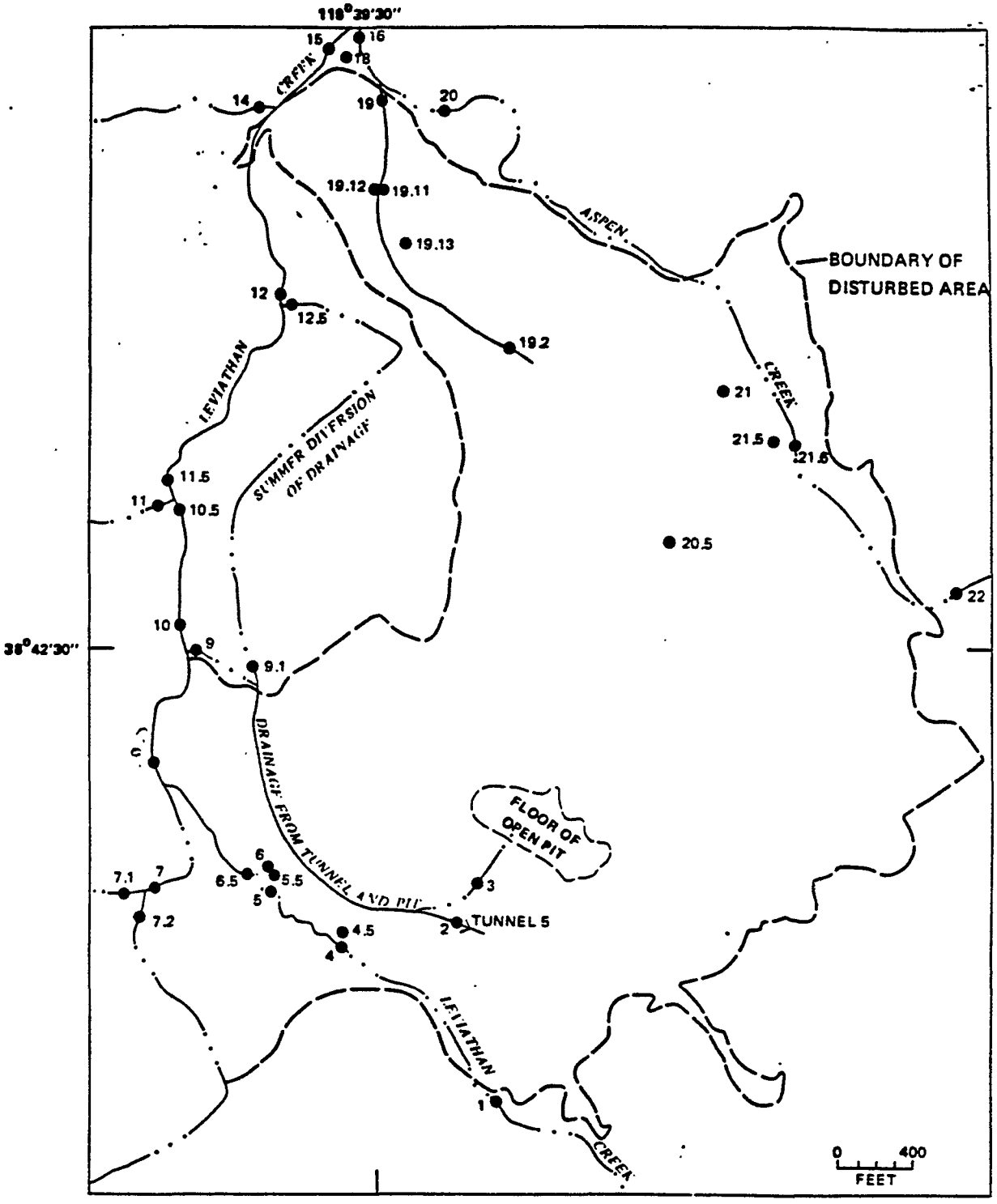


Figure V.B.2: Surface water sampling sites in mine area

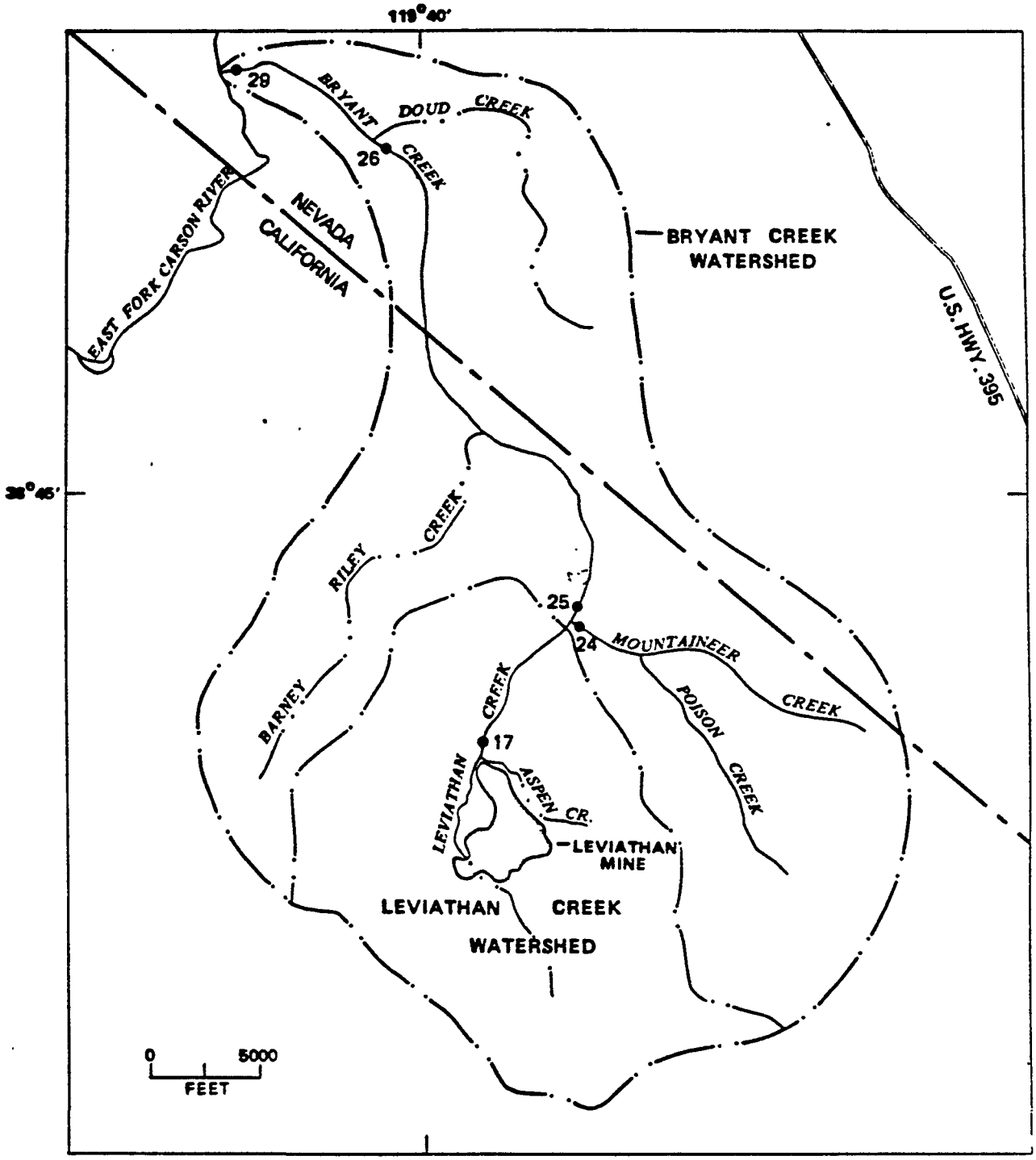


Figure V.B.3: Surface water sampling sites down stream of mine area

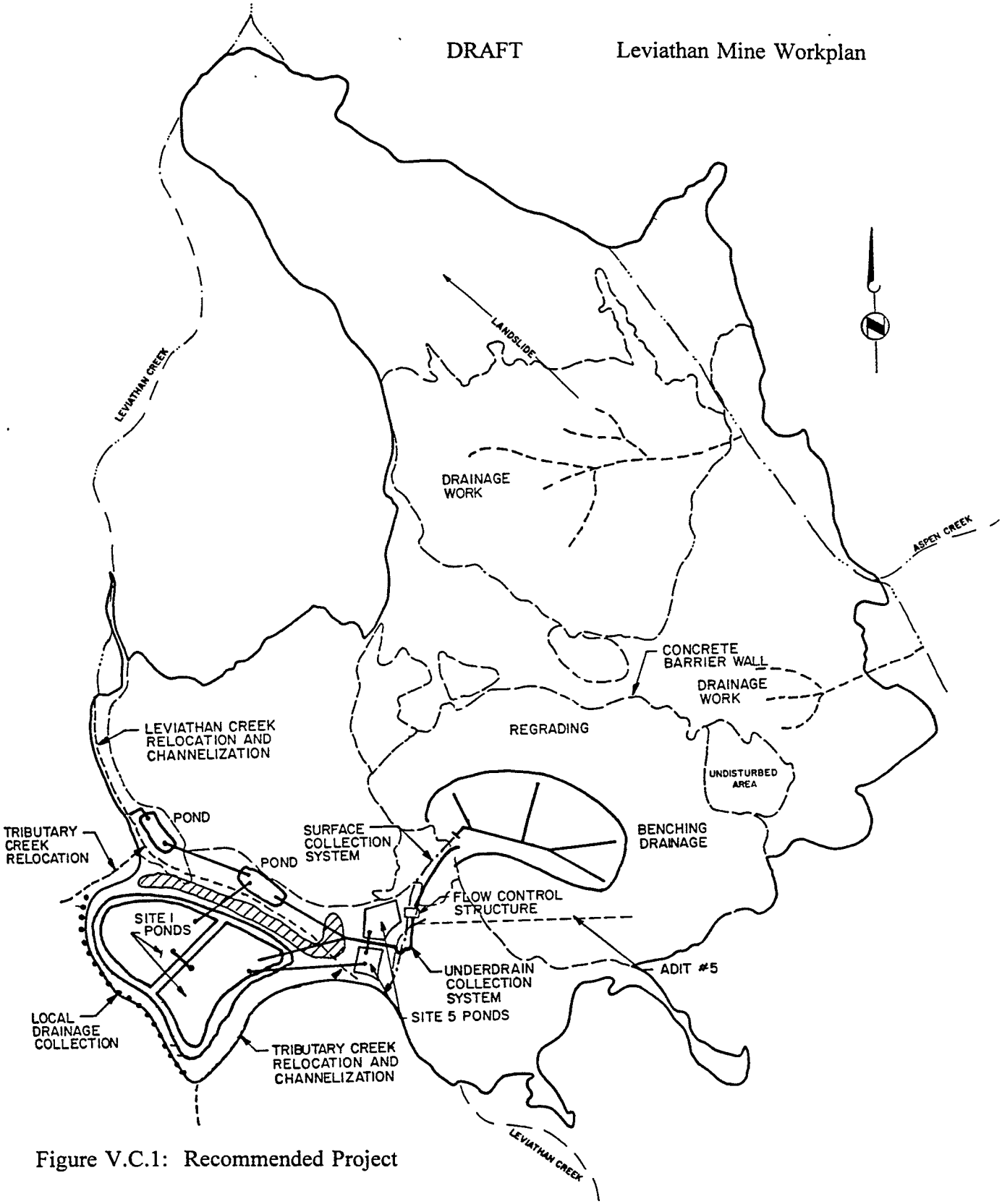


Figure V.C.1: Recommended Project

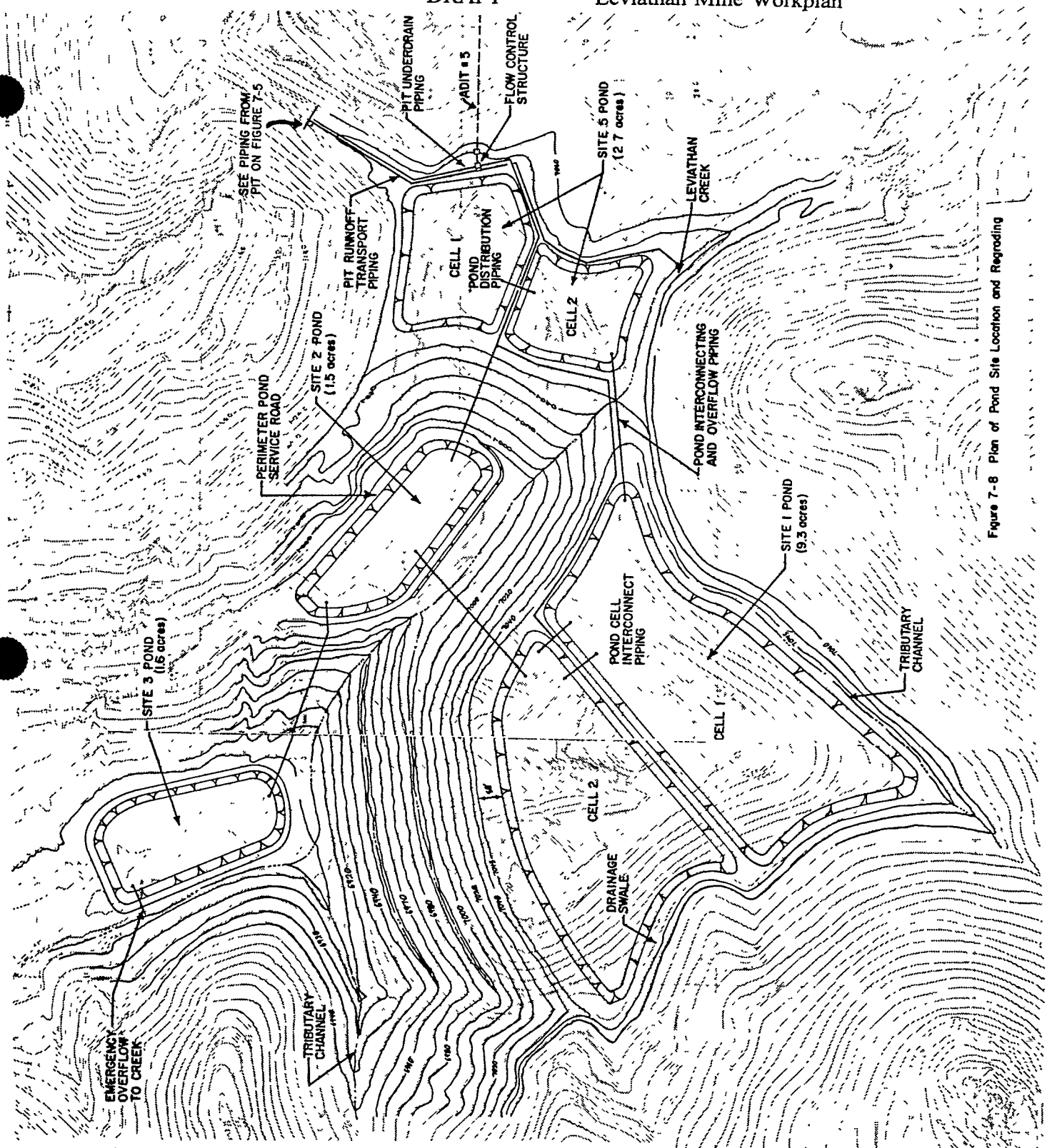


Figure 7-8 Plan of Pond Site Location and Regrading

Figure V.C.2: Location and surface area of proposed ponds

VI. Project construction

Construction of the Leviathan Mine Pollution Abatement Project was advertised for bid on a statewide basis, and bids were opened in June 1983. The bids ranged from $3.565 million to $7.22 million, with 7 of 12 bids ranging from $4.6 to $5.6 million. The low bid of $3.565 million, from Mittry-G.E.B., Inc., was significantly more than the $2.9 available to the Regional Board, therefore a bid was not immediately awarded.

On April 14, 1983 the Regional Board adopted Resolution No. 83-3 which directed the Executive Officer to request the California Attorney General to initiate legal actions under the authority of the Comprehensive Environmental Response and Liabilities Act of 1980 (CERCLA) against Anaconda Minerals, a wholly-owned subsidiary of ARCO, to recover funds for the cleanup and abatement of water pollution generated by Leviathan Mine. As a result of negotiations, Anaconda and ARCO agreed to supplement the project funds. The Regional Board accepted the settlement, and awarded a construction contract for $3.565 million on August 15, 1983 to Mittry-G.E.B, Inc. of Anderson California.

Construction of the project began August 22, 1983, and with two winter shutdowns, was completed in 1985. Many alterations were made to the project design during construction as a result of the ARCO settlement, site conditions, and the anticipated transfer of title to the U.S. Forest Service. Attachment C contains descriptions of these factors, and a list of 14 contract change orders. As a result of project modification the final total cost of the Leviathan Mine Pollution Abatement Project reached $ 4.227 million.

VII. Site acquisition

When first looking for project funds, the Regional Board learned that to obtain a Federal demonstration grant the project proponent must be able to assure site access and continued project operation. From this, site ownership developed in to a Regional Board objective. In September 1980, the Regional Board contracted with the California Department of General Services, Real Estate Services Division to prepare a title report on Leviathan Mine including mineral rights and to prepare an appraisal of the fair market value of the site. The June 18, 1981 appraisal by Leo Brady stated the fair market value of the 465 acre disturbed mine site was $54,500. The unit fair market value was set at $500 per acre. Cleanup costs were assessed for each 20 acre parcel and subtracted from the assigned fair market value of $10,000. The $54,500 appraisal compensated the property owner for 5 undisturbed parcels (Numbers 5, 23, 31, 32 and 43), the mill site (a noncontiguous 5 acre parcel), and one slightly disturbed parcel (Number 13). Figure VII.1 shows the area appraised.

While the appraisal was being developed, the Regional Board sought advice from the Department of Health Services Hazardous Material Management Section about the extent of liability that the State would assume if it were to purchase Leviathan Mine. In response, Ester Low of the Office of Legal Services, concludes in an August 28, 1981 letter that "if the State took ownership and control of Leviathan Mine for the purposes of conducting a pollution abatement project, it would probably not be liable for foreseeable hazardous substance damage if its acts or omissions are reasonable and not negligent." This statement was based on the presumption that the State would not agree to assume the previous liabilities relating to pollution.

The purchase of Leviathan Mine was delayed because the State of California was unable to sell Clean Water Bonds on September 2, 1981 and suspended indefinitely by the Regional Board at the December 10, 1981 Board meeting until a viable restoration project was ready to be implemented. On August 10, 1983, the Regional Board again set the wheels in motion to purchase Leviathan Mine. In the mean time, 42 unpatented claims for the site became abandoned when the owner, Alpine Mining Enterprises, Inc. failed to register the claims with the Bureau of Land Management between 1976 and 1979.

On December 19, 1993 Alpine Mining Enterprises deeded 23 patented lode claims and the Leviathan Mill site claim to the State of California. The State Public Works Board authorized acquisition of Leviathan Mine with a resolution dated January 31, 1984 and transferred jurisdiction of Leviathan Mine to the State Water Resources Control Board in a letter dated August 20, 1984.

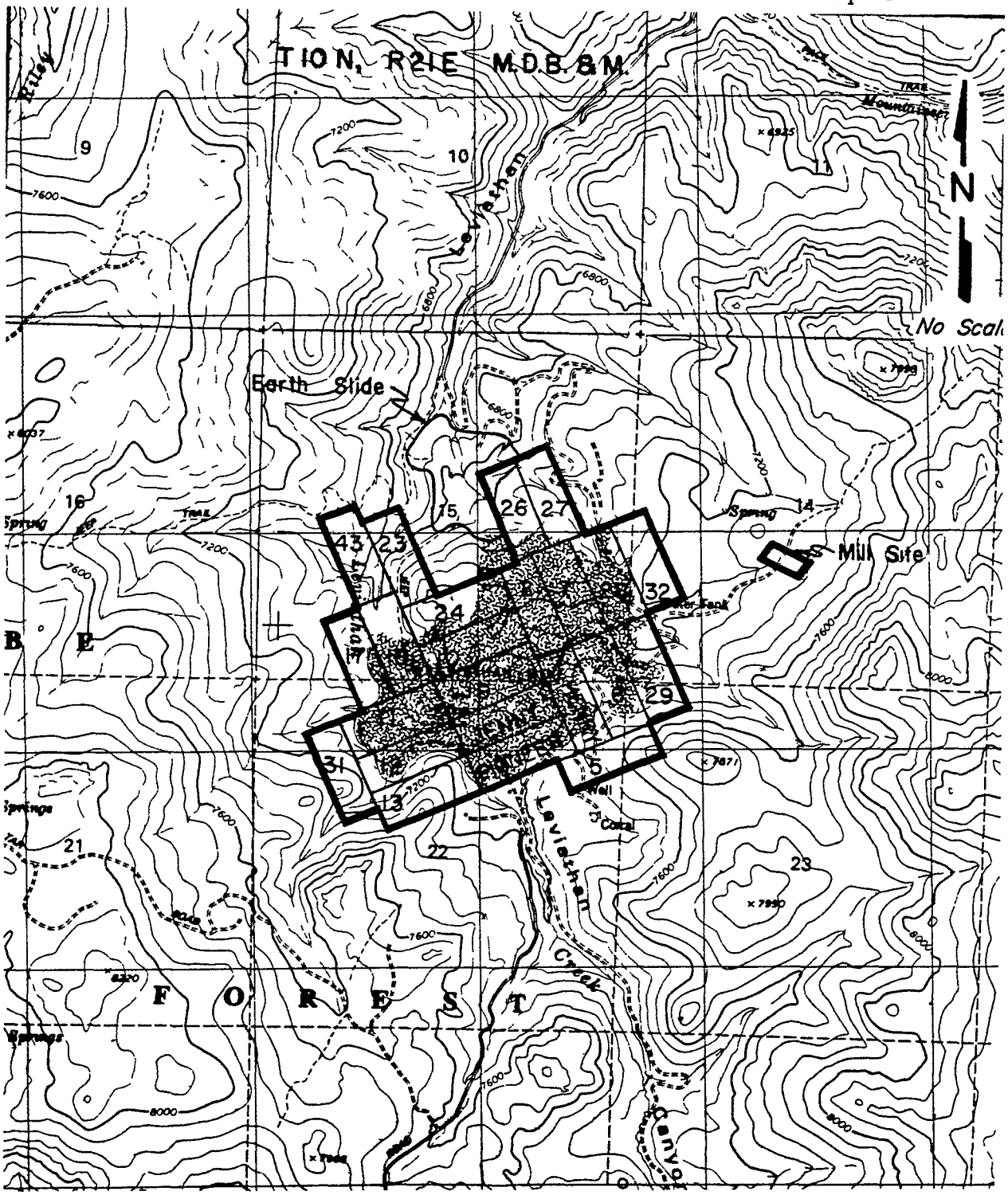


Figure VII.B.1 Leviathan Mine property appraised

VIII. Final project

Though some of the problems encountered during construction went unsolved, the completed project achieved several important objectives that would benefit water quality. **Infiltration in the pit was reduced, Leviathan Creek was channelized to prevent contact with mining wastes, and acid mine drainage was being stored in evaporation ponds to reduce volumes of acid mine drainage discharged and to coincide discharges with periods of high creek flows. These site improvements were expected to reduce the length of stream impacted and reduce contaminant loads.** Figure VIII.1 shows the pit, evaporation ponds, and channel components of the finished project.

A. Leviathan Creek Channel with underdrain

A channel was designed to capture Leviathan Creek and convey it across the mine site, preventing contact with mine wastes dumped in the creek canyon. From upstream to downstream, this diversion consists of approximately 200 linear feet of grouted riprap channel, 465 linear feet of 5 feet by 8 feet rectangular cross section reinforced concrete channel, 1070 linear feet of twin 72-inch reinforced concrete pipelines, and 540 linear feet of 9 feet by 14 feet rectangular cross section reinforced concrete channel. Both the upper and lower portions of the channel were constructed with weep holes to relieve pressure from groundwater that may backup behind the channel walls.

Many acidic springs were encountered while digging the trench for the twin 72-inch pipes. A system of construction drains were centered under the pipes to dewater the foundation for the pipe bedding (Contract Change Order (CCO) Nos. 3 and 6). The underdrain was extended around the western side of the lower concrete channel, providing additional drainage of the delta area, and discharging directly to Leviathan Creek below the channel outfall. CCO No. 6 also describes a shallower rock drain designed to be located under the elevated twin 72-inch pipeline and to discharge to the concrete channel near the outlet structure. After the under drains were constructed, the pipeline trench was filled with selected bedding material and compacted to 90 percent relative density. On September 17, 1984, underdrain flow was observed to be 70 gallons per minute, but flows were expected to decrease. It was immediately recognized that the underdrain discharge decreased the effectiveness of the project, but there appeared to be no alternative.

By creating a barrier between the creek and the mining waste, the channel prevents seepage of the creek through the waste piles. This decreases the amount of acid mine drainage generated and creates an additional volume of

unpolluted water that dilutes remaining acid mine drainage discharges. Though contaminated groundwater is discharged to the creek, the creek has been kept out of the mining wastes. The channel also stabilized a significant erosion problem. Pre-project slides show Leviathan Creek eroding a canyon through the mine waste.

B. Lined Evaporation Ponds

There are five lined evaporation ponds with an approximate total capacity of 14 million gallons and total surface area of 11.5 acres. The evaporation ponds receive acid mine drainage from the adit, the pit underdrain system, and from various drains collecting springs and seeps. Because of the isolated setting of the Leviathan Mine and the desire for absolute minimum in maintenance costs, the design emphasis was on passive acid mine drainage control methods which would operate under the site conditions. Consequently, all flows in the project are by gravity, and no energy inputs or chemicals are required for the operation. The highest ponds (elevation 7040 feet), 1, 2S and 2N, receive flow from the flow control structure and overflow into pond 3. Pond 3 (elevation 6990 feet) receives flow from the upper ponds and seeps collected by an underdrain east of pond 1. Pond 4 (elevation 6915 feet) receives overflow from pond 3, from a drain below the south levee of pond 3, and from developed springs to the east and south of pond 4. Figure VIII.B.1 shows the piping system between the ponds. Ponds 1, 2S, 2N, and 3 each have an individual leak detection system that consists of a branched drain constructed with drainrock and liner that connects to a monitoring well.

According to Weekly Progress Report (WPR) No. 22, the ponds were the pond bottoms were to be subexcavated 3 feet, and the pond levees were to be subexcavated 6 feet below finish pond bottom elevation. The specifications in the bid packet required compaction of the pond bottoms and levees to 95 percent relative density. The north slope of the waste pile was compacted to 90 percent relative density. Ponds 1, 2N, 2S, and 3 are lined with 36 mil Dynaloy, and pond 4 with a 30 mil unreinforced PVC liner. The levees are trapezoidal in shape with a 12-foot width across the top, 3:1 slope on the water side, 2:1 slope on land side, and maximum height of 6 feet.

No surface runoff is directed into the ponds, though they do receive direct precipitation. Surface runoff around the ponds and on slopes between the ponds is collected in concrete v-ditches and conveyed to Leviathan Creek. The collection of surface runoff around the ponds is necessary to protect the structural integrity of the ponds, to prevent additional generation of acid mine drainage by infiltration, and to prevent surface runoff from entering the ponds.

When Brown and Caldwell estimated that the project costs would be higher than the funds remaining, the final pond in the delta area was deleted from the project. As the project was being constructed, it became apparent that available stable sites would limit the area of ponds that could be constructed. As an example, springs around and below pond 3 had to be drained to establish a stable foundation for the levee and to keep the liner from floating. It was late in the construction of the project that a final pond in the delta area was again added to the project. Pond 4 was added because design calculations showed that ponds 1, 2S, 2N and 3 would not be able to treat all the acid mine drainage expected to be collected. Pond 4 was also added to receive contaminated groundwater from under pond 3 that would otherwise be discharged directly to Leviathan Creek. The project manager and engineers determined that it would be too expensive and risky to try to direct flow from the channel underdrain into pond 4 (WPR No.39). Connecting the channel underdrain to pond 4 would have required lateral drilling that might have damaged the pipeline. The project engineer believed that full capacity of the site to evaporate the acid drainage was utilized with the construction of pond 4.

According to early Brown and Caldwell estimates, the site allowed a maximum of 15.1 acres of evaporation ponds. The recommended project was expected to collect 8.5 million gallons of acid mine drainage from the adit and pit underdrain in an average year. Based upon an average yearly evaporation of 19 inches, which takes direct precipitation into account, 15.1 acres of pond surface area would have evaporated 7.8 million gallons or 92 percent of the acid mine drainage generated at the site. Funding and site limitations resulted in a total of 11.5 acres of evaporation ponds. The 11.5 acres of surface area will prevent 5.93 million gallons of acid mine drainage (70 percent) from being discharged annually to Leviathan Creek.

The capacity of the ponds allows for the collection and evaporation of acid mine drainage up until early spring before overflows occur. Spring discharges of acid mine drainage have the least impact because that is when the peak flow rates and assimilative capacity occur. It has been estimated that 2.6 to 3 million gallons of acid mine drainage overflow from pond 4 to Leviathan Creek in years of average precipitation.

C. Regraded, compacted pit with surface and subsurface drainage

A total of 1,920 linear feet of pit underdrain were trenched into the bottom of the pit (CCO No. 6). The underdrains stabilized the pit area for regrading and construction of surface runoff structures by removing the pooled water. The pit underdrains continue to intercept infiltrating precipitation before it has a chance

to enter the deeper underground mine workings.

The pit was regraded and compacted to promote surface runoff and eliminate infiltration. A total of approximately 970,000 cubic yards of overburden and mining wastes were brought back into the pit. The fill was keyed into existing slopes and compacted to specifications of 85 to 90 percent relative density.

The bottom of the pit was raised above the throat, and reinforced concrete v-ditches constructed along regraded terraces. Pit runoff is collect by surface ditches and conveyed to Leviathan Creek in a concrete pipe. No runoff is directed into the evaporation ponds. Infiltration and acid mine drainage generation is reduced by collecting the surface runoff. In addition, the v-ditches provide some protection against erosion.

Regrading and installing surface and subsurface drainage in the pit worked to eliminate the "bath tub" effect, where all precipitation was captured and infiltrated through the remaining underground workings. A reduction in pit and adit flow was expected, along with additional dilution capacity in the creek from clean runoff.

D. Regrading of overburden

Overburden piles to the north of the pit (spoil pile A) were regraded to prevent impounding and infiltration of precipitation and promote surface runoff. Pools of water were released by regrading the overburden piles and installing culverts. It was hypothesized that the overburden placed above the landslide was surcharging a slip layer with infiltrated precipitation. A significant source of water to the slip layer may have been reduced by regrading this area to promote drainage.

Figure VIII.1: Final project

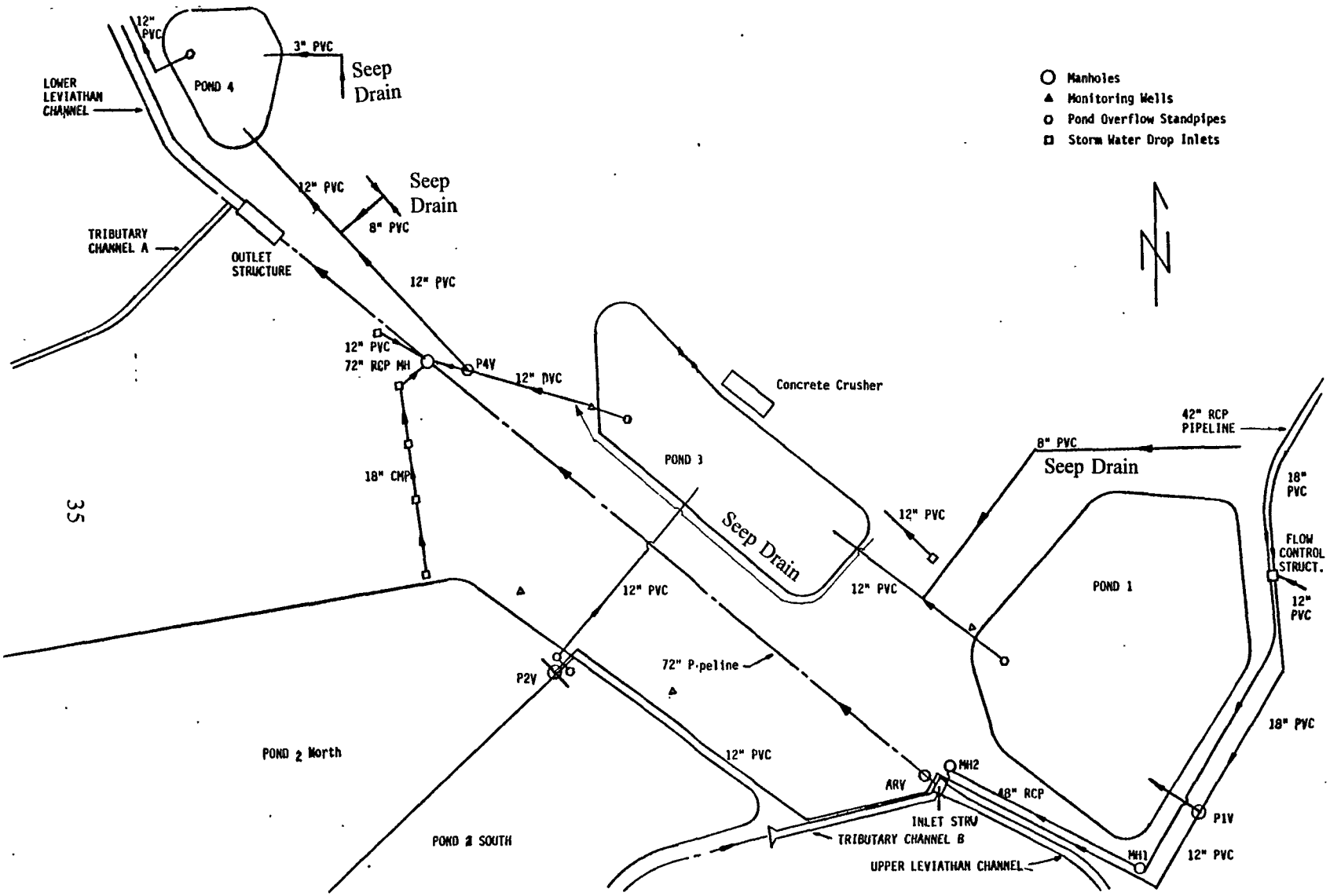


Figure VIII.B.1: Pond system

IX. Concrete Deterioration

The first signs of premature deterioration of concrete at the Leviathan Mine Pollution Abatement Project were observed after the winter of 1983-84, with more significant deterioration observed after the winter of 1984-85. The deterioration was, for the most part, confined to the upper one to two feet of channel walls with no deterioration of the lower channel walls or bottoms. The channels showing the most deterioration were the tributary in the delta area below pond 2N and the Leviathan Creek channel. The concrete failed because it did not meet the special design specifications developed to produce "a workable, strong, dense, and impermeable concrete resistant to sulfate attack from native soils." Technical specifications for the concrete included: maximum water-cement ratio of 0.45, minimum cement content of 7.25 sacks per cubic yard of concrete, pozzolan content of 18 to 20 percent by weight, and a minimum 56 day compressive strength of 6000 pounds per square inch (psi). The rationale behind these design specifications was that a dense concrete mix would significantly limit infiltration of water into the concrete, thereby reducing the opportunity for corrosion of the concrete matrix. By observation alone, Regional Board staff could tell that the ready mixed concrete batches delivered to the project by Bing Materials, from a batch plant in Gardnerville, Nevada were inconsistent in quality. The delivered concrete was either too dry to pour, or too soupy, as supported by slump measurements. Compressive strength tests on concrete samples, collected by July 4, 1984, showed that the average strength was only 4733 psi after 56 days.

Brown and Caldwell contacted Kleinfelder and Associates, a materials testing firm, to perform an evaluation of the concrete deterioration. Kleinfelder retained concrete expert Robert Adams. Samples were taken from cement deliveries and core samples from the channel walls and analyzed by Met-Chem Laboratories, Inc. The results of petrographic examination of the concrete samples were: 1) the concrete does not contain entrained air, 2) damage to the concrete is probably due to freezing and thawing, 3) cement content is lower than specified, 4) water-cement ratio is higher than specified, in some cases, much higher, and 5) pozzolan is in the concrete, but less than the 15 percent reported. In a report submitted to Kleinfelder, Robert Adams concluded that the primary cause of freezing and thawing damage to the concrete was the lack of entrained air in the concrete, and a secondary cause may have been the high water-cement ratio. There was no evidence that the aggregate was reacting with the cement paste, even though the aggregate was found to be potentially reactive. Additionally, there were no indications of other deleterious chemical reactions such as sulfate attack or acid attack from water or soil. In the same report, Adams explained that "concrete in the tops of walls is more vulnerable to freezing and thawing damage because of bleeding of water into the top resulting in higher water-cement ratio and consequently lower quality concrete." Leo R. Ferroni of the California Department of Transportation concrete testing laboratory also investigated the deteriorating concrete

for the Regional Board. Ferroni's results and conclusions supported Adams'. Both agreed that the aggregate was potentially reactive but the presence of pozzolan in the mix should prevent the reactions from taking place. Ferroni also believed that the design mix, which was slow and difficult to place, was most likely watered to increase the slump for placement in the reinforced channel walls which increased the water-cement ratio to a level that compromised the concrete's strength and durability.

To prevent catastrophic failure of the deteriorating concrete structures, Mittry's crews worked to repair the deteriorating concrete between June 11, 1985 and August 30, 1985. Repairs were made according to the following directions given by Adams: in areas of extensive deterioration, make a one inch deep sawcut in the interior face of the wall below all deterioration, remove all concrete above sawcut, expose and clean rebar to make a secure concrete joint, reform and pour concrete that meets the original specifications and has an air content of four to six percent by volume. Where freeze thaw damage was not more that one to two inches deep, the deteriorated concrete was removed and patched with Thoroseal Plaster Mix. Of the approximately 7000 linear feet of concrete wall, nearly 1000 linear feet was partially reconstructed with concrete and 640 linear feet was repaired with patches. Thoroseal Foundation Coating was applied to the top two feet of all concrete structures.

During a Leviathan Mine inspection performed on December 6, 1985, the Thoroseal Foundation Coating was observed to be peeling off all structures. In addition, one small area of concrete covered by sealer on the south wall of the tributary channel in the delta area below pond 2N was showing the same signs of deterioration that occurred during the winter of 1984-85. Because the Thoroseal Foundation Coating did not remain intact, it was expected that the concrete with a low air content would continue to deteriorate.

The below standard concrete and cost of concrete repairs lead the State into litigation with Mittry and negotiations with Brown and Caldwell. In 1986 the Regional Board requested an additional $400,000 to fund concrete repairs while in litigation with Mittry. This request was approved and a $400,000 Cleanup and Abatement Project Account Number 26 was established. As a result of the negotiations, the State received $110,000 from Brown and Caldwell in a December 1988 settlement agreement, and a total of $70,000 from Mittry and their subcontractors in a July 1990 settlement agreement. Cleanup and Abatement Account Number 5 was established with the $180,000 received from the concrete settlements.

From December 1, 1988 to June 30, 1990 the Regional Board retained Omni-Means, Inc. to evaluate the state of the deteriorating concrete structures, to develop and evaluate at least three repair alternatives, and to recommend an alternative for implementation. Omni-Means submitted a letter report on November 17, 1989 to the

Regional Board that briefly commented on the state of the concrete and presented four repair alternatives. The report states that the absence of entrained air and lower than specified compressive strength are likely to be found throughout the concrete, and that these two problems "combined to create a product that has not weathered well." They also observed that the repairs made to the concrete seem to have decreased the rate of deterioration. Table IX.1 presents the four concrete repair alternatives developed by Omni-Means.

Table IX.1: Concrete repair alternatives

ALTERNATIVE	PRESENT WORTH*	ANNUAL COST*	LIFE
1. Reconstruct top of channel walls	$181,450	$15,820	20 yrs
2. Replace entire wall sections	$611,600	$44,430	30 yrs
3. Repairs as needed	$163,800	$11,900	30+ yrs
4. Combine alternatives 1 and 3	$285,200	$20,720	30+ yrs

*In 1990 dollars.

The cost comparison was based on a 6 percent interest rate and $400 per cubic yard for removal and replacement of damaged concrete. The report recommended alternative 4, even though it states that if properly maintained the "system could continue to function adequately beyond the 30 year life." Omni-Means believed alternative 4 was the most cost effective approach because it would repair existing known damage and provide long term maintenance protection without causing a major disruption to the project's operation. The results and recommendations of the Omni-Mean report were presented to the Regional Board at the February 8 and 9, 1990 meeting in Truckee, California. The Regional Board was asked to select a repair alternative or reject all alternatives. The Regional Board choose not to make a decision about concrete repairs at that time, and directed staff to analyze and develop options to address the remaining water quality problems at Leviathan, namely pond overflows, the channel underdrain, and revegetation. The Regional Board did not want to consider the concrete repair alternatives separate from solution alternatives for all problems at Leviathan Mine.

X. Post-project water quality

Results from monitoring conducted before and after the construction of the Leviathan Mine Pollution Abatement Project show that it has resulted in significant improvements to water quality. Prior to project construction, the USGS conducted extensive monitoring both up and downstream of the site. Forty-five monitoring sites

were sampled at least once during the 1981-1982 monitoring period, and samples from 26 sites were analyzed for major cations, anions, and a wide range of minor constituents. Following project construction, Regional Board staff continued sampling from 8 of the USGS monitoring stations for pH, total dissolved solids (TDS), sulfate, and total aluminum, arsenic, iron, and nickel. Most monitoring was conducted in summer and fall because of site inaccessibility during winter months. Until recently, no information was collected from spring snow melt periods, when the evaporation ponds are known to overflow. For this reason, the post-project data best represents baseline conditions for discharges from Leviathan Mine and depicts the impact of the continuous underdrain discharge on Leviathan Creek. Average pH and constituent concentrations from the USGS pre-project data, all post-project data, and Spring '93, '94, and '95 pond discharges are compared in Table X.1. A marked improvement in the water quality can be seen at both downstream monitoring points. Whereas the USGS data are all dissolved constituent concentrations, the post project data are a combination of dissolved and total constituent concentrations, therefore the actual reductions would be greater than demonstrated by Table X.1.

Table X.1: Post-project versus pre-project water quality

Leviathan Cr	LM Project	Date	pH	Sulfate (mg/l)	Iron (mg/l)	Arsenic (mg/l)	Aluminum (mg/l)	Nickel (mg/l)
Above mine	pre	3/81 to 4/83	7.4	13.4	0.5	0.004	0.3	0.01
	post	8/84 to 5/95	7.4	8	0.8	0.003	0.39	0.03
Below all mine impacts (Station 17)	pre	3/81 to 4/83	3.3	769.4	81.9	0.3	29.8	0.7
	post	8/84 to 5/95	5.7	356	30	0.09	9.5	0.26
		Spring 93, 94, and 95, Pond 4 discharging	4.6	325	24	0.10	14	0.22
Bryant Cr	pre	3/81 to 4/83	4.6	362	19.5	0.1	9.9	0.3
	post	**8/84 to 5/95**	6.6	193	17	0.04	6.8	0.19
		Spring 93, 94, and 95, Pond 4 discharging	5.1	265	40	0.06	5.1	0.11

As can be seen from Table X.1, even during periods when the ponds are overflowing, the post-project conditions in downstream receiving waters are significantly better than pre-project conditions.

An instream bioassay conducted prior to the project showed toxicity in Bryant Creek all the way to its confluence with the East Fork Carson River, nine miles downstream

of the Leviathan Mine. Monitoring conducted in the East Fork Carson River showed impacts to benthic invertebrates for approximately two miles below Bryant Creek's confluence with the East Fork Carson River. Following project construction, the U.S. EPA, in conjunction with the Regional Board, conducted a toxicity study in Leviathan and Bryant Creeks with samples collected on September 4, 1991. Pond 4 was not overflowing into Leviathan Creek at the time of the sampling. Bryant Creek demonstrated neither acute or chronic toxicity below the confluence of Leviathan and Mountaineer Creeks, a point approximately two miles downstream from Leviathan Mine. **This study demonstrates that the pollution abatement project has substantially reduced the length of downstream waters made toxic by Leviathan Mine discharges during periods when pond overflows do not occur.**

The improvements in downstream water quality can be attributed to components of the Leviathan Mine Pollution Abatement Project. Prior to project construction, Leviathan Creek flowed through mine waste, became acidified, and leached metals from the waste rock. The project channelized Leviathan Creek, thus providing greater dilution capacity by preventing creek contact the waste rock. Surface drainage to the creek was also increased by regrading and compacting the pit, and installing 17,000 linear feet of concrete v-ditches.

The evaporation ponds also provided significant immediate benefits to downstream water quality. While the ponds do overflow during periods of high runoff (primarily during spring thaw), for a majority of each year they contain all acid mine drainage flows except those from the channelized underdrain and uncollected seeps. The considerable reduction in pollutant discharges has resulted in improved post-project water quality and some restoration of beneficial uses. When the ponds do overflow, the downstream surface waters are at their annual peak flows, providing their maximum assimilative capacity.

Regional Board staff shall continue to develop at water quality monitoring program at Leviathan Mine to more fully characterize post-project conditions. However, the data currently available is sufficient to conclude that while the mine site is still adversely impacting downstream surface waters the project, as constructed, has resulted in the elimination of a major source of acid mine drainage and significant improvements in water quality.

XI. Water Quality Monitoring Program

Continued discharges of acid mine drainage from Leviathan Mine necessitate a water quality monitoring program. Water quality monitoring is also required by the Toxic Pit Cleanup Act exemption granted to the State Board by the Regional Board (Resolution 6-89-204). The Regional Board has recently increased the frequency of

sample collection from quarterly to monthly and, with the assistance of the Division of Water Rights, supplemented water quality sampling with flow measurements to determine contaminant loading rates. The goals of the water quality monitoring program are: to measure the effectiveness of the Leviathan Mine Pollution Abatement Project and future projects, to measure the impact of Leviathan Mine on downstream waters, and to assess the feasibility of complying with all water quality standards at Bryant Creek. Accurate flow measurements may indicate additional source controls or project management alternatives to decrease water quality impacts from Leviathan Mine.

A. Flow measurements, Division of Water Rights

The Division of Water Rights began a streamflow monitoring program at Leviathan Mine in August 1993 under the direction of the State Board Division of Water Quality, Nonpoint Source Staff. Water Rights staff set up 12 flow control stations, six with continuous stage recorders, separated the adit flow from the pit underdrain in the flow control structure, surveyed the evaporation ponds, and began developing stage-flow curves. The original purpose of the program was to determine if the source of the channel underdrain was uncaptured subsurface creek flow, to determine pond volumes and detect leaks, to identify the magnitude of acidic seep originating on and near the landslide, and to assess the current impact to downstream water. Intensive monitoring of the flow in Leviathan Creek as it enters the site has shown that no significant loss is occurring except for a strong diurnal pattern during sunny periods that is characteristic of evapotranspiration. No irregularities were found in the pond bottoms that suggested significant leaks or damaged liners. The Division of Water Rights has received a total of approximately $95,000 in funding for personnel and supplies from Leviathan Mine Cleanup and Abatement Account No. 5 for these efforts.

Currently, Mark Stretars of Water Rights is developing a workplan for a flow monitoring program directed by the Regional Board staff to characterize the evaporation ponds and the channel underdrain for treatment design purposes. The new program will utilize most of the previous work and will provide continuous flow measurement of the adit, pit underdrain, and channel underdrain, with monthly measurements at points upstream and downstream of the mine in Leviathan, Aspen, and Bryant Creeks. Water Rights will also process the pond survey data to develop sight gages for each pond for quick volume determinations.

B. Water quality monitoring

Regional Board staff will continue to collect water samples on a monthly basis at eight permanent stations and two intermittent stations. The samples will be analyzed for dissolved metals (aluminum, arsenic, iron, and nickel), hardness, total dissolved solids, sulfate, and any other analysis necessary to demonstrate compliance with water quality standards. Additional monitoring needs may arise as a result of treatment operations or operational failures. The water quality monitoring program also includes macroinvertebrate collection and identification. Pre-project macroinvertebrate study results will be compared with current data to determine the extent of recovery achieved by the pollution abatement project and the degree of impact that remains.

Regional Board staff has compiled all of the useful water quality data contained in the Leviathan Mine files. New data will be added as collected. The data will be interpreted on a continuing basis so as to detect any patterns or changes in water quality.

The Regional Board has funding at the rate of $9,000 per year for water quality analysis until June 30, 1996. Water quality monitoring must continue at Leviathan Mine as long as the evaporation ponds are in operation, and as long as there are discharges of acid mine drainage. The Regional Board will require long term funding for water quality analysis at Leviathan Mine.

XII. Geophysical surveys at Leviathan Mine

Leviathan Mine has been the subject of two geophysical studies since the completion of the pollution abatement project. Both surveys attempted to locate seeps of acid mine drainage by measuring terrain conductivity. Conductivity was measured with the Geonics EM-34, an instrument made up of one sending and one receiving coil of approximately one meter diameters and connected by a cable of 10, 20, or 40 meters in length. The EM-34 measures the average conductivity of a three dimensional shape that depends on the dipole alignment of the coils. Because the instrument averages over the underground volume, the response is not sharp enough to pinpoint the exact location of points of higher conductivity, but can only be used to give approximate areas, or verify surface evidence of springs (willows). The depth of a reading depends on the coil spacing and corrections must be made for changes in surface topography.

The first survey was performed by a Regional Board student assistant, Kevin Graves, in August 1992 as a thesis project for a masters of science in civil engineering. The thesis details the difficulty and limitations of obtaining electromagnetic terrain conductivity measurements at a site like Leviathan Mine. All conductivities measured were above the linear response range of the instruments used (0 to 40 mmhos/meter), with background readings of 40 to 60 mmhos/meter. Properties that increase soil

conductivity include: high clay/water content, highly conductive minerals, highly magnetic minerals, small particle size, good physical contact between soil particles, shallow ground water, and high total dissolved solids in groundwater. In addition, buried metal objects and the evaporation ponds have the potential to interfere with measurement of soil conductivity. The thesis reports uncorrected apparent conductivities that do not take the nonlinearities of the instrument into account. Isoconductivity contours were developed from the data collected. The thesis discusses how high readings in the pit could be attributed to the close proximity to exposed ore, pooled groundwater in the adit, or pooled water in the pit underdrain. The thesis suggests soil borings to verify the occurrence of acid mind drainage in the areas of high conductance readings in the pit. Other hot spots were interpreted as possible adit locations, and groundwater springs. Graves admits that the data in this survey is suspect and does not provide a sound basis for drawing conclusions.

The second survey was conducted by Kit Custis, and other staff from the California Department of Conservation's Office of Mine Reclamation in November 1993. In addition to the Geonics EM-34, they used a Geonics EM-31, a magnetometer, a self-potential meter, and a Wenner resistivity meter to generate data. The magnetometer was used to locate buried metal, and the self-potential survey was run to identify groundwater seepage through the vadose zone. Custis is currently working with a mathematical model to interpret the data. Because the conductivity and resistivity data obtained are not mathematically unique, boundary conditions, such as the depth of the waste material/bedrock contact, are necessary for a more accurate interpretation. Information about the depth of waste materials, and pre- and post-project topography has been sent to Custis by Regional Board staff. At this time the report is incomplete and the Regional Board has only the preliminary results of this geophysical survey.

XIII. Site maintenance program

While efforts to improve water quality are being developed, Regional Board staff must conduct ongoing maintenance to prevent damages to the improvements constructed as part of the original pollution abatement project. The yearly site maintenance program mainly addresses impacts from erosion, vandalism, and trespassing cattle. Erosion causes sedimentation that blocks the surface runoff collection system and promotes infiltration through mine wastes. Also, rill and gully erosion develops quickly on the unstable slopes, often threatening the dirt access roads, the evaporation ponds, and the flow control structures. Acts of vandalism have often resulted in substantial damage which required costly repairs to maintain project operations. Cattle grazing on the surrounding USFS land requires that a boundary fence be maintained to prevent cattle from entering the site. The cattle pose a threat to the lined evaporation ponds, pilot wetland treatment project, and site revegetation.

Each year Regional Board staff inspects the site for erosion and sedimentation problems when it is first clear of winter snow. Regional Board staff arranges for large equipment and hand labor crews to clear sedimentation from the surface runoff collection system. Large equipment crews are also directed to regrade rutted dirt roads, and develop new, stable drainageways along the roads. Regional Board staff work with Pat Murphy and Dr. Leiser to develop strategies for halting slope erosion in areas that threaten site improvements. Hand crews, working under supervision, implement bioengineering measures, such as willow wattles. Hand crews are also needed to repair the barbed wire fence line that surrounds the mine site. At first notice, Regional Board staff investigates vandalism which impacts the project's operation, and develops plans for emergency repairs. Regional Board staff conducts an ongoing site maintenance program which consists site inspections to identify problems and contract development and management for services needed to maintain the Leviathan Mine Pollution Abatement Project.

A. Yearly maintenance

The following is a break down of yearly maintenance needs at Leviathan Mine with cost estimates based invoices from past years.

Yearly maintenance	**Per year**
Heavy equipment to regrade and repair roads, and clear sedimentation	$12,000
Hand labor to clear sediment, repair fence line, and install erosion control	$7,000
Planting stock and fence materials	$3,000
Total	**$22,000**

B. Other maintenance needs

In addition to the regular maintenance the site has a conspicuous lack of warning signs, the locking gates need realignment, and barbed wire and post gates have proven to be ineffective at keeping cattle out. The cost of these items including installation are estimated below.

Present site needs:	Qty	Individual Cost
replacement of warning signs on gates,	2	$50
new warning signs for ponds and unposted gates,	7	$80
repair of locking gates, and	2	$500
replacement of barbed wire and post gates with self closing swinging gates.	3	$1000
Total		**$4,660**

As the project ages, the concrete structures and pond liners will need to be inspected. The cost of these maintenance services have not been researched and would be difficult to estimate.

XIV. Current efforts to address remaining sources of contamination at Leviathan Mine

Post-project water quality monitoring shows that discharges from Leviathan Mine continue to impact Leviathan, Aspen, and Bryant Creeks. The Regional Board is confident that addressing the channel underdrain, pond overflows, and eroding mine site will vastly improve the quality of downstream waters. Descriptions of the three major sources and the options being investigated and developed for treating them are presented in the subsections that follow.

A. Channel underdrain

The discovery of the seeps below the twin 72-inch pipeline alignment was a major setback during the construction of the Leviathan Mine Pollution Abatement Project. These seeps were collected in a rock filled underdrain that discharges directly to Leviathan Creek at the channel outfall. It was immediately recognized that the channel underdrain would significantly decrease the water quality benefits expected from the project. Underdrain discharge flows were approximately 70 gallons per minute in September 1984 when the channel and underdrain were completed. Surface drainage, creek channelization, and the collection of seeps around ponds 1 and 3 have changed the groundwater hydrology of the site, and may have reduced the water source

for the underdrain seeps. Underdrain flow rates typically range between 15 to 30 gallons per minute. A maximum flow rate of 134 gallons per minute was observed during the Spring snow melt of 1995 following above average winter precipitation.

Though the underdrain contaminant concentrations are much less than the pond overflow concentrations, its impacts to Leviathan Creek are increased during low streamflow periods. A toxicity study performed by U.S. EPA in 1991 determined that the underdrain had a LC_{50} (percent concentration fatal to half of test population) of 8.8 percent for flathead minnows, and 7.4 percent for daphnia magna. Leviathan Creek is toxic to aquatic life when the underdrain exceeds 7 percent of the combined creek and underdrain flow, which often occurs in the fall. Therefore the underdrain alone creates excessively toxic conditions in Leviathan Creek and ranks high among the remaining sources of water contamination at Leviathan Mine. Until the sources of water feeding the underdrain can be identified and eliminated, effort should be invested in developing treatment options. Regional Board staff suspects that the underdrain is fed by regional ground water and site infiltration.

The Regional Board retained the University of Nevada, Reno to conduct a pilot scale constructed wetlands treatment feasibility study directed by Dr. Glen Miller. Difficulties with metal precipitates clogging piping, and armoring limestone plagued the study and resulted in two system modifications. Very promising removal rates were achieved for arsenic and nickel (Table XIV.A.1). Iron removal was initially very good, but as the system aged the iron and sulfate concentrations approached untreated levels. Dr. Miller associates initial iron and sulfate removal to adsorption and utilization of readily available food source by sulfate reducing microbes. Substitution of arsenic and nickel for adsorbed iron may be responsible for sustained arsenic and nickel removal efficiencies. Other manure substrate treatment studies (Dr. Cohen, Colorado School of Mines) have demonstrated that a system capable of treating 20 gallons per minute could be constructed in the limited space available down gradient of the channel underdrain.

Table XIV.A.1: Constructed wetland treatment of underdrain

Analysis (mg/L except pH)	**Channel Underdrain**			**Treated Wetland effluent**			U.S. EPA Safe Drinking water standards
	min	**ave**	max	min	**ave**	max	
pH	4.4	**4.7**	4.9	5.72	**6.8**	7.49	6.5 to 8.5
Aluminum	37	**44**	48	<0.02	**0.24**	1.2	0.05 to 0.2
Arsenic	0.2	**0.29**	0.41	0.01	**0.03**	0.22	0.05
Iron	290	**350**	390	<0.02	**150**	340	0.3
Nickel	1.5	**1.9**	2.1	<0.01	**0.03**	0.11	0.1
Sulfate	1580	**1900**	2160	1010	**1730**	2090	400 to 500

The wetland pilot study produced the four reports which are on file at the Regional Board office and list below.

> Leviathan Mine Passive Treatment System As-built Letter Report, Knight Piésold and Company, May 1993
>
> The Use of Constructed Wetlands for Remediating Acid Mine Drainage at the Leviathan Mine, Jim Schechtman, Summer 1993
>
> Summary and Recommendations, Pilot Scale Treatment Facility for Acid Mine Drainage at the Leviathan Mine, Glenn Miller, University of Nevada, Reno, April 1995
>
> Final Report, Field Performance and Monitoring Data for the Chemical and Biological Treatment of Acid Mine Drainage At Leviathan Mine, Hamilton Reed, University of Nevada, Reno, April 1995

Based upon the results of the wetland study, the Regional Board proposes the development of two wetland projects. The first project is a scale-up of the channel underdrain pilot project and it can be characterized as a limited space, high contaminant concentrations bioreactor. The design flow will be increased from 0.5 gallon per minute to approximately 8 gallons per minute. The distribution system will be modified from pipe and valves to open channel with weirs, and the treatment units containerized for easier replacement of spent substrate. The scale-up study will address questions unanswered by the one year pilot study concerning substrate sustainability, the maximum concentration of contaminants in the substrate, and exhausted substrate disposal options. Dr. Ronald Cohen, of the Colorado School of Mines, has demonstrated success

with similar substrate bioreactors and has expressed an interest in assisting with further investigations. Regional Board staff will need to develop and manage contracts for the channel underdrain wetland design, construction, monitoring, and concurrent study of spent substrate disposal options. It is estimated that the scale-up wetland study will cost $250,000.

The second wetland project consists of designing and constructing a low technology, no maintenance large surface area wetland to treat a recently rediscovered acidic seep from the overburden pile. The overburden seep has been observed to discharge approximately ten gallons per minute of pH 3.7 water that flows to Aspen Creek. The overburden seep contaminant concentrations analyzed from one sample event closely resembles the corresponding concentrations found in the channel underdrain (Table XIV.A.2) except it has half the iron. The seep surfaces at the top of a large open area that gently slopes to Aspen Creek and would allow for the construction of a large shallow wetland. A preliminary conceptualization of the constructed wetland consist of several treatment benches containing both sulfate reducing substrate and plant materials. The seep constructed wetland will function more like a natural wetland with its metal capturing capabilities. Regional Board staff will need to develop and manage contracts for the overburden seep wetland design, construction, and monitoring. It is estimated that the overburden seep treatment wetland project will cost $150,000.

Table XIV.A.2: Comparison of overburden seep and channel underdrain

Analysis (mg/l except pH)	pH	Aluminum	Arsenic	Copper	Iron	Nickel	Zinc	Sulfate
Overburden Seep (10/27/94)*	3.7	40	0.11	0.53	140	0.48	1.6	2000
Channel Underdrain (5/92)*	4.5	45	0.25	0.021	340	1.8	0.459	1960

* Seep sample taken in fall after below average winter, underdrain sample taken in spring of sixth consecutive drought year.

If amenable, constructed wetlands may be applied as a polishing step to neutralization treatment of adit or evaporation pond waters.

B. Pond overflows

The evaporation ponds are a major component of the Leviathan Mine Pollution Abatement Project. The pond system was designed to contain the acid mine drainage generated at the site, and reduce the volume of acid mine drainage discharged to surface waters. Brown and Caldwell's recommended design had 15.1 acres of ponds to evaporate 90 percent of the acid mine drainage

discharged from the pit and the adit seep on a yearly basis. Due to slope instability, only 11.4 acres of ponds could be constructed at the site. In addition, as the mine cleanup project was being constructed, several seeps were discovered. The largest of these seeps is collected and discharged by the channel underdrain, but the remainder were directed to the ponds. Because of both the reduced evaporation capacity and the increased inflows, the ponds were expected to evaporate only 70 percent of the acid mine drainage and discharge the rest. Based on estimated flow rates and average precipitation and evaporation rates, Regional Board staff calculated that the ponds discharge an average of three million gallons per year to Leviathan Creek. The Regional Board anticipates that the Division of Water Rights' flow monitoring program will provide more definitive numbers for annual overflow volumes.

Although the ponds do not eliminate all discharges, the Regional Board considers the system to be a significant improvement over the pre-project conditions, and a very important first step in correcting the adverse environmental impacts resulting from Leviathan Mine. Prior to the project, acid mine drainage from the adit discharged to Leviathan Creek year-round. The ponds contain all flows from the pit, adit, and seeps except during Spring snow melt. The increased dilution capacity of spring peak streamflow partially mitigates discharges from the pond system.

The Regional Board has been screening methods of reducing or treating and discharging the evaporation pond water. The methods being considered include enhanced evaporation, extraction of contaminant metals, continuous and batch neutralization, and interception of direct precipitation to the ponds. The Regional Board is searching for a method that will produce the following results:

1. Reduce or eliminate acid mine drainage discharges from evaporation ponds.

2. Reduce contaminant loads held in the ponds, to lessen impact if overflow does occur.

3. Extend holding time and delay pond overflows until the site is accessible to treatment equipment and personnel.

The Regional Board has been actively investigating the application of neutralization treatment. In 1992, the Regional Board contracted with the University of California, Davis (UCD), to study the feasibility of neutralization treatment of acid mine drainage at Leviathan Mine. Dr. Richard Burau of

UCD has determined that simple neutralization with an alkaline material such as calcium carbonate or calcium hydroxide will result in the precipitation of nearly all the metals contained in Leviathan Mine evaporation pond water. Bench scale neutralization of pond waters has produced acceptable water quality. Table XIV.B.1 shows contaminant concentrations before and after treatment by a simple neutralization process where pond water was raised to the indicated pH's using calcium hydroxide, $Ca(OH)_2$.

Table XIV.B.1: Neutralization treatment of pond 4 water

Pond 4 10/28/92	pH	Al (mg/l)	As (µg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	S (mg/l)
Untreated	2.3	3300	65000	27.6	3660	48	11700
Treated	6.6	2.7	2	<0.01	<0.1	0.3	910
	8.0	10.0	21	<0.03	0.6	0.3	1467

At the optimal pH of 6.6, contaminant concentrations are low enough that treated pond water may be discharged to Leviathan Creek during seasonal high flows and meet water quality objectives in the receiving waters. Dr. Burau has indicated that practical application of the neutralization process in the field will most likely result in a final pH around 8.0, which also achieves significant reductions. Unfortunately, the sludge generated by the process qualifies as a hazardous waste according to California total threshold limit concentration (TTLC) standards for arsenic. The feasibility study determined that the cost of sludge disposal will depend on moisture content. Sludge produced from neutralizing one million gallons of pond water with 40 percent moisture content will cost $165,800 to dispose of at a permitted site in California and $94,000 in Nevada. The Regional Board has the final report for the UC Davis study on file. The report is titled "Bench Scale Studies to Treat Acid Mine Drainage at the Leviathan Mine, Alpine County, California" by Burau, Jacobson, Zasoski, and Walker, May 1995.

A field study performed by Terry Ackman of the U.S. Bureau of Mines (USBM) Pittsburgh Research Office confirmed that a simple neutralization process with adequate mixing and settling times will produce water quality that meets the U.S. EPA National Ambient Water Quality Criteria for the protection of freshwater aquatic life. Ackman used the USBM's patented in-line system (ILS) to mix acid mine drainage with lime slurry. The ILS is a low cost mixing device with manageable operation and maintenance requirements. A final report of the field study is expected shortly.

Immediate Action to Prevent Pond Overflows

The Regional Board proposes to take immediate action to prevent pond overflows. All involved with the design of the Leviathan Mine Pollution Abatement Project conceded that the evaporation ponds would discharge to surface waters on an annual basis due to site limitations. The Regional Board has come to recognize during the project's eleven years of operation that pulse releases of concentrated acid mine drainage to the Bryant Creek watershed are not acceptable. Pond 4 overflows to Leviathan Creek each spring snow melt with the possible exception of one or two years at the end of the recent six-year drought (1986-1992). Approximately three million gallons of acid mine drainage overflows from the pond system to Leviathan Creek in an average year. Although direct precipitation allows for some dilution, the pond water tends to have higher contaminant concentrations than its sources, the adit and pit underdrain, due to evapoconcentration.

In an earlier attempt to prevent pond overflows, the Regional Board staff sent out an invitation for bid on May 13, 1994 for neutralization treatment with calcium hydroxide of three million gallons of evaporation pond water. The bid package was based on preliminary UC Davis treatment study findings that showed simple neutralization would produce acceptable water quality for discharge. The contractor was to provide a complete service including equipment, transportation, neutralizing agent, hazardous waste sludge disposal, operation, and maintenance. The five bids received ranged from $350,000 to $950,000. The contract award was protested and found invalid based on evaluation procedures. In order to avoid further dispute, the neutralization project contract process was terminated by the Regional Board Executive Officer on October 12, 1994. With this contract experience and the final bench scale study results, the Regional Board staff will develop a request for proposal for the prevention of pond overflows. The proposal will have the same volume, water quality, and sludge disposal specifications, but leave the process unspecified. The new project contract process will likely generate bids that fall within or possibly below the previous range as a result of the increased design flexibility.

A low technology, manageable operation and maintenance neutralization treatment system was field tested by Terry Ackman of the U.S. Bureau of Mines (USBM). A pilot scale USBM's patented in-line system (ILS) successfully treated Leviathan Mine pond and adit water at a rate of 10 gallons per minute. The treatment related costs of the study was approximately $50,000 for 60,000 gallons and two weeks of operation. A scaled-up ILS with a 3-inch jet nozzle would cost approximately $20,000 to construct and would

treat at a rate of 160 gallons per minute. A work schedule of 40 8-hour days would be sufficient to treat three million gallons at this rate. The UC Davis report estimates neutralizing agent material and transportation will cost $18,450 per million gallons of pond water. The estimated cost for sludge disposal in Beatty, Nevada is $94,000 per million gallons treated if the sludge moisture content is 40 percent. Combining cost estimates for equipment, materials, and sludge disposal, the cost of treating three million gallons of evaporation pond water with an ILS would be $360,000. This figure does not include the cost of labor for ILS operation and onsite sludge handling. The disposal of neutralization sludge, which is classified as a hazardous waste by California standards for total arsenic content, is clearly the most expensive element of the ILS option at approximately 70 percent of the total cost. This option would also require multiple contracts and intensive management by Regional Board staff.

In summary, the Regional Board is aware of two options for immediate action to prevent pond overflows: proposal project or ILS project. Estimated costs for the two options are presented in the table below.

Table XIV.B.2: Option Costs for immediate action to prevent pond overflows

Option	Cost
Proposal project	$350,000 to $400,000
ILS project	$360,000+

At this time, the Regional Board chooses to contract a proposal project because the option costs are nearly equal but the management demands are higher for the ILS project. This decision will allow staff to concentrate on developing methods for reducing sludge volumes and enhancing sludge stability for on site disposal.

Additional Neutralization Studies

Sludge disposal makes neutralization treatment extremely costly. Various possibilities exist for reducing the volume of toxic sludge produced by neutralization including high density sludge process and a two phase procedure. The Regional Board proposes an additional neutralization treatment study to investigate sludge reduction methods, the option of onsite disposal, and to determine the level of moisture content attainable by conventional dewatering methods. The sludge stability needs to be fully characterized before a case can be made for onsite disposal. The principle investigators of the UC Davis study

estimate that the additional neutralization treatment study would cost approximately $40,000.

Regional Board staff will continue to explore new technology and management alternatives in an attempt to find more efficient, cost-effective methods of acid mine drainage treatment and reduction.

C. Unreclaimed site - Preliminary revegetation workplan for Leviathan Mine

Reclamation and revegetation are functionally defined as follows:

> Reclamation (refers to) the construction of topographic, soil, and plant conditions after disturbance, which may not be identical to the pre-disturbed site, but which permits the degraded land mass to function adequately in the ecosystem of which it was and is a part. ...The term *revegetation* is restricted to the vegetative phase of reclamation. (Frank E. Munshower. 1994. Practical handbook of disturbed land revegetation.)

As such, revegetation is considered an integral part of the overall reclamation process.

The "Leviathan Mine Pollution Abatement Project: Design Report and Draft Environmental Impact Report" (Brown and Caldwell, 1983) emphasized engineered approaches to Leviathan Mine site acid mine drainage remediation, but included revegetation as a component of site reclamation. The resultant project was implemented by the Regional Board beginning in 1983. It involved relocating and regrading one million yards of tailings, constructing 11.4 acres of evaporation ponds, channelizing streams to prevent contact with mine tailings, constructing 17,000 feet of drainage ditches to prevent stormwater infiltration, and initial efforts at site revegetation. Although the project met most of its intended goals in water quality improvement, problems still remain. Erosion continues to result in the discharge of spoils and soils into local waterways, particularly from steep bare slopes. Acid mine drainage continues to enter Leviathan Creek via intermittent pond overflows when water inputs are in excess of evaporative losses, and the underdrain of the engineered concrete channel for Leviathan Creek as well as natural seeps. Establishment of sustainable vegetation would minimize pollution of local waterways by: minimizing soil erosion with physical soil stabilization, reducing acid mine drainage and pond overflows by increasing losses of soil water by evapotranspiration, and improving top soil and runoff water quality. An overview of revegetation efforts at Leviathan Mine is given in Table D.1

(Attachment D).

1. Summary of Research Studies at Leviathan Mine to Guide Revegetation Efforts

Butterfield and Tueller (1980) studied volunteer vegetation, analyzed soil chemical and physical properties, performed a greenhouse soil fertility assay, and conducted field trials from fall of 1975 through summer of 1979 at the Leviathan Mine in the area of the waste dump.

Volunteer vegetation was sparse. Little vegetation had been established since cessation of mining activities in 1962. Average plant cover was only 0.45%, and average density was only 0.65 plants per square meter. Mine spoils were dominated by six perennial volunteer species. These included, in order of descending percent cover: Jeffrey Pine (*Pinus jeffreyi*); curl-leaf mountain mahogany (*Cercocarpus ledifolius*); white fir (*Abies concolor*); nude erigonium (*Erigonium nudum var. deductum*—a relative of buckwheat); western needlegrass (*Achnatherum occidentalis*); and bottlebrush squirreltail (*Elymus elymoides*). Western needlegrass and bottlebrush squirreltail apparently preferred dark colored, weakly altered spoils.

Ten soil sites were analyzed for soil pH; exchangeable calcium, magnesium, aluminum; available iron, manganese, zinc, copper; nitrate (NO_3), potassium, water soluble aluminum, texture, and seasonal soil moisture (April-August). Soil pH ranged from 3.22 to 7.0 with a median value of 4.2. Aluminum was the only metal found in clearly phytotoxic concentrations. Calcium and nitrate nitrogen were potentially deficient for plant growth. Soil textures were predominantly fine clay, with a few coarser sandy clays to sandy loam. Soil moisture at depths of zero to ten centimeters (cm) fell below the permanent wilting point by late May and early June, whereas available moisture was present at depths from 30 to 40 cm (approximate depth of tree and shrub transplanting) throughout the growing season.

A factorial lime by nitrogen by phosphorus greenhouse soil fertility assay was conducted for three spoil samples. Both nitrogen and phosphorus were deficient. There was a significant lime and fertilizer interaction, suggesting that metal biotoxicity or calcium deficiency may have limited plant growth on unlimed soil. Plant growth was ten-fold greater on limed spoils for comparable fertilizer treatments.

In Fall of 1975, a mixture of six grass species and three legume species were planted on seven sites. Two sites were limed to either a 10 or 15 cm depth. Treatments were straw mulch versus bare soil; nitrogen fertilizer (67 kg/ha as $(NH_4)_2SO_4$) versus no fertilizer; and drilled versus broadcast seed. Fifteen species of containerized shrubs were also planted on six sites, two of which were surface limed. In Spring of 1976, bare root Jeffrey pines and shrubs were planted on six additional sites, one of which was limed. Grass and legume seedling emergence and survival was increased by liming and by straw mulch, but decreased by nitrogen fertilization. Surface liming had no consistent effect on tree and shrub survival. Shrubs and Jeffrey pine showed good survival on slopes as great as 60%. Shrubs showed greater survival overall on southerly-facing slopes than on northerly-facing slopes, as did Jeffrey pine, though to a lesser degree than shrubs. Survival of trees and shrubs ranged from 25 to 89% after the first year to 0 to 71% after the third year. Data suggest that soil pH was not a significant factor for tree and shrub transplant establishment during the first year. However, long term survival appears to have been directly correlated with soil pH (Figures D.1 and 2, Attachment D). For third-year data, soil pH explains 72% of the variability in survival rates overall (Fig. D.1, Attachment D), and 86% of the survival for trees and shrubs on southerly aspects (Fig. D.2, Attachment D).

All species of shrubs had good survival except fourwing saltbrush (*Atriplex canescens*). Jeffrey pine was prevalent in the surrounding undisturbed areas and as volunteers on-site. It did well in field trials and was considered a prime candidate for revegetation attempts.

In Spring of 1983 through Fall of 1984, a field revegetation trial was conducted to determine feasibility of revegetation with various tree and shrub species and to provide feedback in optimizing the revegetation workplan of Leiser (1984). This workplan relied both on the expertise of the author, and the previous study of revegetation on Leviathan Mine spoils by Butterfield and Tueller (1980). Field trials included 12 angiosperms (broad leaf) and 5 gymnosperm (conifer) species. The experiment was of a factorial of two planting seasons (spring versus fall) times two fertilizers (no fertilizer versus one ounce of osmocote fertilizer per plant). Plant survival was very good overall, averaging 76% for angiosperms and 95% for gymnosperms after the first summer (Table D.2, Attachment D). There was no consistent difference between spring and fall plantings (Table D.3, Attachment D). Fertilization was highly beneficial (Table D.4, Attachment D). This was particularly

pronounced in the example given for Wood's rose (Table D.5, Attachment D). Though squaw carpet, a nitrogen fixer, performed relatively poorly the first year, the long term vigor of the plant was good (Table D.6, Attachment D).

2. Implementation and Results of Revegetation at Leviathan Mine

Starting in about 1980, the U.S. Forest Service (USFS) began negotiating a memorandum of understanding (MOU) with the Regional Board to define conditions under which they would assume title of the Leviathan Mine site. A primary condition was the site be revegetated according to the specifications of USFS experts. The USFS revegetation plan (Attachment D) was developed by Farmer and Richardson (1984) of the USFS Intermountain Station in Logan, Utah. Their plan consists of surface liming and fertilization followed by establishment of 15 grass and legume species with interplantings of 10 species of trees and shrubs. This workplan was implemented beginning in Spring of 1985. The liming, fertilizing, and grass seeding was carried out by a contractor, Selby's Soil Erosion Control Company. Transplanting of 20 different species of trees and shrubs was carried out by Dr. Leiser of University of California, Davis, and Pat Murphy of the Nevada Division of Forestry. The first year, grass emergence and cover was very good. However, by the Summer of 1987, the beginning of a long drought in California, the grass had essentially failed, having a soil coverage of only about 1 to 2%. Reasons for failure of long-term grass establishment apparently include: (i) lack of adequate soil moisture for shallow rooted grasses, (ii) too low a liming rate with too shallow a depth of soil incorporation for adequate neutralization of soil acidity, and (iii) poor adaptation of grass species to soil and climatic conditions at the site.

In contrast, Dr. Leiser 's revegetation plantings were largely successful. Utilizing knowledge acquired from the field study on successful plant species and fertilizers, over 100,000 trees and shrubs were planted on the site from 1985 through 1988 under the direction of Dr. Leiser and Patrick Murphy.

Long-term visual follow-up of Dr. Leiser's plantings shows that plant establishment was usually good, but that plant vigor was limited in some locations (see Table D.7, Attachment D). The reasons for this appear to be primarily related to poor soil conditions, such as excessive soil acidity, and unstable steep slopes, which may either erode to expose

plant roots on the slope, or bury plants at the toe of the slope. To address the latter problem, bioengineering approaches have been used from 1992 to present, under the guidance of Dr. Leiser and Pat Murphy, to stop erosion where acid mine drainage control structures are threatened, or where siltation of ponds may occur. This approach employs willow wattles buried along the contours of slopes. Though not all wattles have sprouted new growth, they work as a mechanical restraint. Bioengineering has shown a measure of success and continues to be used on site as needed. The problem of poor soil conditions still needs to be more thoroughly addressed.

3. Staff Evaluation of Revegetation at Leviathan Mine

Low pH creates aluminum toxicity, a major plant growth limiting factor. Biotoxic concentrations of other metals is also a possibility. Although Butterfield and Tueller (1980) found no other metal toxicity, their study was nearly 20 years ago. The site has probably become more acidic. Copper and nickel are likely candidates for toxicity screening, based on site geochemistry and the relatively low concentrations of these heavy metals required to inhibit plant growth. Calcium deficiency can occur because of accelerated calcium leaching in excessively acid soils. Phosphorus adsorption on acidic aluminum and iron oxides and phosphorus coprecipitation with free aluminum ions is a recognized mechanism for inducement of phosphorus deficiency. Liming should help alleviate all of these problems. However, liming requirement is a function of both soil buffering capacity and pH. Care must be taken to use the right method for determination of lime requirement (McLean, 1982; Robson, 1989). Over the long-term, sulfur oxidation must also be factored into a reasonable rate of lime application. For some sites, it may be difficult to lime, so it may be necessary to utilize highly acid tolerant species.

Soil nitrogen and phosphorus have been demonstrated to be deficient on site. Fertilization with nitrogen and phosphorus is necessary and beneficial for good plant survival and vigor. No testing has been done to determine if any other plant nutrients are limiting plant growth. Intermountain valleys of the Sierra Nevada are commonly deficient in sulfur, boron, and molybdenum, though it is reasonable to assume that sulfur is not deficient at this site. Soil moisture was a much more critical factor for establishment of grass and legumes than for deeper-rooted shrubs and trees. This is probably the primary factor why the USFS grass revegetation attempt failed. Moisture is the critical factor

in determining whether to attempt a fall or spring planting. Fall plantings have the advantage of allowing for root system establishment under low evapotranspiration conditions, but there must be adequate summer rains or carryover from spring to give good plant survival. Initial soil moisture is usually higher for spring plantings, but plant water stress during summer is a potential problem that could reduce plant survival. Establishment of vegetation should make use of excess soil water which might otherwise feed acid seeps and springs passing through mine spoils.

The negative relationship between volunteer vegetation and slope steepness probably indicates seedbed instability because of erosion. Observation indicates that plants at the toe of slopes can be buried by processes of erosion. Plant species that can sprout and re-root from their stems would be most successful in these locations. Plants on slopes may have their roots exposed by erosion. Deep-rooted, drought tolerant plant species might be more successful on unstable slopes.

Complete reclamation of the Leviathan Mine site has not yet been realized because: difficult localized site conditions have partially limited the success of revegetation efforts; more information needs to be gathered about edaphic conditions, site characteristics, plant physiology, and plant-soil management factors to maximize plant establishment and growth; and funding has been too limited to complete necessary revegetation efforts.

4. Proposed Workplan for Continuing Revegetation of Leviathan Mine:

The Leviathan Mine site revegetation plan is organized in two tiers: initial implementation measures with data collection, and development of a comprehensive site revegetation plan. The initial implementation measures will also serve as trial beds for planting strategies including densely planted islands or strips that are contiguous with undisturbed areas, and cobbles to enhance soil moisture. The overall approach in developing a comprehensive site revegetation plan will be to match specific sub-sites with plant species and management factors to maximize plant establishment and growth. This will be accomplished using data already presented and data to be collected. The nature of the information required is as follows:

a. Edaphic: Soil physical and chemical characterization-compaction, texture, soil water relations, pH, lime requirement,

available nutrients (e.g. nitrogen, phosphorus, boron, molybdenum), toxic elements (e.g. aluminum, copper, manganese, nickel).

b. Site Characteristics: Slope, aspect (exposure), position on slope (e.g. top versus toe), degree of compaction, location of local topsoil resources.

Once the site is characterized, plot trials will be developed using plant species that are best adapted to local conditions. Following are variables that will be tested:

a. Plant Physiology: Species - grasses, herbaceous perennials, shrubs, woody trees (as appropriate to the sub-site). Seedling versus seed; containerized versus bare root; dormant versus actively growing; root-shoot ratios; thickness of stem caliber; seedling size.

b. Planting Time: spring vs. fall - optimum planting window.

c. Management Factors: Irrigation; soil amendments; slope stabilization (e.g. jute matting); exposure and plant protection; inoculation with mycorrhizal fungi.

The work will be phased as follows:

Tier One - Implementation measures

a. Growth enhancement of existing plants on site

The 103,000 trees and shrubs planted during 1983-87 period demonstrated high survival rates, but low vigor. Various studies indicate the need for plant nutrients/soil amendments including P, Ca, lime, N, K, and Mo. Tasks include: locating past revegetation efforts, investigating critical growth-enhancing factors, analyzing soil and plant tissue, amending/fertilizing existing plantings, and monitoring of growth/treatment effects.

b. Seed and bud gathering

The plants with the greatest chance of survival are those grown from seeds collected from plants adapted to the climate, soil,

moisture, and acidity. Seed collection requires brief intense efforts that could be achieved by volunteer community effort with expert guidance. Tasks include: scoping seed sources on and near site, analyzing seed viability, public outreach, training, collecting, preserving and storing seeds.

c. Volunteer Islands

Healthy volunteer vegetation will be used as nuclei for revegetation islands of higher density plantings. The organic matter buildup around vigorous plants will be used to expand vegetative cover. Diverse island planting stock will be selected to minimize competition and enhance synergistic effects. Tasks include: locating and selecting healthy volunteers for island expansions, applying seeds, propagating of planting stock, planting, and monitoring.

d. Amendment with organic materials

The Bureau of Land Management in Palomino, Nevada and ranchers in the upper Carson River Watershed have an excess of manure that would be highly beneficial as a soil amendment at Leviathan Mine. Other sources of organic material may be utilized or mixed with manure: wood chips, pine needles, grass clippings, etc. Salvage logs may be anchored cross-slope for soil stabilization and organic matter. The organic amendments will be deposited on site to enhance the spreading of volunteers, improve the growth of existing plants, and later used for planting efforts. Tasks include: locating manure surpluses, improving site access, coordinating manure delivery, local timber harvest, wood chipping, optimizing organic amendment quality and nutrient release characteristics (mixing different sources of organic materials, adding amendments, or composting as necessary), spreading, and monitoring.

Tier Two - Comprehensive revegetation plan

a. Phase I—Edaphic and Site Characterization

The objective is to classify sub-sites where specific plant species and management factors may be applied. A site survey will determine the spatial distribution of the above listed edaphic and

site factors.

b. Phase II—Field Trials

The objective is to determine feasibility and optimize strategy for reclamation of distinct sub-sites using appropriate treatments based on plant physiological factors, planting time, and management factors.

c. Phase III—Site Revegetation

Based on results of Phase II, implementation of full-scale site revegetation using appropriate plant physiological factors, planting time, and management factors, matched to identified sub-sites.

d. Phase IV—Monitoring

The goal is to provide a quantitative measure of the success of revegetation efforts. A comprehensive revegetation monitoring plan will be developed. Components of the monitoring plan include: (1) establishment of baseline conditions including (a) characterization of comparable un-revegetated sub-sites, and (b) estimation of growth rate of key species (e.g. Jeffrey pine) in adjacent forest for comparative purposes; (2) a monitoring schedule; (3) development of revegetation success criteria, such as plant growth rate, cover, density, species-richness, etc., and (4) determination of sampling scope--utilize a sampling size that provides a minimum statistical confidence level of 80 percent for treatment comparisons.

Site revegetation is presently the only feasible form of source control at Leviathan Mine. The performance of Tier One tasks can be accomplished in two to three years at a cost of $350,000. Tier Two tasks will require five to ten years and cost an estimated $1,045,000.

Site maintenance and erosion control efforts will continue during the development of a revegetation plan. The un-revegetated site is extremely dynamic with new and old erosion problem areas evolving each year. The highly eroding areas that threaten site improvements and contribute excessive sediment loads to the surface waters will continue to be identified and addressed with biomechanical methods.

Experience gained with each erosion control effort will be used to develop and refine erosion control methods and site management practices.

XV. Overall objective of pollution abatement efforts at Leviathan Mine

The Regional Board sets the restoration of all beneficial uses to Bryant Creek, with significant improvements to Leviathan and Aspen Creeks as the overall objective of pollution abatement efforts at Leviathan Mine. The beneficial uses to be restored to Bryant Creek include agricultural supply, cold freshwater habitat, wildlife habitat, and contact and non-contact water recreation. Post-project toxicity studies show that water quality is already approaching levels necessary for supporting cold freshwater habitat in the headwaters of Bryant Creek. The Regional Board is committed to developing the projects described within this workplan and confident that such efforts will significantly contribute to achieving the stated objective.

XVI. Leviathan Mine project funds

The Leviathan Mine Pollution Abatement Project was constructed with a State Assistance Program (SAP) Grant from the Clean Water Bond and the Anaconda/ARCO settlement. Approximately $640,000 remains from the original SAP grant. The Regional Board is currently drawing from the SAP funds to finance one associate water resource control engineer position for the oversight and management of Leviathan Mine due to the loss of Federal Old Bond money.

Cleanup and Abatement Project Account Number 26 of $400,000 was established for concrete repairs. These funds have been used for various site maintenance and repair projects leaving a current uncommitted balance of approximately $280,000. Several other Cleanup and Abatement Project Accounts were established for the wetland and UC Davis neutralization treatment studies, erosion control projects, and emergency repairs. All of the funds for these projects will be exhausted once the final invoices are approved for payment.

As a result of the negotiations relating to premature concrete degradation, the State received $110,000 from Brown and Caldwell in a December 1988 settlement agreement, and a net of $70,000 from Mittry and their subcontractors in a July 1990 settlement agreement. Cleanup and Abatement Account Number 5 was established with the $180,000 received from concrete settlements. The Division of Water Rights streamflow monitoring program and the U.S. Bureau of Mines field neutralization study were funded from Account Number 5, leaving a balance of $50,000.

XVII. U.S. EPA regulation

The Federal government recognized pollution was emanating from Leviathan Mine in 1958 when the "Summary Report on Quality of Interstate Water - Leviathan Creek (California-Nevada)" was developed by the Water Supply and Water Pollution Control Program of the U.S. Public Health Service. Initially, the location of Leviathan Mine and its impact on interstate waters gained Federal attention but more recently the U.S. Environmental Protection Agency (EPA) is concerned about the mine as a source of toxic pollutants and stormwater pollution.

A. Clean Water Act Section 304(l)

Pursuant to the requirements of the Federal Clean Water Act Section 304(l), the U.S. EPA, Region 9 issued lists of impacted water bodies. Leviathan Creek was placed on the "short list", and Leviathan Mine was placed on the "source list". The "short list" included waters which, due entirely or substantially to discharges from point sources, do not meet numeric or narrative water quality standards for the toxic pollutants listed under Section 307(a) of the Clean Water Act. "Substantially" is defined by U.S. EPA to mean if the cumulative contribution, of a Section 307(a) pollutant, from point sources is enough to cause exceedance of California water quality standards, then the problem is due "substantially" to point sources. The "source list" is a list of point sources which are discharging the Section 307(a) pollutant into the waters on the "short list". Leviathan Creek and Leviathan Mine were listed for discharges of arsenic and nickel. The State must develop and submit an individual control strategy (ICS) for each point source. The ICS must be a draft or final National Pollutant Discharge Elimination System (NPDES) permit with documentation to show that State water quality standards will be met. The ICS must be designed to ensure that applicable water quality standards are achieved no later than three years after the establishment of the ICS.

B. NPDES Storm Water Permit with discharge limits and compliance schedule

U.S.EPA and the State Board have been working to develop a general NPDES permit for abandoned mines. This permit would require application of best management practices and best available technology to reduce or eliminate storm water pollution from these sites. The Regional Board hopes that a permit with a similar format can be developed for Leviathan Mine. And, if water quality standards must be applied, that the point of compliance be set at the headwaters of Bryant Creek.

XVIII. Water Quality Standards

Appropriate water quality standards need to be developed and approved by the Regional Board, State Board and U.S. EPA for discharges from Leviathan Mine and the surface waters of Bryant Creek watershed. Past practice in discussions of pre-project water quality and in the design of the Leviathan Mine Pollution Abatement Project has been to apply water quality criteria that protects beneficial uses. Recently, U.S. EPA National Ambient Water Quality Criteria for the protection of freshwater aquatic life and Safe Drinking Water Standards have been used to gage treatment success in the neutralization and wetland studies.

The 1995 Water Quality Control Plan for the Lahontan Region contains specific numerical water quality objectives (Tables XVIII.1 and 2) and beneficial uses for the Bryant Creek Basin (Table XVIII.3).

Table XVIII.1: Numerical Water Quality Objectives for Bryant Creek Basin

	Total filterable residue (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	Percent Sodium	Boron (mg/l)	Total nitrogen (mg/l)	Total phosphorus (mg/l)
Annual average	140	15	35	-----	0.20	0.20	0.02
90th percentile value	200	25	50	50	0.50	0.30	0.03

Table XVIII.2: Numerical Water Quality Objectives for Bryant Creek Basin, Maximum values (mg/l, except as noted)

Turbidity (JTU)	Total Alkalinity, as $CaCO_3$	Total Acidity, as $CaCO_3$	Dissolved Iron	Manganese	Color, PCu	Aluminum	Copper	Arsenic
15	70 (minimum)	10	0.5	0.5	15	0.1	0.02	0.05

Table XVIII.3: Existing and potential beneficial uses of surface waters in Bryant Creek Basin

Feature	MUN	AGR	IND	GWR	FRSH	REC-1	REC-2	COMM	COLD	WILD	SPWN
Leviathan Creek (above Leviathan Mine)	X	X		X		X	X	X	X	X	
Leviathan Creek (below Leviathan Mine)	X	**X**		X		**X**	**X**		**X**	**X**	
Aspen Creek	X	X		X		X	X	X	X	X	
Bryant Creek	X	**X**		X		**X**	**X**		**X**	**X**	
Minor Surface Waters	X	X	X	X	X	X	X	X	X	X	X

No distinction is made between existing and potential beneficial uses in the 1995 Water Quality Control Plan for the Lahontan Region. The beneficial uses recognized as potential in the Water Quality Control Plan for the North Lahontan Basin as amended in 1991 are indicated with bold X's in the table above. A waste load allocation study would be useful to determine the total maximum daily loads (TMDLs) that can be discharged from Leviathan Mine and remain in compliance with standards set for Bryant Creek. If the TMDLs are unachievable, the Regional Board may want to consider performing a use attainability analysis to determine which beneficial uses can be fully restored.

XIX. Conclusions

Leviathan Mine is a multifaceted project with substantial funding needs. Regional Board staff has identified three priority problems that must be addressed: pond overflows, channel underdrain, and 265 acres of barren and eroding disturbance. The Leviathan Mine 5-Year Workplan proposes application and continued investigation of acid mine drainage treatment methods as the most direct strategy for achieving improvements in water quality. The workplan also calls for the development and implementation of a site revegetation plan as a method of long term source control. Execution of the workplan will significantly contribute to the restoration of all beneficial uses to Bryant Creek, with notable improvements to Leviathan and Aspen Creeks.

In addition, considerable time and effort is needed to maintain the Leviathan Mine Pollution Abatement Project and its improvements. The surface runoff structures, roads, and boundary fence must be maintained to insure proper operation, site access, and protection of delicate mine revegetation from cattle grazing. Problem erosion areas are identified each year and addressed with bioengineering erosion control measures. Emergency repairs are needed regularly due to vandalism of site improvements.

Tables XIX .1 and 2 contain estimates of PY's and contract dollar requirements for tasks discussed in this workplan. The Leviathan Mine 5-Year Workplan has a total funding requirement of 14.75 PY's and $4,064,600.

Table XIX .1: Leviathan Mine 5-Year Workplan PY requirements

Task	FY 95-96	FY 96-67	FY 97- 2000
Project management	0.2	0.2	0.6
Site maintenance	0.5	0.5	1.5
Water quality monitoring	0.1	0.1	0.3
Wetland treatment projects	0.5	0.3	0.5
Pond overflow prevention project	0.4	0.2	0.6
Neutralization treatment study	0.2	0.3	0.5
Site revegetation	1.3	1.15	4.8
Total	3.2	2.75	8.8

Table XIX .2: Leviathan Mine 5-Year Workplan contract dollar requirements

Priority	Task	FY 95-96	FY 96-97	FY 97 -2000
1	Site maintenance	$26,660	$22,000	$100,000
	Water quality monitoring	----	$9,000	$27,000
	Flow monitoring (Division of Water Rights)	$30,000	$10,000	$10,000
2	Proposal project to prevent pond overflows	$400,000	$400,000	$1,200,000
	Overburden seep wetland	$100,000	$25,000	$20,000
	Channel underdrain wetland study	$150,000	$25,000	$75,000
	Neutralization treatment study	$40,000		
3	Site revegetation	$150,000	$590,000	$655,000
Total		896,600	1,081,000	2,087,000

The Regional Board is committed to improving water quality in the Bryant Creek basin by executing the tasks discussed in this workplan. The work will require funding in the amounts

indicated above. Without stable funding of the maintenance needs, the Leviathan Mine Pollution Abatement Project will develop serious operational problems. Complete funding of site revegetation and treatment proposals is necessary to address the remaining water quality problems at Leviathan Mine.

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ATTACHMENT A

Early Data Collections and Studies of Water Pollution as a Result of Leviathan Mine

1. Table summarizing Anaconda Company monitoring reports

As reported in a 1975 Regional Board staff report, this table gives a summary of water quality data collected from 1954 to 1962 by Anaconda. Samples were taken above the mine, below the mine, from Bryant Creek below the confluence of Mountaineer and Leviathan Creeks (approximately 2 miles below mine), and from Bryant Creek at the ranch diversion (approximately 7 miles below mine). The samples were analyzed for pH, and concentrations of sulfate, turbidity, and total iron. This data shows a decrease in pH, and increases of sulfate, and turbidity as a result of Leviathan mine discharges. Data for some of the total iron concentrations reported in this table were erroneously assigned units of mg/l when they were actually reported in grams per liter as verified by comparisons with data sheets from Anaconda. No indication was given as to whether the metal concentrations were for total of dissolved metals. The average pH and concentrations of sulfate, and turbidity at the ranch diversion from Bryant Creek shows that impact from the mine discharge extended at least 7 miles downstream.

Table A.1 Anaconda Data 1954-1962
(Unit assignment errors suspected for shaded values.)

		Leviathan Cr. Above Mine	Leviathan Cr. Below Mine	Headwaters of Bryant Cr. (2 miles downstream from mine)	Bryant Cr. at diversion to ranch (7 miles downstream from mine)
pH	max.	8.2	6.8	8.8	9.1
	median	**7.7**	**3.4**	**5.7**	**6.9**
	min.	7.2	2.2	3.4	3.2
# of samples		*12*	*73*	*90*	*13*
Sulfate	max.	13	4513	1331	732
mg/l	**median**	**8.4**	**2183**	**320**	**285**
	min.	3.3	280	41	35
# of samples		*13*	*60*	*76*	*13*
Turbidity	max.	16	770	350	108
Units	**median**	**6.5**	**115**	**60**	**53**
	min.	3.4	4.5	7	1.7
# of samples		*4*	*54*	*51*	*12*
Total Iron	max.	2	470	0.2	22.3
mg/l	**median**	**0.3**	**0.12**	**0.02**	0.58
	min.	0.08	0.01	0.01	0.01
# of samples		*7*	*35*	*30*	*12*

2. Consolidated water quality data from the Regional Board's Anaconda files

These data sets contain monitoring results spanning from 1955 to 1974. The consolidation efforts do not reference the data sources, but by observation contain Anaconda data and Regional Board sampling results from 1968-69, and 1974. There are substantial data sets for pH, total iron, ferric iron, apparent color, turbidity, and sulfates, while only sparse data was collected for phenolphthalein and methyl orange acidity, aluminum, arsenic, bicarbonates, boron, cadmium, calcium, carbonates, chlorides, chromium, specific conductance, copper, cyanide, ferrous iron, fluoride, total hardness, lead, manganese, magnesium, mercury, nickel, nitrate, potassium, dissolved oxygen, selenium, silver, sodium, total dissolved solids, and zinc. There is no indication whether the metal concentrations are for total metals of dissolved metals. Table A.2 contains the maximum concentrations, except were indicated, for monitoring points above and below the mine from the consolidated data tables. It can be seen from this data that degradation of water quality occurred prior to 1975 and that the mine discharge affected many parameters.

Table A.2 Consolidated Water Quality Data 1955-1974

Constituent	Above mine	Below mine	Constituent	Above mine	Below mine
Aluminum (mg/l)	0.7	38	Mercury (mg/l)	0.0	0.0
Apparent Color	40	960	Methyl Orange Acidity (as $CaCO_3$, mg/l)	0	1600
Arsenic (mg/l)	0.01	1.7	Nickel (mg/l)	0.03	16
Bicarbonate (mg/l)	59	0	Nitrate (mg/l)	0.9	5.2
Boron (mg/l)	<0.5	3.5	pH, minimum	6.9	2.2
Cadmium (mg/l)	<0.01	<0.01	Phenolphthalein Acidity (as $CaCO_3$, mg/l)	25	492
Calcium (mg/l)	0.3	1.5	Potassium (mg/l)	3.1	5.8
Carbonates (mg/l)	0	0	Selenium (mg/l)	<0.01	<0.01
Chlorides (mg/l)	1.4	259	Silver (mg/l)	<0.05	<0.05
Chromium (mg/l)	<0.025	0.16	Sodium (mg/l)	9.2	17.3
Copper (mg/l)	0.288	1.10	Specific Conductance (micromhos)	68	1140
Cyanide (mg/l)	<0.01	<0.01	Sulfate (mg/l)	20.51	4513
Dissolved Oxygen (mg/l), minimum	8.2	<0.01	Total Hardness (as $CaCO_3$, mg/l)	59	135
Ferric Iron (mg/l)	1.1	220	Total dissolved solids (mg/l)	125	1778
Fluoride (mg/l)	<0.1	5.3	Total Iron (mg/l)	9.0	730
Lead (mg/l)	<0.01	1.9	Turbidity (Turbidity Units)	1.3	800
Magnesium (mg/l)	2.7	14	Zinc (mg/l)	<0.01	0.53
Manganese (mg/l)	<0.05	13			

3. Bioassay Investigations, Nevada State Fish Hatchery, Verdi, Nevada and Report on Leviathan Creek Bioassay, by S. J. Coli, July 1958

Two bioassay studies were performed in January and July of 1958 to show the toxic impacts of Leviathan mine discharges on Leviathan and Bryant Creeks. The first study was performed at the Verdi Fish Hatchery in aquarium tanks, and the second on site in live boxes constructed of wire mesh. Both studies showed toxicity in the head waters of Bryant Creek (at the confluence of Mountaineer and Leviathan Creeks). The in-stream study indicated that toxicity existed at the mouth of Bryant Creek before it entered East Fork Carson River. The results of these studies confirm impairment of cold fresh water habitat, a beneficial use designated for Leviathan and Bryant Creeks. Tables A.3.1 and 2 summarize the bioassay results.

Table A.3.1 Verdi fishery Bioassay, January 1958, conducted according to bioassay method recommended by T.J. Trelease, the Chief of Fisheries, Nevada Fish and Game Commission, fishstock - cutthroat trout

Date	Sample location	Concentration, %	Time of death, all fish (hours)	Percent survival, 72 hours
1/13	Leviathan Cr. below mine	100 to 25 4 2-1	3 to 7 9	0 0 100
1/29	Leviathan Cr. half way between mine and Mountaineer Cr.	100 (filtered) 50 (unfiltered)	5 12	0 0
1/13	Confluence of Mountaineer and Leviathan Crs.	100 100 (settled 2 days)	7 55.5	0 0
1/19	Bryant Cr. at East Fork Carson River	100		100
1/19	East Fork Carson, 200 yards downstream from Bryant	100		100

Table A.3.2 Instream Bioassay, July 1958, fishstock - rainbow trout

Date	Location	Time of death, all fish (minutes)	Percent survival, 48 hours
7/14	Leviathan Cr. above Mountaineer Cr.	25	0
7/14	Mountaineer Cr.	----	100
7/14	Bryant Cr. between Mountaineer and Doud Crs. (State line)	135	0
7/14	Doud Cr.	----	100
7/14	Bryant Cr. below Doud Cr.	160	0
7/16	Mouth of Bryant Cr.	170	0

4. Summary Report on Quality of Interstate Waters, Leviathan Creek, (California-Nevada), U.S. Department of Health, Education, and Welfare, Public Health Service, October 1961

   In accordance with Federal Water Pollution Control Act, Public Law 660 as amended by Public Law 87-88, the U. S. Public Health Service conducted on investigation of Leviathan and Bryant Creeks. This brief report recognizes that Anaconda Copper Company was responsible for pollution of this interstate watershed. It noted that deterioration of water quality existed to the extent that it interfered with fish and aquatic life, and had the potential to impact agricultural irrigation. The report also discusses treatment efforts undertaken by Anaconda that never proved to be effective or were discontinued (disposal acid mine drainage into recharge wells, collection and treatment of acid mine drainage, and a bentonite lined diversion channel).

5. Water Quality Sampling and Stream Gaging by personnel from the Desert Research Institute, University of Nevada System, from October 1968 and June 24-26, 1969, submitted by John V. A. Sharp Ph.D., Associate Professor

   This resource consists of flow rates, and concentrations and loading rates for dissolved sulfate, and dissolved metals in October 1968 and June 24-26, 1969. Tables A.5.1, 2, and 3 show sulfate, iron, and arsenic loading rates in Leviathan and Bryant Creeks as a result of discharges from Leviathan mine.

Table A.5.1 **Sulfate Loading** (lbs/day)

Date	Leviathan Creek Above mine	Leviathan Creek Below mine	Bryant Creek headwaters	Bryant Creek mouth
October 1968	4	4927	3828	3176
June 1969	190	6686	18952	11676

Table A.5.2 **Arsenic Loading** (lbs/day)

Date	Leviathan Creek Above mine	Leviathan Creek Below mine	Bryant Creek headwaters	Bryant Creek mouth
October 1968	0.005	9.0	0.07	<0.102
June 1969	0.038	28	15	3

Table A.5.3 **Iron Loading** (lbs/day)

Date	Leviathan Creek Above mine	Leviathan Creek Below mine	Bryant Creek headwaters	Bryant Creek mouth
October 1968	0.114	1045	66	<0.006
June 1969	<0.05	2242	2088	1102

Judging from these two sampling periods, which were believed to represent low and high flow conditions, the following conclusions were made: 1) contact of groundwater and Leviathan Creek with pit and dump generates sulfuric acid which dissolves toxic metals, 2) discharges of higher concentrations occur in spring, 3) water quality problem are most acute in winter because there is less assimilative capacity during low flow periods, 4) the concentration of deleterious dissolved material exceed USPHS water quality standards for much of the length of Leviathan and Bryant Creek, 5) a relationship most likely exists between suspended and deposited metal hydroxides and the lack of aquatic organisms, and 6) discharges from Leviathan Mine are having a deleterious impact on the East Fork Carson River in the form of increased total dissolved solids and discoloration. The data and conclusions indicate impairment of beneficial uses, municipal and domestic water supply, and cold and warm freshwater habitat, as far downstream as the East Fork of the Carson River.

6. The Effect of Leviathan Mine Drainage on Leviathan and Bryant Creeks, Alpine County, by William F. Jopling, Sanitary Engineering Associate, Bureau of Sanitary Engineering, State of California, Department of Public Health

This report gives the results of a December 5, 1968 sampling investigation of physical and chemical changes in the receiving water as a result of the mine and mine drainage. Field results show Leviathan Creek upstream of the mine was saturated with dissolved oxygen (10 mg/l) and slightly basic (pH 7.7), and flow from the mine adit was extremely acidic (pH 2.7), 26 degrees Fahrenheit warmer, and contained no dissolved oxygen. A comparison of laboratory results showed that both the adit flow and tailing springs in the delta area had high concentrations of iron, total dissolved solids, and sulfate, while the springs from the tailings had lower concentrations of boron, aluminum, copper, nickel, and arsenic (Table A.6.1). There is no indication whether the metal concentrations are for total or dissolved metals.

Table A.6.1 (mg/L)

	Iron	TDS	Sulfate	Boron	Aluminum	Copper	Nickel	Arsenic
Adit	156	1525	2610	73	48	64	2.8	70
Delta springs	286	4235	2900	8.9	14.7	0.58	0.2	<0.02

Table A.6.2 compares the results of downstream sampling points with the background values obtained above the mine.

Table A.6.2 (mg/l except pH)

Analysis	Above mine	Leviathan above Mountaineer (2 miles downstream from mine)	Bryant at ranch diversion (7 miles downstream from mine)
Acidity (as $CaCO_3$) Methyl-orange Phenolphthalein	0.0 5	240 410	0.0 10
Aluminum	<0.01	6.6	0.38
Arsenic	<0.01	not analyzed	0.09
Boron	0.2	2.8	2.4
Copper	0.04	2.0	0.11
Fluoride	<0.01	1.6	0.8
Iron	0.20	112	92
Magnesium	0.50	4.0	0.50
Manganese	<0.01	4.0	0.1
pH	7.7	3.8	7.0
Sulfate	8.8	1010	8.1
TDS	125	1778	404

It was noted that both arsenic and iron exceeded USPHS 1962 Drinking Water Standards at the ranch diversion. Two conclusions were presented: 1) receiving waters were adversely affected, chemically and physically, by discharges from the mine, and 2) chemical impacts extend at least 8 miles below the mine. This investigation confirmed impairment of the municipal and domestic supply beneficial use assigned to Leviathan Creek, Bryant Creek and all water bodies in the North Lahontan Basin (except Alkali Lakes) by Regional Board Resolution No. 6-89-94.

7. Pollution of Leviathan and Bryant Creeks Caused by Leviathan Mine, Alpine County, and Pollution of Leviathan and Bryant Creeks, **and** East Fork Carson River Caused by Leviathan Mine, Alpine County, both by Sterling P. Davis, Associate Water Quality Biologist, California Department of Fish and Game, January 1969 and December, 1969, respectively

These reports present survey results of the biological conditions of Leviathan, Mountaineer, and Bryant Creeks, and East Fork Carson River. The first survey was performed on December 5, 1969 and consisted of sampling stream bottom for organisms, observing the stream conditions, and conducting a bioassay. The second survey consisted of electroshocking sections of Leviathan, Mountaineer, and Bryant Creek on July 9 and August 18, 1969, and sampling five square feet of stream bottom for bottom organisms at the mouth of Bryant Creek and points in the East Fork Carson River on November 14, 1969.

The December 1969 report concludes that pollution from Leviathan Mine completely destroyed all fish and fish food organisms in Bryant Creek from the mouth of Bryant Creek upstream to Leviathan Mine. Bioassay results showed that toxicity existed in Leviathan Creek above Mountaineer Creek, and at the ranch diversion from Bryant Creek. Both reports contain observations of yellowish water, orange slime, and stream bottoms cemented with precipitated metals in Leviathan Creek below the mine, and throughout the length of Bryant Creek, including a portion of East Fork Carson River near the mouth of Bryant Creek. No fish or bottom organisms were found at any point below Leviathan Mine in Leviathan and Bryant Creeks. Trout were found in Leviathan Creek above the mine and in Mountaineer Creek, and an abundance of aquatic life was found in Doud Creek. Based upon the number of bottom organisms found in East Fork Carson River above and below the confluence with Bryant Creek it was estimated that 100 percent recovery of aquatic insect population occurred two miles down stream from the entrance of Bryant Creek. The results of the surveys are summarized in Tables A.7.1 and 2. This data clearly demonstrates the cold freshwater habitat was eliminated in Leviathan and Bryant Creek was and impaired in the East Fork Carson River.

Table A.7.1 December 5, 1969 Bottom organisms and bioassay results

Station	Number of bottom organisms	Undiluted Bioassay time of death all fish
Leviathan Cr. above mine	15	nontoxic to fish
Adit	0	30 minutes
Mountaineer Cr.	83	nontoxic to fish
Leviathan Cr. above Mountaineer Cr. (2.9 miles below upper reaches of mine)	0	24 hours
Bryant Cr. at ranch diversion (7.8 miles below upper reaches of mine)	0	90 % survived 96 hour test
Bryant Cr. at mouth (9.3 miles below upper reaches of mine)	0	
East Fork Carson River, one half mile above Bryant Cr.	249	
East fork Carson, 100 yards below Bryant Cr.	4	
East Fork Carson River, 0.9 mile below Bryant Cr.	114	

Table A.7.2 Electro shocking results (July and August 1969)

Station	Length of creek shocked (feet)	Number of trout
Leviathan Cr. above mine	by observation	3
Leviathan Cr. above Mountaineer Cr.	75	0
Mountaineer Cr.	150	9
Bryant Cr. below Leviathan and Mountaineer Crs.	75	0
Bryant at ranch diversion	150	0

8. Report on Hydrologic Study Leviathan Mine Area, Alpine County, State Water Resources Control Board Division of Water Rights

The Division of Water Rights measured flow rates at water quality sampling points from May 14 to September 26, 1969 on an average of two week intervals. The sampling locations were comprised of points of discharge from the mine, and points

along Leviathan and Bryant Creeks. The study determined that the water sources for acid mine drainage were infiltrated precipitation, and Leviathan Creek seepage into the spoil pile placed in the old creek channel. This determination was based on the following observations: precipitation in the pit and the upper watershed created flows from the pit and adit, Leviathan Creek and infiltrated precipitation created springs in the spoil area, and flow in the delta area was from Leviathan Creek. The total flow from mine discharges during this period was calculated to be 105 acre-feet, of which 62 acre-feet seeped through the spoil piles from Leviathan Creek, and the remaining 43 acre-feet was believed to have come from precipitation. Table A.8 summarizes average monthly flows of acid mine drainage from the pit, adit, and seeps.

Table A.8 Pit, adit , and seep flows

Month	Pit Flow cfs (gpm)	Adit cfs (gpm)	Delta spring flows cfs (gpm)	Total acid mine drainage cfs (gpm)
May	0.045 (20)	0.125 (56)	0.36 (162)	0.53 (238)
June	0.017 (7.63)	0.097 (43.5)	0.34 (153)	0.454 (204)
July	0.004 (1.8)	0.078 (35)	0.27 (121)	0.353 (158)
August	0 (0)	0.070 (31.4)	0.20 (90)	0.27 (121)
September	0 (0)	0.074 (33.2)	0.19 (85)	0.26 (118)

9. Investigation of Soil and Irrigation Water Conditions on the Brooks - River Ranch, Nelson Laboratories, Agricultural Chemists and Consultants

This investigation compared analytical results of soil samples taken from adjacent irrigated and unirrigated areas on November 11, 1969. The most significant impact that occurred as a result of irrigation with Bryant Creek water was lowered soil pH. Soil pH's as low as 4.9 and 5.1 were measured in the top three inches of soil in an area irrigated by Bryant Creek water. The report suggests that soil pH's in this range could cause loss of productivity and should be limed back to a pH of 6.0 to prevent future crop losses. The general soil analysis showed that there was no chloride or total salt problems present in any of the soil sampled. Analysis for soluble and available levels of boron (max. soluble 0.39 ppm), iron (max. soluble 0.21 ppm, min. available 81.2 ppm) , manganese (max. soluble 2.67 ppm, min. available 15.0 ppm), zinc (max. soluble 0.18 ppm, min. available 0.93 ppm), and copper (max. soluble 0.05 ppm, min. available 2.04 ppm) showed that the acidic soil conditions had not caused any

problems of deficiency or toxicity (Table A.9).

Table A.9 Soil analysis (parts per million)

	Boron	Iron	Manganese	Zinc	Copper
Max. soluble	0.39	0.21	2.67	0.18	0.05
Min. available		81.2	15.0	0.93	2.04

10. An appraisal of the effects of contaminants in irrigation water derived from Bryant Creek on the Agricultural potential of River Ranch, by Ralph A. Young, Ph.D., Agricultural consultant

This report is based on water, soil and plant samples obtained from River Ranch on September 7, 1970. The soil and plant samples were taken from adjacent areas irrigated with water from Bryant Creek and Cottonwood Creek. The soil irrigated with Bryant Creek showed elevated total concentrations of iron (845 ppm), copper (11.6 ppm), manganese (160 ppm), zinc (6.6 ppm), cobalt (14.5 ppm), and nickel (24 ppm). Though the plant analysis showed elevated levels of iron (315 ppm) and manganese (135 ppm), it did not indicate toxic levels of any constituents. Water from Bryant Creek was rated as having a medium salinity hazard and low sodium hazard. Analysis of Bryant Creek water indicated that it contained contaminants considered undesirable in irrigation water, but not whether the concentration of contaminants exceeded levels that can be tolerated, which depends on the plants being grown, soil properties, and the period of irrigation. All soils showed sub-optimal levels of phosphorus. Bryant Creek irrigated soils exhibited an average pH decrease of 0.7 units. This study warns that with continued use of Bryant Creek water the soil pH will continue to decrease, which will increase the solubility of contaminant metals to the extent that one or more will become toxic to the plants and will decrease the availability of major plant nutrients. The beneficial use of agricultural irrigation supply was impaired because continued use had the potential to produce soil toxicity and nutrient deficiency.

Attachment B
Brown and Caldwell Recommended Project Design Development

Brown and Caldwell's first step in developing the project design was to screen potential control methods. Methods were eliminated based on limiting factors such as the remoteness of the site, limited amount of stable surface area, the impracticality of treating the entire creek flow, limited funds, and the need to minimize operation and maintenance. Source, discharge, and landslide control methods were considered for application to the adit seep, mine pit, waste dump, spoil areas, and landslide. Table B.1 lists the potential technologies, areas of application, and brief rational for elimination or potential applicability.

Table B.1 Potential control method screening

Source Control Methods:		Adit seep	Pit	Waste dump	Spoil Area A	Spoil Areas B and C	Land-slide	Rational for elimination or applicability
Up gradient inter-ception of ground-water:	a. wells	✓	✓		✓			pump power, operation, and maintenance requirements too high
	b. groundwater cutoff barriers	✓	✓		✓			groundwater too deep, bedrock obstacle
	c. hydrauger holes (horizontal wells)	✓	✓		✓			topography prohibits effective use
Interception of adit flow before contamination		✓						no indication of uncontaminated adit flow
Sealing of stream beds, rerouting of streams				✓	✓		✓	most effective means of preventing contact
Clay or soil cement seals, synthetic membranes		✓	✓	✓	✓	✓	✓	Small-scale - prevents infiltration, large-scale - too costly, vegetation conflict
Regrading, compaction		✓	✓	✓	✓	✓	✓	slope stabilization, improve drainage
Revegetation		✓	✓	✓	✓	✓	✓	slope stabilization, water quality improvement, aesthetic restoration
Drainage facilities		✓	✓	✓	✓	✓	✓	improve runoff, reduce infiltration
Deoxygenation of upgradient groundwater		✓	✓		✓			area too large, potentially high operation and maintenance requirements, sulfur oxidation can occur in anoxic conditions

Table B.1 Continued Discharge Control Methods:	Adit seep	Pit	Waste dump	Spoil Area A	Spoil Areas B and C	Land-slide	Rational for elimination or applicability
Adit seal	✓						rock too fractured
Containment of contaminated flows	✓	✓					evaporation, controlled releases during high flow periods
Chemical treatment on site	✓	✓	✓				high level of operation and maintenance
Collection and export for off-site disposal	✓	✓	✓				larger pond areas available

In the first step, control method screening, the following methods were eliminated: up gradient interception of groundwater by wells, groundwater cutoff barriers, or hydrauger holes (horizontal wells), interception of adit flow before contamination, deoxygenation of upgradient groundwater, adit seal, and chemical treatment on site.

Next, Brown and Caldwell analyzed applicable control methods based on cost effectiveness. Two to four levels of treatment were proposed to treat the identified problem areas. The problem areas were grouped into: 1) pit and adit, 2) waste dump, delta, and spoil areas B and C, and 3) spoil area A and landslide, as identified in Figure C-1. Engineering estimates were made for the cost of construction, and the amount of total dissolved solids (TDS) removed from the mine discharges by each proposed level of treatment. Unit removal cost, dollars per ton TDS removed per year, were calculated for each level of treatment and compared. Table B.2, 3, and 4 list the control levels for each problem area with brief descriptions, estimated costs, TDS load removed, and unit removal costs.

Table B.2 **Pit and adit** control levels

Control Level	Control Elements A) Slopes, benches, and drainage, B) Rock underdrain system to collect acid mine drainage (AMD), C) Underdrain control structure regulating acid mine drainage flow to ponds and creek, D) Evaporation storage ponds	Cost (million dollars)	TDS removed (tons/ year)	Unit removal costs ($/ton TDS/yr)
1	a) pit regraded to provide drainage of 45% of pit, 10.9 million gallons (mg) of surface runoff, b) collects 9.5 mg of AMD, c) to discharge 7.8 mg of AMD to creek, d) 2 ponds with total of 3.3 acres of surface area to evaporate 1.7 mg of AMD	0.92	325	2830
2	a) fill pit to elevation of 7160 feet with 600,000 cubic yard excavated from waste dump, 37% of pit resurfaced, 11.9 mg of surface runoff, b) collects 8.5 mg of AMD, c) discharges 3.2 mg of AMD to creek, d) 3 ponds with total of 10.3 acres of surface area to evaporate 5.3 mg of AMD	2.59	487	5320
3	a) no pit work, b) collects 20.4 mg of AMD, c) 10 mile pipe line, d) Ponds in Double Spring Flats area with 40 acres of surface area	4.18	600	6970
4	a) fill pit to an elevation of 7300 feet with 1.8 million cubic yards excavated from waste dump and spoil area, 83% of pit area resurfaced for drainage, 16.6 mg of runoff, b) collects 3.8 mg of AMD, c) not necessary, d) 2 ponds with total of 8.5 acres of surface area to evaporate 3.8 mg of AMD with 15 % additional storage capacity	5.78	563	10270

Table B.3 **Waste Dump, delta, and spoil areas B and C** control levels

	Control Elements	Cost	TDS removed	Unit removal costs
Control Level	A) Leviathan Creek channelization and lining of tributary creeks, B) Regrading to reduce infiltration	(million dollars)	(tons/ year)	($/ton TDS/yr)
1	a) relocation around western edge of waste dump, soil cement and rip-rap channel b) minimum to eliminate surface depressions	0.68	495	1300
2	a) engineered concrete channel along present alignment east of waste dump, engineered channel for southwest tributary, b) excavate 600,000 cubic yards from waste dump to create 7 acres of ponds	2.42	535	4520

Table B.4 **Spoil area A and Landslide** control levels

	Control Elements	Cost	TDS removed	Unit removal costs
Control Level	A) Regrading, B) Slope stabilization	(million dollars)	(tons/ year)	($/ton TDS/yr)
1	a) filling of depressions, b) 4-inch-diameter rock on steeper channel sections	0.11	197	560
2	a) filling of depressions, b) regrading slopes, install terraces to limit slope length to 50 feet, revegetation of terraced slopes, rip-rap and revegetation to stabilize channels	0.40	216	1850
3	a) removal of approximately 1.2 million cubic yards (mcy) for placement in pit	cost included in pit and adit Level 4	238	cost included in pit and adit Level 4

Brown and Caldwell then combined the control methods into seven alternative projects and evaluated them on the basis of cost, control effectiveness, and water quality benefits. Each of the seven alternatives is presented in Table B.5 with the combination of problem area control levels. These are the same control levels developed in the previous design step and

described in Tables B.2, 3, and 4. The control level combinations indicate the control methods employed in each alternative.

Table B.5

Alter-native		Adit and Pit Control Level	Waste dump, delta, and spoil areas B and C Control Level	Spoil area A and Landslide Control Level
A-1	Creek relocation and channelization west of waste dump, minimum site regrading, spoil pile A drainage	1	1	1
A-2	Creek relocation and channelization west of waste dump, minimum site regrading, spoil pile A regrading	1	1	2
B-1	Creek relocation and channelization east of waste dump, 0.6 mcy excavation/fill, spoil pile A drainage	2	2	1
B-2	Creek relocation and channelization east of waste dump, 0.6 mcy excavation/fill, spoil pile A regrading	2	2	2
C-1	Creek relocation and channelization west of waste dump, minimum waste dump regrading, export line, spoil pile A drainage	3	1	1
C-2	Creek relocation and channelization west of waste dump, minimum waste dump regrading, export line, spoil pile A regrading	3	1	2
D	Creek relocation and channelization east of waste dump and 1.8 mcy excavation/fill,	4	2	3

Figures B.1, 2, 3, and 4 are schematic drawings of the seven alternatives.

Table B.6 contains the cost, percent reduction in TDS, and unit control cost estimated for each alternative.

Table. B.6

Alternative	Cost (million dollars)	Percent reduction in TDS	Unit control cost (dollars/ton/year)
A-1	1.71	60	1680
A-2	2.00	62	1930
B-1	3.12	72	2560
B-2	3.41	74	2750
C-1	4.96	77	3840
C-2	5.26	78	4010
D	6.21	79	4660

Very little difference existed between the alternatives in terms of estimated TDS and metals concentrations and beneficial uses returned to Leviathan and Bryant Creeks. Metal concentrations in all alternatives were too high to allow a thriving trout population in either creek. The estimated metal concentrations for Bryant Creek would cause chronic toxicity problems in trout. Less sensitive fish would be able to inhabit Bryant Creek without any adverse effects. Irrigation and stock watering criteria would be met by all alternatives, and most of the groundwater recharge and domestic water supply criteria would also be met.

Alternative B-1 was selected as apparent best project because it came closest to meeting the objectives set out for this project, which were to restore the water quality of Leviathan Creek to conditions as near as possible to those which existed prior to mining activity, within the available financial resources ($2.5 million). The apparent best alternative needed further analysis and refinement to reduce cost while maintaining effectiveness.

The recommended project was developed by making modifications to the apparent best alternative that reduced cost and improved effectiveness. The major differences between the recommended project and apparent best alternative include the following:

1. Addition of a 2.7 acre evaporation pond located west of the pit, and expansion of pond on excavated waste dump from 7 acres to 9.3 acres.

2. Reduction in the quantity of material excavated from the waste dump to develop the pond site, from 600,000 to 472,000 cubic feet.

3. Deep limestone underdrain system in the mine pit replaced with a shallower rock underdrain at the mouth of the pit.

4. Open drainage channels on fill slopes and pit floor in lieu of pipeline transport.

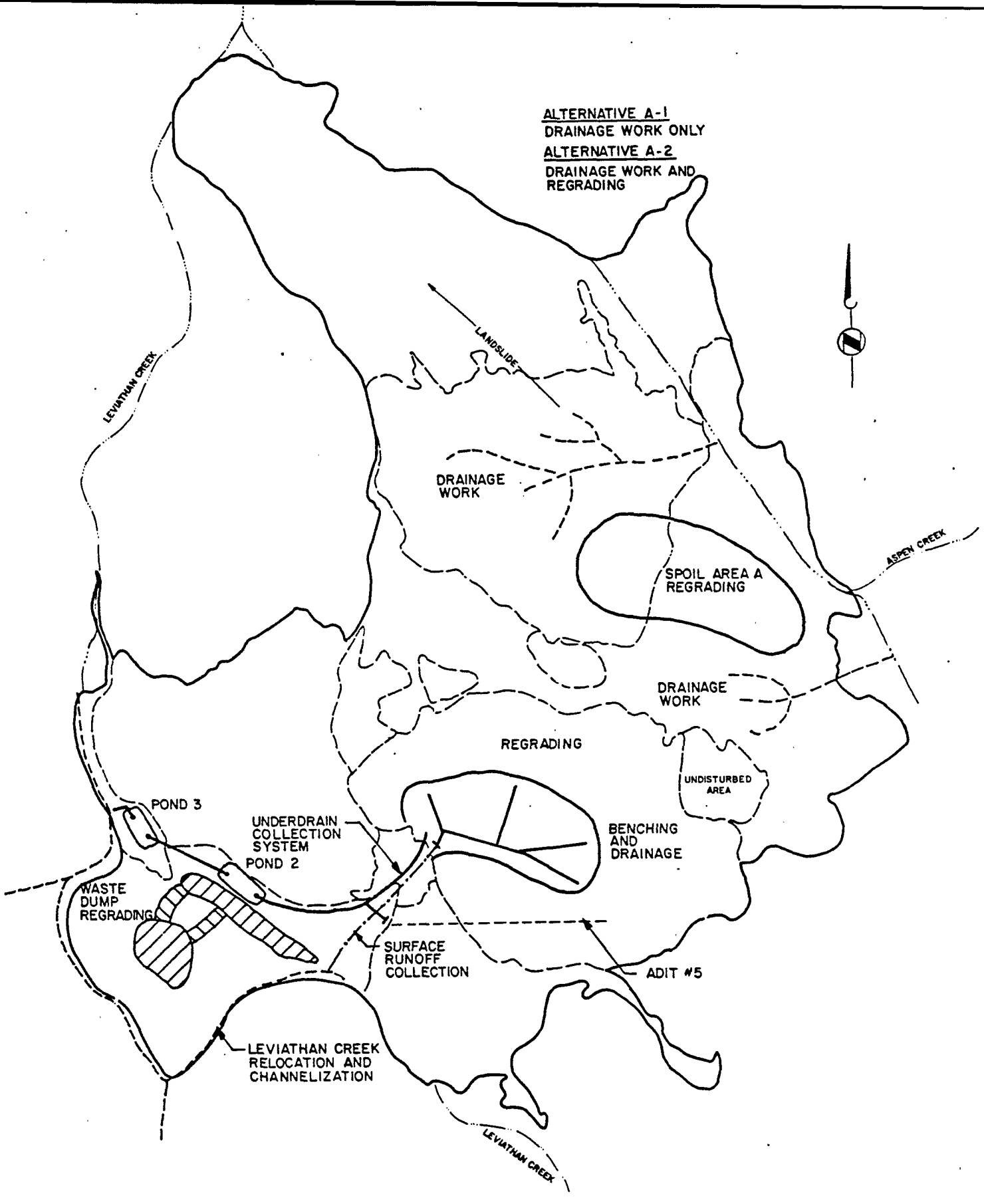

Figure B.1: Alternatives A-1 and A-2, Creek relocation and minimum site regrading.

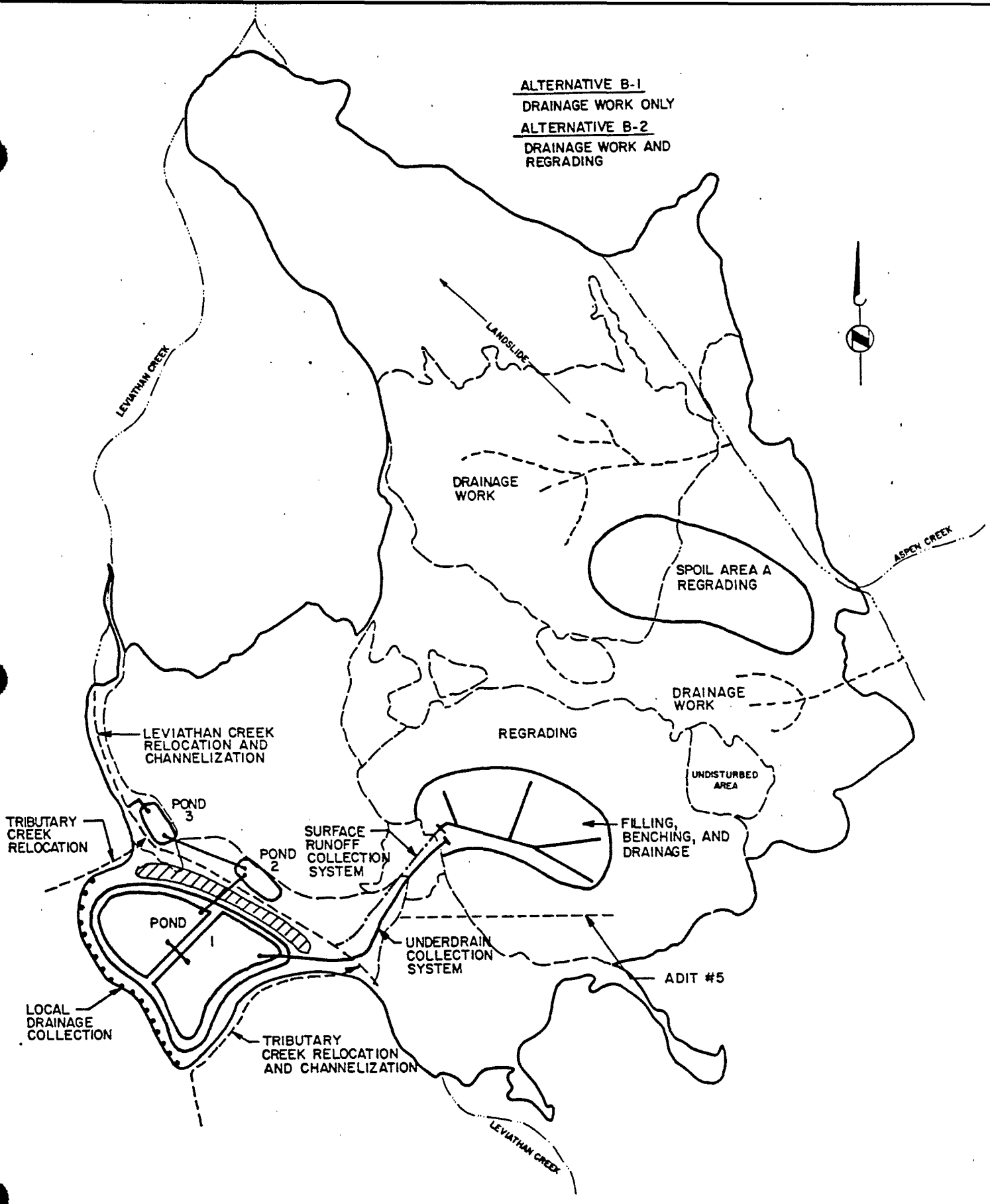

Figure B.2: Alternatives B-1 and B-2, Creek relocation and 0.6 million cubic yards of excavation/fill.

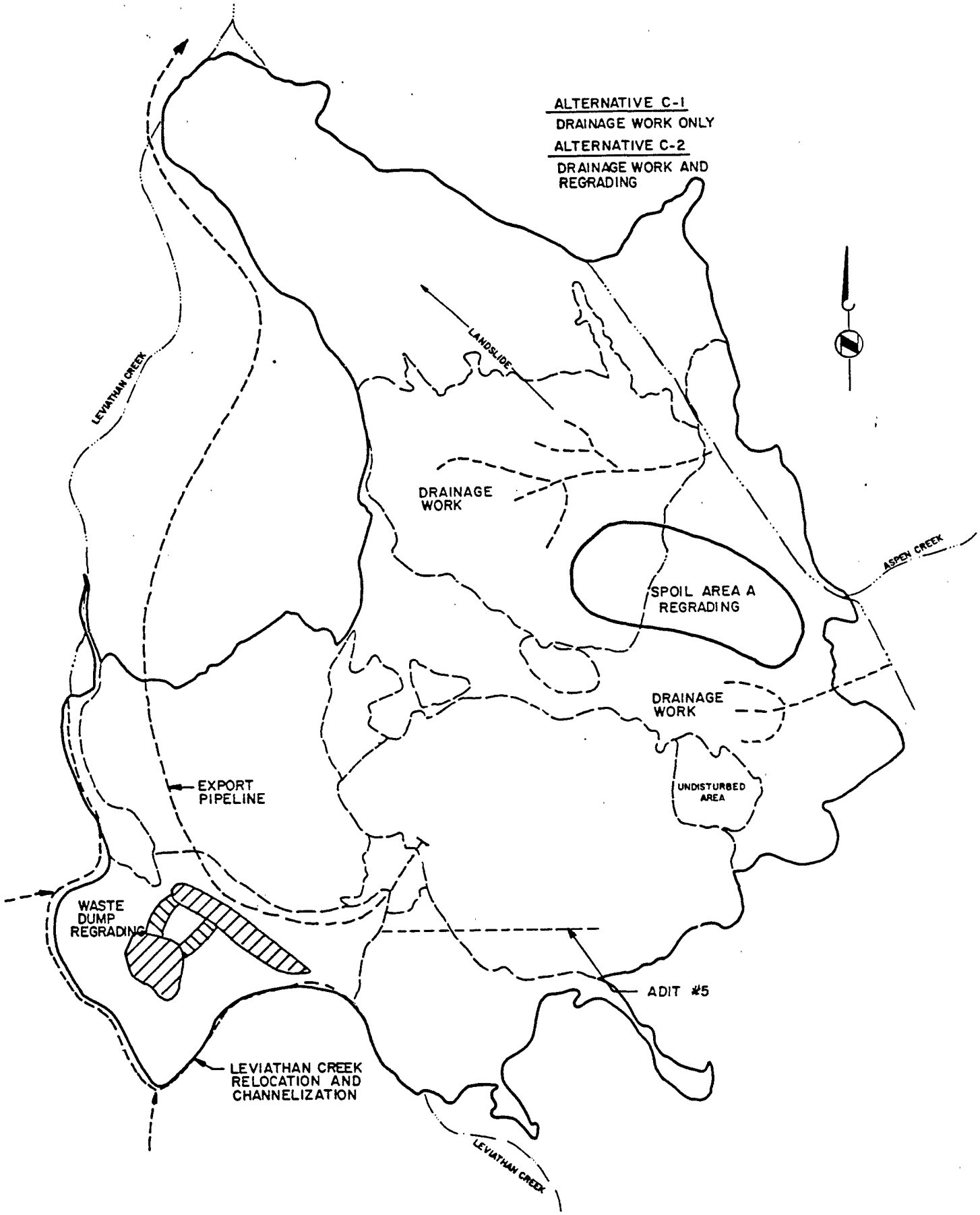

Figure B.3: Alternatives C-1 and C-2, Creek relocated and minimum waste dump regrading, and export line.

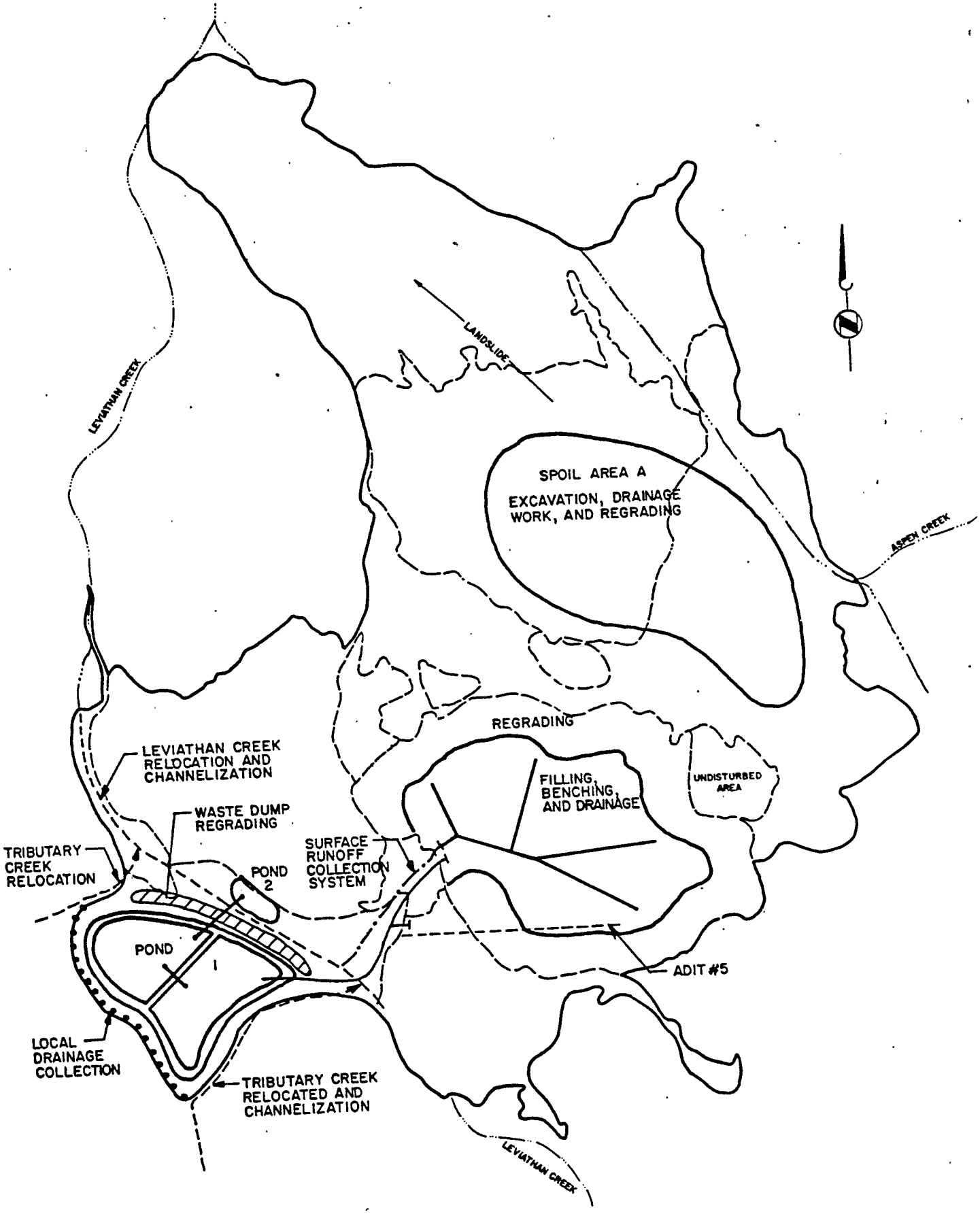

Figure B.4: Alternative D, Creek relocation and 1.8 million cubic yards of excavation/fill.

Attachment C
Project changes during construction

I. Project changes during construction

A. Arco Settlement

The availability of additional funding provided by the Anaconda contribution allowed the Regional Board to improve various project components. Among the modifications made after award of the construction bid was changing nearly 17,000 linear feet of the drainage ditches from soil-cement to concrete, the addition of a fifth evaporation pond providing and additional acre of evaporation pond area, the extension of subsurface drains into the pit floor to collect infiltrating precipitation and springs creating needed stability for pit fill operations, the collection of additional acid mine drainage seeps, and the addition of various valves and structure changes to make site operation more efficient.

B. Unanticipated acidic seeps and springs

Site conditions also caused some changes in the project components. During the course of excavating for the twin 6-foot diameter reinforced concrete pipeline, numerous springs were uncovered, and very muddy conditions existed along the upper portions of the pipeline alignment. This required a design modification to drain the spring area with construction drains and to raise the pipeline 6 feet to get it out of the area where poor foundation conditions existed.

The areas east of pond 1 and under the south levee of pond 3 also exhibited acidic springs. Drains were constructed to collect these springs. Seeps below the pit cutoff wall were collected by a drain along north side of the pit throat (Weekly Progress Report No. 24, 30, 39) and connected to the drain for pond 1. And although it was decided that an acid seep near adit 5 need not be developed because the flow rate was too low to justify the expense of draining it (WPR No. 37), Mittery constructed a drain that connected to the pond 1 drain to remove water from the flow control structure excavation (WPR No. 39). The drain near pond 1 was piped to pond 3 and the drain under the south levee of pond 3 was piped to pond 4 (WPR No. 29). Acidic springs in slopes east and south of pond four were also collected by drains and discharged directly to pond 4. Figure C.1 shows the locations of the captured seeps.

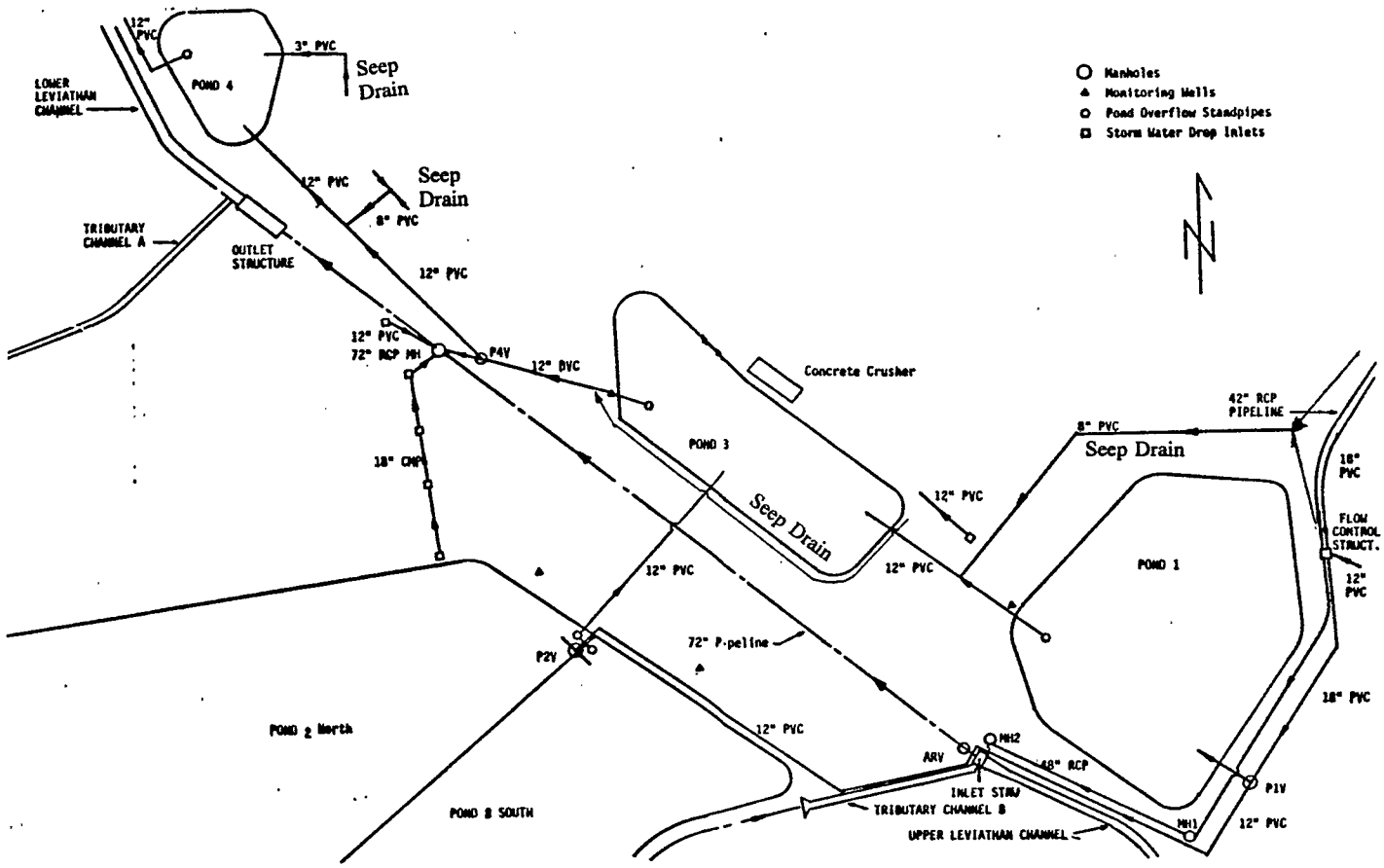

Figure C.1 Location of drains constructed to capture acidic seeps

C. Revegetation

Essentially all the property surrounding the Leviathan Mine is under the stewardship of the U.S. Forest Service (USFS). In addition, all of the land downstream of the mine to the California-Nevada boarder is also USFS land. It was hoped that the USFS would agree to accept title to the site and provide the necessary management and maintenance which would be required. The USFS agreed to explore the possibility, and certain requirements for transfer of title were established.

Among the main concerns of the USFS were that all possible overburden materials be revegetated, and the site be fenced to restrict access of the public and grazing cattle to the evaporation ponds and the revegetated areas. Additionally, the Regional Board agreed to provide funding for site maintenance for the initial five year period following transfer of title. The USFS had tentatively agreed to the Regional Board's proposal, and it was thought that the transfer would take place during the federal fiscal year 1986.

Providing revegetation for the mine presented many difficulties. As part of the original design work for the site, a pilot-scale revegetation project was also initiated in 1983. This project was designed and installed by Dr. Andrew Leiser of the University of California, Davis, with valuable assistance of Mr. Patrick Murphy of the Nevada Division of Forestry (NDF). More than 5,000 seedlings of many locally occurring varieties of trees and shrubs were planted at trial locations throughout the mine site. Locations were chosen to give different soil moisture conditions, slopes and aspects. Plantings were made in both the spring and fall to demonstrate seasonal planting variations. Survival data on the seedlings have been collected through 1985, and the survival of the native species in the acid soil conditions of the overburden material was beyond expectations, generally over 80 percent. Based upon these results, the Regional Board entered into a contract with the NDF for their nurseries to produce more than 120,000 seedlings for planting at Leviathan.

In addition to the shrubs and seedlings, the USFS required that grass revegetation be attempted on as much of the exposed overburden materials as possible. Expertise for this was provided by the USFS Range and Experiment Station in Logan, Utah. The USFS provided recommendations for amendments and seeds which would provide the highest likelihood of a successful grass revegetation effort. Plans and specifications for the grass revegetation of Leviathan Mine were prepared by the Regional Board based upon the USFS recommendations.

D. Contract Change Orders

The contract change orders (CCOs) detail the changes that were made to Brown and Caldwell's final plans as a result of the additional funding and site conditions. There were a total of 14 CCOs, some with more than one component. The CCOs are listed below with brief descriptions.

1. Air vent lines on top of each 72-inch pipe line at Station 22+10.

2. Install approximately 1,920 linear feet of underdrain channels and collector piping in the open pit, deleting 40-foot long T-section parallel to cut-off wall. Drain dimensions: 12" perforated PVC pipe centered in the bottom of 3' by 3' cross section of drain rock rapped in geotextile drainage fabric.

3. Install nearly 1,100 linear feet of rock-filled underdrain channels with perforated collection piping under the twin 72-inch pipeline from inlet structure to outlet structure. The underdrain consists of a 12-inch perforated PVC pipe bedded in a 2-feet by 2-feet cross section channel of drain rock rapped in geotextile fabric, with up to six laterals to collect springs of ground water entering the pipe trench.

4. Changes to the twin pipe inlet structure including increased wall and slab thickness, 12 inches of drain rock under inlet structure and adjacent 50 feet of Leviathan Creek concrete channel to tie in with underdrain of CCO No. 3, and 3-inch diameter weep holes with 1 cubic foot of drain rock at 5-feet spacing in the walls of the channel and lower walls of the inlet.

5. Placement of approximately 12 feet of additional fill on the floor of the pit and related changes to fillslope channels, pit access road and gate/cutoff wall locations.

6. Extension of rock/pipe underdrain installed under CCO No. 3 westerly around outlet structure and parallel to the lower Leviathan Creek open channel, removal and replacement of saturated unstable soils with drain rock along pipe alignment between stations 18+00 and 20+50 to be covered with filter fabric and tied into the existing rock/pipe drain with a cutoff collector trench and pipe line, elevation of the twin 72-inch pipeline approximately 6 feet along most of the alignment and 15 feet at the outlet in the delta area, filling and grading the delta area to accommodate raising the outlet structure, constructing an additional

rock-filled drain under the elevated pipeline starting at station 18+00 and terminating with 40 feet of perforated pipe that penetrates the outlet structure wall, and 8 inches of drain rock under the outlet structure and lower Leviathan Creek open channel.

7. Deletes bid item number 16 and changes regrading areas of spoil pile A to a cost-plus basis at the direction of the engineer.

8. Placement of galvanized steel grating over the inlet structure, and manholes located on 48-inch pipeline from flow control structure to inlet structure (containing collected pit surface runoff).

9. Changes grading on north face of waste dump, adds a junction box over 72-inch pipeline, reduces depth of drop-inlets for slope drainage of waste dump, and provides a connection for waste dump surface drainage to 72-inch pipeline junction box.

10. Substitutes soil-cement drainage channels with reinforced, concrete-lined drainage channels throughout the project, specifies a 4-inch reinforced concrete liner for the entire alignment of tributary channel B (tributary to Leviathan Creek that flows immediately south of waste pile) with a cutoff wall extending to bedrock at the invert, and adds bench drainage collector flumes to the west edge of the north face of the waste dump to transport surface runoff into tributary channel A.

11. Construction of pond 4 in delta area adjacent to the outlet and piping modifications.

12. Lists the following items to be completed under specific direction of the project engineer: additional drainage control work, connection of drains in pit throat to Pond 3, road construction to restrict access to ponds, construction of pond 3 underdrains, addition of valve and manhole for pond 1, construction of safety fencing around Leviathan Creek channels, and other miscellaneous work items required by the project manager.

13. Amending change order number 7 to increase the funds available for change order number 6.

14. Revegetation of the north and east slopes of the waste dump and the slopes of the open pit with lime, seed mix, fertilizer, and wood/straw mulch.

Attachment D: Site Revegetation figures, tables, and references

Figure D.1: Overall effect of soil pH on third-year survival of shrubs and conifers.
Figure D.2: Effort of soil pH on third-year survival of shrubs and conifers grown on southerly aspects.

Table D.1: History of Leviathan mine revegetation efforts.
Table D.2: Leviathan mine Demonstration Plantings: survival data of June 1983 planting in Fall 1983.
Table D.3: Comparison of Spring and Fall plantings, 1983-84, Leviathan mine.
Table D.4: Leviathan mine: Effects of fertilizer on three-year survival and growth of selected species, October-November 1985, planted 1983.
Table D.5: Leviathan mine Rosa woodsii with and without fertilizer, planted 1983, measured 1985.
Table D.6: Leviathan mine: 1983 to 1984 test revegetation plots.
Table D.7: Leviathan mine: 1885 to 1986 revegetation planting results.

USFS revegetation plan

Figure D-1: Overall effect of soil pH on third-year survival of shrubs and conifers.

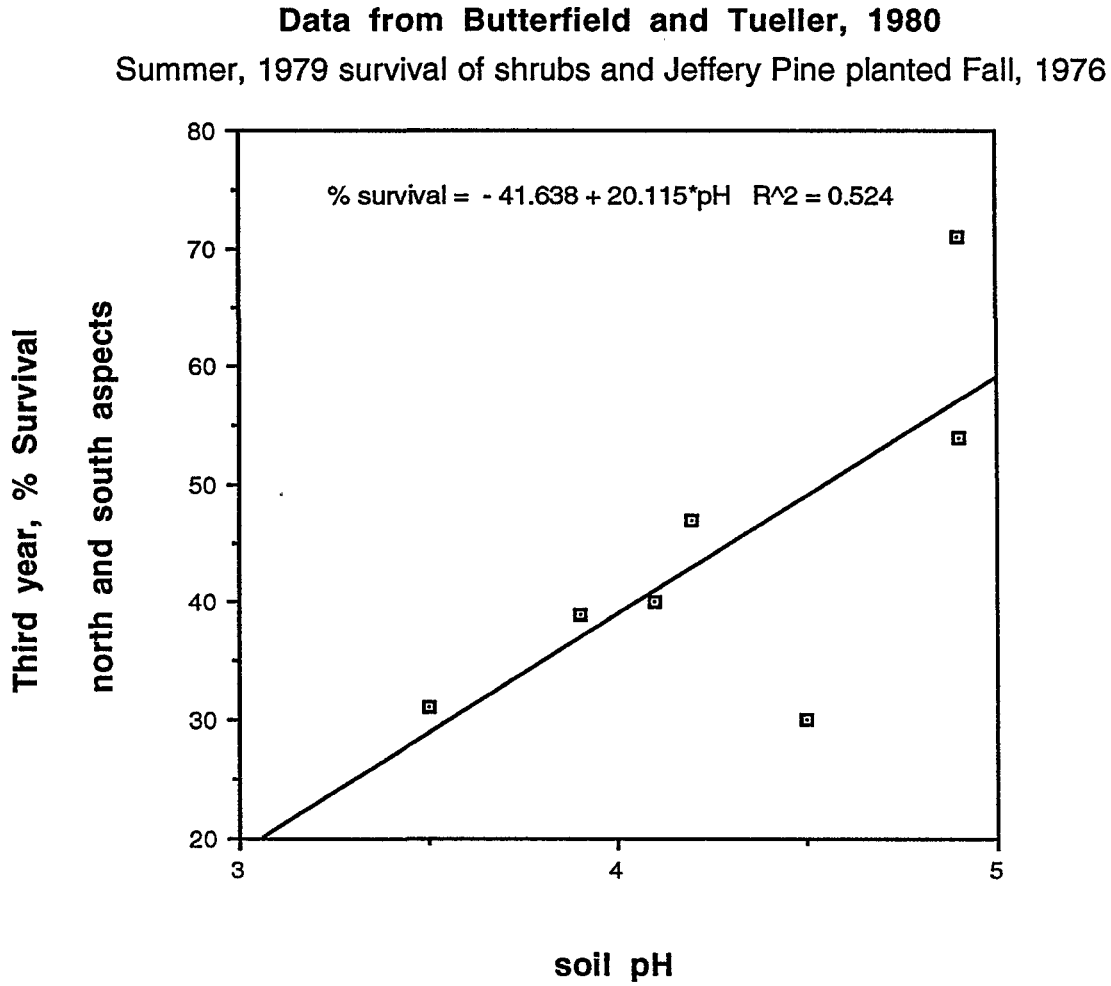

Figure D-2: Effect of soil pH on third-year survival of shrubs and conifers grown on Southerly aspects.

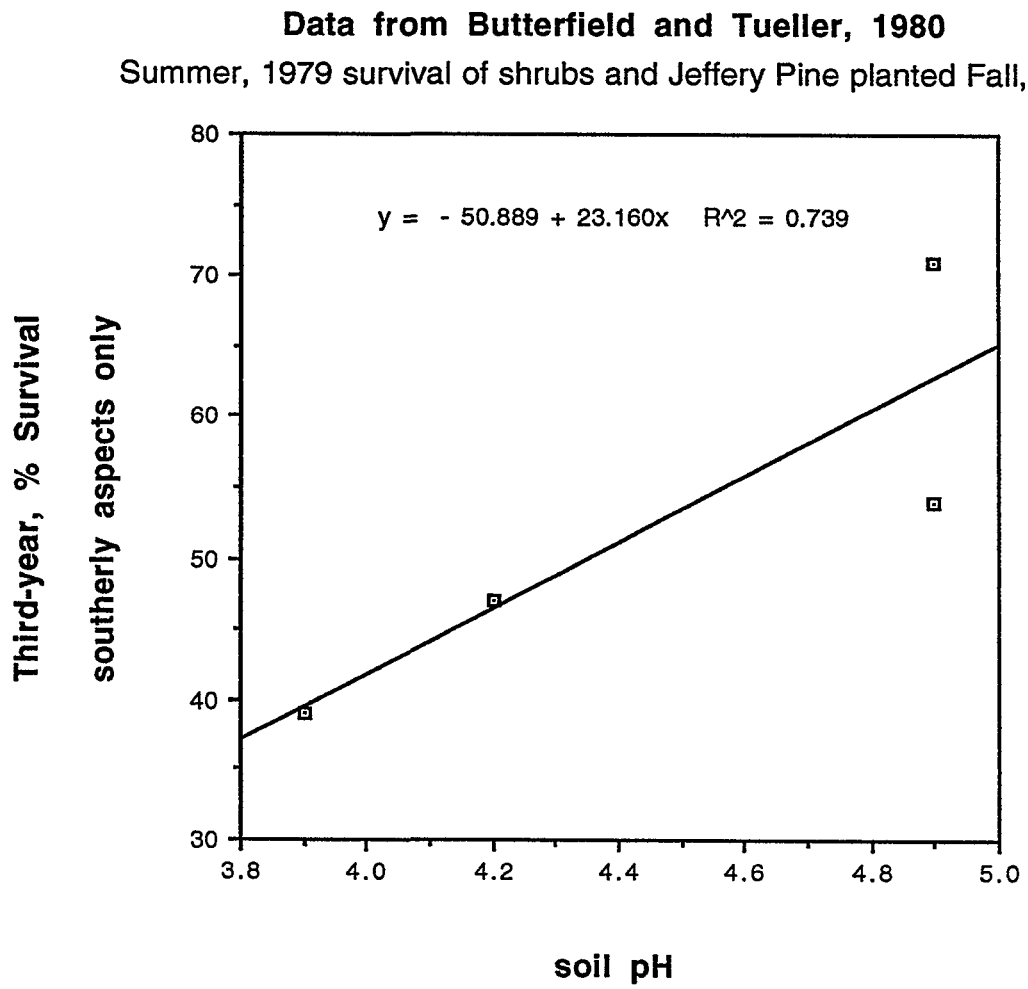

Table D.1: History of Leviathan mine revegetation efforts

Dates	Workers	Nature of Work	Parameters Assessed / Project Components	Main Treatments/ Addition
1975-'79 (pre-project)	Butterfield and Tueller	Study Masters thesis, UNR	○On-site volunteer plant species ○ Soil physical and chemical characteristics ○ Greenhouse soil fertility assay ○ Field trials	○ Lime ○ Fertilizer ○ Mulch ○ Seeding method ○ Tree, shrub, and grass species
1983-'84	Leiser (UC Davis) and Murphy (Nevada DF)	Study Contract work with UC Davis and the Nevada Division of Forestry	○ plant survival ○ plant vigor	○ 2 Fertilizer (0 or 1 oz osmocote / plant) x 2 Planting time (Spring vs. Fall) factorial
Spring, 1985 to Summer 1987	USFS via private contractor	Implementation Contracted with Selby's Soil Erosion Control Company	○ plant survival ○ post-treatment soil pH	○ Lime ○ Fertilizer ○ Mixed grasses/legumes
Spring, 1985 to Spring 1988	Leiser (UC Davis) and Murphy (Nevada DF)	Implementation Contract work with UC Davis and the Nevada Division of Forestry	○ plant survival	○ Tree and shrub species
1992-present	Leiser (UC Davis) and Murphy (Nevada DF)	Implementation Bioengineering	○ plant survival ○ soil erosion control	○ Willow Wattles ○ Brush boxes

Table D.2: Leviathan Mine Demonstration Plantings: Survival Data of June, 1983, planting in Fall, 1983, Plantings. Alpine Co., CA., 7500' elevation.

Species name	Common name	Site 1	Site 2	Site 3	Site 4	Weighted Average†	Std. Dev.
		% survival					
Angiosperms							
Acer glabrum	Mountain maple	100	0	71	88	69	45
Artemisia tridentata	Sagebrush	61	71	61	65	65	5
Atriplex canescens	Four-wing saltbrush	99	99	97	99	98	1
Ceanothus prostratus	Squaw carpet	71	4	50	79	41	34
Chrysothamnus na.	Rabbitbrush	93	60	72	86	66	15
Cornus Stolonifera	Creek dogwood	100	50	75	83	79	21
Cowania mexicana	Cliff rose	100	63	92	100	88	18
Physiocarpus malvaceus	Ninebark	72	44	58	0	55	31
Prunus virginiana	Chokecherry	98	42	93	90	80	26
Rhus glabra	Smooth Sumac	94	42	83	92	77	24
Ribes aureum	Golden currant	97	75	94	96	90	10
Rosa Woodsii	Wood's rose	100	86	99	100	97	7
Quercus gambelii	Gambel Oak	100	63	92	100	88	18
Subtotal, Mean		91	54	80	83	76	16
Gymnosperms							
Cuppressus arizonica	Arizona Cypress	99	97	100	100	99	1
Juniperus scopulorum	Rocky Mountain juniper	100	51	96	99	87	24
Pinus jeffreyi	Jeffrey pine	99	97	99	99	98	1
Pinus murrayana	Lodgepole pine	96	79	96	100	93	9
Pinus Ponderosa	Ponderosa Pine	99	97	100	100	99	1
Subtotal , Mean		99	84	98	100	95	7

† Because of limited availability of some species, the number of plants at each site was not always equal.

Table D.3: Comparison of Spring and Fall plantings, 1983-1984:
Leviathan Mine

Planted	Growth period Assessed	Plot 1	Plot 2	Plot 3	Plot 4	Total	Std. Dev.
Sub-totals: Broad Leaved Species							
6/83 (Spring)	6/83 - 9/83	95.2	53.3	85.8	90.5	81.1	19.0
6/83 (Spring)	6/83 - 9/84	85.6	53.3	79.2	84.4	75.5	15.1
6/83 (Spring)	9/83 - 9/84	89.9	100	92.2	93.2	93.1	4.3
9/83 (Fall)	9/83 - 7/84	77.1	91.7	96.8	89.5	88.7	8.4
Sub-totals: Conifers							
6/83 (Spring)	6/83 - 9/83	98.3	84.2	98.1	99.4	95	7.2
6/83 (Spring)	6/83 - 9/84	90.5	68.6	93.9	95.8	87.2	12.6
6/83 (Spring)	9/83 - 7/84	92	81.5	95.8	96.3	91.8	6.9
9/83 (Fall)	9/83 - 7/84	60	90.8	81.7	79.4	78	13.0
Grand Totals							
6/83 (Spring)	6/83 - 9/83	97.1	71.8	93.2	95.8	89.4	11.9
6/83 (Spring)	6/83 - 9/84	88.6	62.5	88.0	91.2	81.8	13.5
6/83 (Spring)	9/83 - 7/84	91.2	87.0	94.5	95.1	92.3	3.7
9/83 (Fall)	9/83 - 7/84	67.6	91.2	88.4	84.0	82.8	10.6

Table D.4: Leviathan Mine: Effects of Fertilizer on Three Year Survival and Growth of Selected Species. October-November, 1985. Planted 1983.

Species	Treatment†	# Planted	# Alive	Diameter, mm	R2, mm	Height, cm	New Growth, cm
Pinus jeffreyi	NF	36	35	10.1	26.6	20.5	6.2
	F	36	35	15.7	64.0	28.4	12.4
Pinus murrayana	NF	36	36	8.5	18.9	19.9	6.8
	F	36	33	13.1	44.4	28.2	12.2
Pinus Ponderosa	NF	36	34	10.8	31.9	25.6	6.7
	F	36	36	18.3	86.1	36.9	12.8
				Height, cm	Spread	Spread R2	R2h , cm3
Rosa Woodsii	NF	36	36	10.8	7.6	17.00	8.80
	F	36	36	49.4	53	722.50	39,959.00
Prunus virginiana	NF	27	25	6.6	1	0.25	1.70
	F	27	23	29.8	18.9	102.20	3,427.00
Aibes aureum	NF	36	17	4.2	1	0.25	1.04
	F	34	33	15.9	32.2	55.20	888.50
Chrysothamnus spp.	NF	36	5	2.7	2	2.00	11.20
	F	36	22	20	23.9	67.80	1,533.80
Atriplex canescens	NF	34	5	1	1	0.25	0.25
	F	34	23	10.8	10.1	27.60	301.20

† NF = not fertilized; F = fertilized (1 oz. osmocote/plant)

Table D.5: Leviathan Mine *Rosa Woodsii* with and without fertilizer.
Planted 1983, Measured 1985.

			Means - cm			
Replicate	Treatment†	# of plants	Height	Spread (d)	Spread r2	r2 x Ht.
1	NF	9	10	6.1	10.1	104.00
2	NF	9	9.8	8.4	20.1	208.00
3	NF	9	10.9	7	17	258.00
4	NF	9	12.4	8.9	20.9	262.00
subtotal		36	10.8	7.6	17.2	208.00
1	F	9	47.4	50.3	658	33,266.00
2	F	9	52.2	52.8	703	36,450.00
3	F	9	49.7	52.9	715	47,829.00
4	F	9	50.3	56	814	42,291.00
Subtotal		36	49.4	53	722.5	38,959.00
Total		72				

† NF = not fertilized; F = fertilized (1 oz. osmocote/plant)

Table D.6: Leviathan Mine—1983 to 1984 test revegetation plots†

Rating of plant establishment/vigor		
Poor	**Moderate**	**Good**
Redoser Dogwood	Rocky Mountain Maple	Squaw Carpet (bare root)
Staghorn Sumac	Woods Rose	
Nine Bark	Chokecherry	
Rabbit brush	Jeffrey Pine	
Big Sage	Golden Currant	
Rocky Mountain Juniper	Ponderosa Pine	
Arizona Cyprus	Lodgepole Pine	
4 Wing Saltbrush		
2 Wing Saltbrush		
Willows (unrooted cuttings)		

† source: Patrick M. Murphy, State of Nevada, Division of Forestry

Treatment Results:

	Plant Vigor	
	No fertilizer	1 oz Osmocote*
Spring Plant	Poor	Good
Fall Plant	Poor	Good

* Osmocote is an 18-6-12 slow release (~8-9 mo.) fertilizer material.

Other Results:

- Containerized plants performed better than bare root stock.
- Up to 300% difference in fertilized vs. non-fertilized treatments.
- No difference between spring and fall plantings, probably because of good moisture in '83-'84.
- Drought was not a factor.
- All plants had high (about 70-90%) survival the first year.

Table D.7: Leviathan Mine—1985 to 1988 revegetation planting results†

Time/Site	Rating of plant establishment/vigor: Poor	Fair	Moderate	Good
Spring '85 Site 'B'	Willow	Buffaloberry	Rose	
			Caragana	
			Currant	
		Russian Olive		
		Gambel Oak		
		Skunk Brush	Jeffrey Pine	
Fall '85 Site 'A'	Mixed grasses		Jeffrey Pine	
Site 'B'	Bitterbrush		Elderberry	
			Mountain Mohogany	
		Serviceberrry		
Spring '86 Overburden-NE side-high drainage area				Native Willow
				Currant
				Wild Rose
Spring '88 Site 'B'	White Fir			
	Washoe Pine			

† source: Patrick M. Murphy, State of Nevada, Division of Forestry

Observations:

- Two main sites were used: 'A' and 'B', corresponding roughly to waste areas A and B (Taxer et al., 1991, Fig. 2) Site A was intended primarily for grasses. But an accidental plant of Jeffrey Pines in Fall '85 had 85% survival, whereas grass didn't survive because of drought in spring of '86. Deep rooted plant do better once established.
- Planting density was approximately 8' x 8' (about 64 sq. ft/plant)
- no Fall planting in 1987 because of drought.
- Results of plantings in Fall '86 and Spring '87 not reported because they were the same as other years.
- Success in Spring '86 was primarily because of location—good soil and moisture conditions for establishment.
- All plants received fertilizer (1 oz. osmocote).
- White Fir survival was < 50% because of drought, but may have potential with a good planting window.
- During drought, Spring is the only time to plant.

United States Department of Agriculture
Forest Service
Intermou lin Station
860 North 12th East
Logan, UT 84321

Reply to 4050

Date Augsut 8, 1984

8-178

Rec'd.	AUG 13 1984
WPR	✓
GJT	✓
cc Pat Murphy Lewis Foster	
GML- Site Rec File	

Mr. Gerard J. Thibeault
California Water Quality Control Board
Lahontan Region
2092 Lake Tahoe Boulvard
South Lake Tahoe, California 95731-2428

Dear Gerry:

This letter is in response to your request for recommendations for revegetating approximately 23 acres at the Leviathan Mine. These recommendations apply to the waste dump slopes below the evaporation ponds in the southwest corner of the property and to the pit fill. The methods vary somewhat between these areas and we will try to make that clear in the following narrative. All of the recommendations are given on a per acre basis.

WASTE DUMP SLOPE

Except for the benches this slope is too steep for the safe, effective, use of standard revegetation equipment. Therefore, we suggest the use of a hydromulcher to apply lime, fertilizer, part of the seed, and wood-fiber mulch. The sequence of events is as follows: (1) Apply lime as a slurry from the hydromulcher, (2) Wait 7 days, (3) Use a blanket harrow to roughen the surface and work in the lime,(4) Hand broadcast 70 percent of the seed mix using a cyclone type spreader, (5) Use a hydromulcher to spread the remaining seed mix, fertilizer, and wood-fiber with tacking agent, all in one application, (6) Blow on straw mulch and tacking agent, and (7) Apply protective netting if you deem it necessary; we make no recommendation.

Supplies

Lime as calcium oxide, 5.6 tons/ac, hydromulcher slurry.
Fertilizer, 400 lbs/ac, 16-16-16, Chevron UNIPEL
Wood-fiber mulch, 1 ton/ac with tacking agent
Straw mulch, 1 ton/ac with tacking agent (asphalt emulsion)

Safety precautions are required in making the calcium oxide slurry in the hydromulcher; heat is released. Respirators and protective clothing should be worn.

We also recommend that the seeding operation be followed by the planting of containerized stock from the Nevada Division of Forestry. This may be done most effectively in the spring of 1985 but for other considerations you may choose to accomplish this job right after the seeding operation. We would like to see the containerized stock planted on a 4 ft X 4 ft spacing.

Plant Materials

Seeded Species

tufted hairgrass (Deschampsia caespitosa)	1 lb/ac
hard fescue (Festuca ovina duriuscula)	2 lb/ac
Alta tall fescue(F. arundinacea)	1 lb/ac
western needlegrass (Stipa occidentalis)	3 lb/ac
slender wheatgrass (Agropyron trachycalum)	3 lb/ac
bluebunch wheatgrass (A. spicatum)	3 lb/ac
intermediate wheatgrass (A. intermedium)	3 lb/ac
timothy (Phleum pratense)	2 lb/ac
orchardgrass (Dactylis glomerata)	2 lb/ac
Garrison creeping meadow foxtail (Alopecurus arundinaceus)	2 lb/ac
western yarrow (Achillea millefolium lanulosa)	2 lb/ac
Pacific aster (Aster chilensis adscendens)	3 lb/ac
cicer milkvetch (Astragalus cicer)	3 lb/ac
red clover (Trifolium pratense)	1.5 lb/ac
alsike clover (T. hybridium)	1.5 lb/ac

Containerized Species

woods rose (Rosa woodsii)
western chokecherry (Prunus virginiana)
bitter cherry (P. emarginata)
Siberian pea (Caragana arborescens)
buffaloberry (Shepherdi argentea)
smooth sumac (Rhus trilobata)
curly leaf mountain mahogany (Cercocarpus ledifolius)
alder (Alnus tenuifolia)
golden current (Ribes aurium)
Jeffrey pine (Pinus jeffreyi)

PIT FILL AREA

The pit area operations are similar except that the hydromulcher will not be needed. The seeded species will be planted with a Brillion Grass Seeder or equivalent. The sequence of events is as follows: (1) Apply agricultural lime as calcium carbonate, (2) Rip on the contour to 18 inches depth, (3) Apply granular fertilizer, (4) Spring-tooth harrow on the contour, (5) broadcast 25 percent of the seed mix with a hand cyclone type seeder, (6) Sow remaining seed with Brillion Grass Seeder, (7) Blow on straw mulch, and (8) Use straw crimper on the area. Asphalt tacking could be used in place of step #8 but we like the crimper better.

Supplies

Lime as calcium carbonate, 10 tons/ac, apply in granular form.
Fertilizer, 400 lbs/ac 16-16-16, Chevron UNIPEL
Straw Mulch, 2 tons/ac, blown on.

Recommendations concerning plant materials are the same as for the waste dump slope, except that containerized stock can be on 6 ft X 6 ft centers.

If you make the decision to proceed on this basis we suggest that you take immediate steps to procure the necessary seed. It is already late to be procuring seed for a fall 1984 planting. There are probably native seed collectors in the Reno-Lake Tahoe area. Other sources would include Native Plants, Inc., Salt Lake City, Utah; Environmental Seed Producers, El Monte, California; and Mountain Wildland Seed Company, Logan, Utah. I would caution against using seed collected from elevations lower than the Leviathan Mine site. It is more acceptable to use seed collected at higher elevations.

I would also caution against trying to short-cut the steps outlined. Short-cuts will invariably result in reduced plant establishment and ground cover.

Timing of the seeding job is going to difficult. You want to seed early enough to accomplish the job but late enough to severly restrict the amount of precocious seed germination. Plants germinating this fall will be subject to serious losses through frost heaving. But, you also want the site dry enough to be worked effectively. In that clay you will experience great difficulties if the site is too wet.

We have some soil samples that are still being analyzed. We want to get some better numbers on the fertilizer and lime requirements. If the analyses indicate that changes are necessary, we will contact you or Gary Litton by phone. We should know within 10 days.

Finally, we have the greatest desire that you succeed with this project. Feel free to contact either of us. The phone number is 801-752-1311.

Sincerely yours,

EUGENE E. FARMER
Project Leader

BLAND Z. RICHARDSON
Research Forester

cc: Jim Nelson
Mike King
Ben Albrechtsen
Duane Lloyd

2024037

LEVIATHAN MINE SITE

PHASE 1

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY

WORK PLAN

DRAFT

April 2002

Prepared For:

ATLANTIC RICHFIELD COMPANY

307 East Park Street, Suite 400
Anaconda, Montana 59711

Prepared By:

MWH
MONTGOMERY WATSON HARZA

1475 Pine Grove Road
P O Box 774018
Steamboat Springs, Colorado 80477

LEVIATHAN MINE SITE
PHASE 1 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
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Prepared by:

MWH
1475 Pine Grove Road
P.O. Box 774018
Steamboat Springs, Colorado 80477
(970) 879-6260

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B	Summary of 1998 Groundwater Chemical Data
C	List of Documents to be Reviewed
D	EPA Site File Index
E	Database Meeting Minutes

Attachment	Description
1	Leviathan Mine Site Site-wide Sampling and Analysis Plan

LIST OF ACRONYMS

Administrative Order	Administrative Order for Early Response Actions and Remedial Investigation and Feasibility Study
AERL	ARCO Environmental Remediation, LLC
ARD	Acid Rock Drainage
Atlantic Richfield	Atlantic Richfield Company
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
COPEC	Contaminants of Potential Ecological Concern
CSM	Conceptual Site Model
CTE	Central Tendency Estimates
CUD	Channel Underdrain
DQO	Data Quality Objectives
DS	Delta Seep
EFCR	East Fork Carson River
EPA	U.S. Environmental Protection Agency
ERA	Early Response Actions
FS	Feasibility Study
FSP	Field Sampling Plan
ft/ft	feet per foot
GENSCN	Generation and Analysis of Model Simulation Scenarios for Watersheds
GIS	Geographic Information System
HHRA	Human Health Risk Assessment
IRIS	Integrated Risk Information System
gpm	gallons per minute
lbs/day	pounds per day
mg/l	milligrams/liter
NDEP	Nevada Department of Environmental Protection
NPL	National Priority List
ODBC	Open Database Connectivity
ORD	Office of Research and Development
OS	Overburden (Aspen) Seep
POF	Pond Overflow
PRG	Preliminary Remediation Goals
PUD	Pit Underdrain
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Estimates
ROD	Record of Decision
RPM	Remedial Project Manager
RWQCB	Lahontan Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SERA	Streamlined Ecological Risk Assessment
Site	Leviathan Mine Site
SMP	Draft Leviathan Mine Site 2002 Site Management Plan
SOW	Statement of Work
State	State of California

LIST OF ACRONYMS
(Continued)

TAC	Technical Advisory Committee
UNR	University of Nevada, Reno
USFS	United States Forest Service
USGS	United States Geological Survey

1.0 INTRODUCTION

1.1 GENERAL

Atlantic Richfield Company (Atlantic Richfield) is conducting a phased Remedial Investigation/Feasibility Study (RI/FS), including Early Response Actions (ERAs), at the Leviathan Mine Site (Site) in Alpine County, California. This *Draft Leviathan Mine Site Phase 1 RI/FS Work Plan* (Phase 1 Work Plan) describes work elements to be conducted during the Phase 1 RI/FS.

The Leviathan Mine Site is a former sulfur mine located on the eastern slope of the Sierra Nevada at an elevation of 7,000 feet. The Site is located about 25 miles southeast of Lake Tahoe and six miles east of Markleeville, as shown in Figure 1-1, *General Site Location Map.*

Ongoing Site activities being performed by Atlantic Richfield, including ERAs and the Phase 1 RI/FS, are in response to the U. S. Environmental Protection Agency (EPA) *Administrative Order For Early Response Actions and Remedial Investigation and Feasibility Study* (Administrative Order) (EPA, 2000a). The *Draft Leviathan Mine Site 2002 Site Management Plan* (SMP) (MWH, 2001) describes the phased RI/FS approach to Site remediation, consistent with the Administrative Order Statement of Work (SOW).

The Phase 1 RI/FS, described herein, is being conducted concurrently with ERAs, which are addressed in separate work plans (MW, 2001; MWH, 2002). As outlined in the Administrative Order SOW, ERAs are integral to the overall evaluation and alternative selection process. By isolating and treating known sources at the Site, ERAs provide for the identification of other potential Site sources, while evaluating treatment alternatives on known sources and improving overall surface water quality. The RI/FS process proceeds concurrently with the ERAs and data collected for ERA evaluation can be used in the RI/FS process to aid in selection of proven, effective, and comprehensive remedies for the Site.

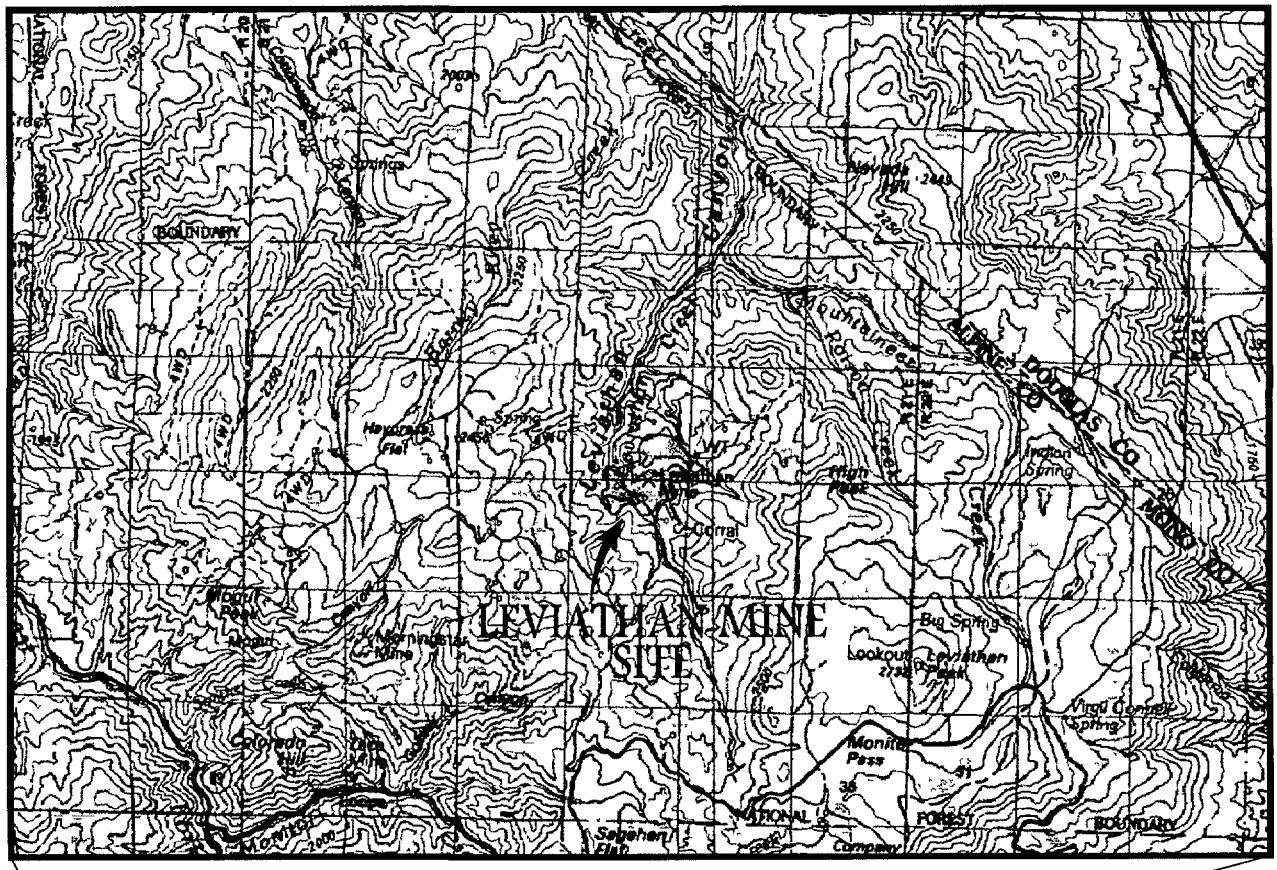
1.2 PHASE 1 WORK PLAN SCOPE

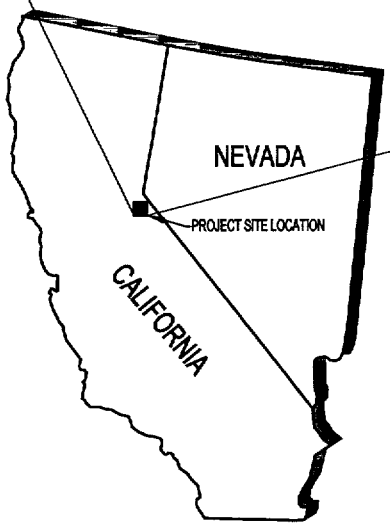
In accordance with the Administrative Order SOW, and as outlined in the SMP, the Phase 1 Work Plan describes the following primary work elements to be conducted under the Phase 1 RI/FS:

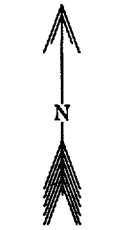
- **Assessment and Management of Existing Data**: Atlantic Richfield will compile and assess existing data, along with other monitoring data collected during implementation of the Early Response Actions. The data will be compiled into a central document and electronic data management system compatible with EPA data systems and Geographic Information System (GIS). The information will be assessed for data quality, potential data gaps, and improvements to the conceptual site model (CSM) presented in the SMP.

- **Site Characterization**: Under the Phase 1 RI/FS, Atlantic Richfield will characterize the Site, summarizing available data on the physical, demographic, and other characteristics of the Site and surrounding areas, including background engineering information for analysis of Early Response Action alternatives. Site characterization will include a Site description and background discussion; a description of previous response actions at the Site; information characterizing the source, nature, and extent of contamination at the Site; and protocols for collection of groundwater and surface water data consistent with EPA protocols.

- **East Fork Carson River Risk Assessment**: Atlantic Richfield will submit a Risk Assessment (human health and ecological) for the East Fork of the Carson River as an early phase of the RI/FS to be implemented in parallel with Early Response Actions.







NOT TO SCALE

LEVIATHAN MINE - Property lies within a remote portion of Northeastern Alpine County, California, on the eastern flank of the central Sierra Nevada, near the California-Nevada border, approx. 25 miles southeast of Lake Tahoe, and 6 miles east of Markleeville, California.

REV No	REVISIONS	REV DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued For Draft Review	4/02	J Ray	J Gates	J Ray

MWH
MONTGOMERY WATSON HARZA

PROJECT No 5030047
AutoCAD FILE Leviathan Genloc 4 02
SCALE NA
FIGURE No- 11

ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

GENERAL SITE LOCATION MAP

- **Streamlined Risk Evaluation**: Atlantic Richfield will submit a streamlined risk evaluation for the Site upstream of the East Fork Carson River, intermediate in scope between the limited risk evaluation undertaken for emergency removal actions and the conventional baseline assessment normally conducted for remedial action. Site sampling data for various media will be reviewed to identify contaminants of concern (COCs), and provide an estimate of how, and to what extent, people or ecological receptors may be exposed to these COCs. The risk evaluation may also be utilized as a tool to define appropriate interim treatment levels.

- **QA/QC Plan, Sampling and Analysis Plan**: The Phase I Work Plan will include a Site-wide Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for EPA approval. The Site-wide SAP and QAPP will set forth the minimum requirements that must be followed in the project-specific (Work Plan-specific) QAPPs and SAPs included within future work plans being prepared by Atlantic Richfield, the Lahontan Regional Water Quality Control Board (RWQCB), and any other parties collecting data at the Site. Site investigations specified in the SAPs and QAPPs of future work plans (including ERA Work Plans, the Long-term Response RI/FS Work Plan, and RWQCB Work Plans) must be consistent with the Site-wide SAP and QAPP. The Site-wide SAP and QAPP will ensure that future data collected at the Site are of sufficient technical quality to support the Human Health and Ecological Risk Assessments and/or the development and evaluation of the response action during the Feasibility Study.

The Phase 1 Work Plan also includes a schedule for work performed under the Phase 1 RI/FS. As specified in the SOW, work performed under this plan will be incorporated into the final Long-term Response RI/FS following implementation and assessment of the ERAs.

1.3 PHASE 1 WORK PLAN ORGANIZATION

The purpose of the Phase 1 Work Plan is to outline tasks to be completed during the Phase 1 RI/FS, as specified in the SOW. The Phase 1 Work Plan is structured in accordance with guidelines included in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988), as specified in the SMP. It is organized into eight sections, as follows.

- **Section 1.0 - Introduction:** Section 1.0 presents a general introduction to the Phase 1 RI/FS, describes the scope-of-work, and outlines the remaining Phase 1 Work Plan sections.

- **Section 2.0 – Site Background and Setting:** This section provides an overview of the Site history and describes general Site characteristics.

- **Section 3.0 – Initial Evaluation:** Section 3.0 summarizes available data and previous analyses. This section also provides an overview of contaminant sources and evaluates water quality during spring and fall flow scenarios. A CSM schematic is presented.

- **Section 4.0 – Work Plan Rationale:** Section 4.0 describes the general development of Data Quality Objectives (DQOs) for the Site and presents the work plan approach.

- **Section 5.0 – Phase 1 RI/FS Tasks:** This section briefly outlines the phased approach being conducted at the Site, entailing both ERAs and long-term RI/FS responses. Tasks to be implemented under the Phase 1 Work Plan are described in detail.

- **Section 6.0 – Schedule:** Section 6.0 presents a schedule for work to be performed under the Phase 1 RI/FS.

- **Section 7.0 – Project Management:** This section describes general staffing and coordination of Site activities associated the Phase 1 RI/FS.

- **Section 8.0 – References:** Section 8.0 presents a list of references cited within the Phase 1 Work Plan.

Supporting documentation is contained within the appendices. In addition, the Site-wide SAP, which includes the Site-wide QAPP, is included as Attachment 1, *Leviathan Mine Site Site-wide Sampling and Analysis Plan.*

2.0 SITE BACKGROUND AND SETTING

2.1 GENERAL

Section 2.0 provides a brief history of, and introduction to, the Leviathan Mine Site including general history and Site characteristics. Further detail pertaining to the initial evaluation of Site data is presented in Section 3.0, Initial Evaluation.

2.2 BACKGROUND

2.2.1 General Site History

The Leviathan Mine Site is located in a remote mountain area on the eastern slope of the Sierra Nevada range in Alpine County, California at an elevation of 7,000 feet. The Site is located about 25 miles southeast of Lake Tahoe, six miles east of Markleeville, and three miles west of the California-Nevada border. The Site is accessed by a single unpaved road (USFS Road 52) that connects Highway 395 in Nevada with Highway 89 in California. Figure 1-1 shows the approximate location of the Site. Figure 2-1, *Site Layout*, presents the location of Site features.

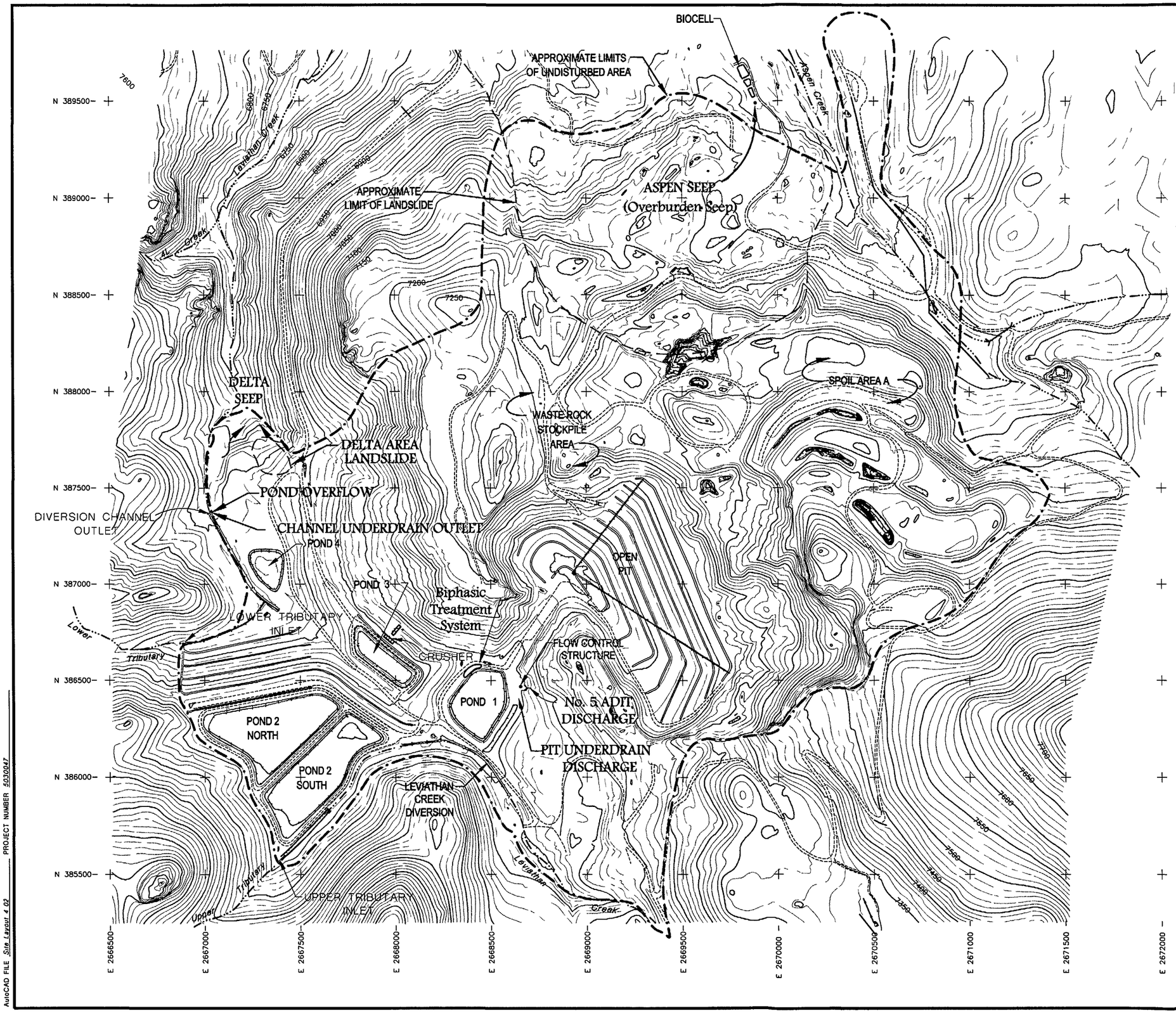
Mining began at the Site in 1863 and continued on a sporadic basis for nearly 100 years. The Site was initially developed as a source of copper sulfate, copper, and gold in the 1860s. Copper sulfate was used for processing silver ore in the Comstock mining region of Nevada. Underground mining and copper production (including smelting) continued until approximately 1873 (Mining and Scientific Press, 1869 and 1870). Mining operations ceased due to the high sulfur and low copper content of the ore. During this period, two tunnels connected by a 200-foot vertical shaft were opened. The lengths of these tunnels were reported to range from 250 to 400 feet long for one and 400 to 700 feet long for the other (Skelly and Loy, 1979).

After 1873, there was sporadic mining activity at the Site until 1933, when a private party acquired the mine and started to develop it for sulfur production. Between 1933 and 1951, several companies reportedly explored and mined the Site for sulfur, developing a sulfur mill (California Journal of Mines and Geology, 1939) and an extensive system of tunnels, drifts, and rises. Tunnel No. 3, the mine's main adit, was extended to 3,000 feet in length with several rises and slopes. One published report describes Leviathan Mine during this period as "one of the largest sulfur producers in the West."

In 1951, the Anaconda Copper Mining Company acquired an interest in the mine and, in 1954 began open pit mining to extract sulfur ore. Mining was accomplished by drilling and blasting to remove the overburden rock and reach the sulfur ore below. The recovered sulfur was loaded onto trucks using power shovels and subsequently used in the extraction of copper at Anaconda's Yerington, Nevada mine.

Approximately 22 million tons of overburden and waste rock were removed to access the ore (EPA, 2000b) and were placed to the north and west of the open pit. The overburden and waste rock contained small amounts of sulfur, in comparison to the average 28 percent sulfur being mined for commercial extraction. Portions of the old Tunnel No. 3 were removed during this period, and the bottom of the pit was within a few feet of portions of Tunnel No. 5 and the adjacent workings when mine operations ceased (Skelly and Loy, 1979).

In 1962, the Anaconda Company sold the mine to Chris and Zella Mann, who formed Alpine Mining Enterprises and transferred the mine to Alpine. The mine has not operated since that time. In 1984, the State of California (State) purchased the Site from Alpine Mining Enterprises and transferred jurisdiction of the Site to the State Water Resources Control Board. The State Water Resources



LEGEND

- LANDSLIDE BOUNDARY
- MINE AREA BOUNDARY
- ROADS
- STREAMS
- DIVERSION CHANNEL

N

SCALE

250' 0 250' 500'

CONTOUR INTERVAL 10FT

REV No	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued For Draft Review	4/02	J.Ray	J.Gates	J.Ray

ATLANTIC RICHFIELD COMPANY

PROJECT
Leviathan Mine Site Phase 1 RI/FS Work Plan

DRAWING TITLE
SITE LAYOUT

MWH
MONTGOMERY WATSON HARZA

Sheet 1 Of 1 Sheets

SCALE: See Scale Bar

DRAWING No: 2.1

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Control Board delegated authority to the RWQCB to implement and oversee cleanup work at the Site.

2.2.2 Site Listing

EPA added the Leviathan Mine Site to the National Priority List (NPL) on May 11, 2000 (EPA, 2000a). According to EPA, four major contaminant sources pose a potential risk to human health or the environment at the Site through releases of untreated acid rock drainage (ARD) to Leviathan and Aspen Creeks, (EPA, 2000a). These source areas include:

- Adit and pit underdrain discharges, currently contained in evaporation ponds on the Site;
- Channel underdrain;
- Delta Seep; and
- Aspen Seep.

Descriptions of these sources are presented in Section 3.2. Based upon available data, these four generalized sources contribute the majority of contaminant loading to surface water at the Site. Interception and treatment of these releases through ERAs is expected to improve surface water quality. In addition, removing known sources of contamination will facilitate evaluation of other sources, if any, during the RI/FS. EPA will determine the scope of subsequent phases of the RI/FS following implementation of ERAs and assessment of monitoring data (EPA, 2000a).

2.2.3 Previous Corrective Actions

Over the history of the Site, different parties have taken various actions to control the release of ARD into Leviathan and Aspen Creeks. A list of these actions is included below.

- Anaconda constructed retention ponds and a diversion channel for Leviathan Creek around the waste piles (Brown & Caldwell, 1983).

- Alpine Mining Enterprises constructed a dam above the mine on Leviathan Creek, diverted the creek through the Site, and diverted adit drainage away from the creek (Brown & Caldwell, 1983).

- Mr. Brooks Park, a local Nevada rancher, attempted to reroute drainage from the pit and adit to prevent flow into Leviathan Creek (Brown & Caldwell, 1983).

- The RWQCB acquired funding for a Feasibility Study (FS) and pollution abatement project, as described further below.

Between 1983 and 1985, the State of California implemented a pollution abatement project at the Site, which included the following components:

- Channelization of Leviathan Creek through the Site;
- Construction of five lined evaporation ponds;
- Regrading, compacting, and improvement of drainage of the open pit;
- Diversion of drainage from a Site adit into the evaporation ponds; and
- Regrading of the overburden piles to the north of the pit (Brown and Caldwell, 1983).

The effectiveness of these actions has been affected by other potential sources of ARD at the Site. Also, during periods of high flow, the evaporation ponds have overflowed into Leviathan Creek (Taxer et al, 1991). Pond overflow no longer occurs, as described below.

Since the implementation of the pollution abatement project described above, the RWQCB has operated and maintained the project and conducted revegetation work. In addition, several projects have been undertaken in an attempt to improve the quality of Leviathan and Aspen Creeks, including:

- Use of a bioreactor to treat the flow from the Aspen Seep by the University of Nevada, Reno (UNR) (conducted by UNR under contract to RWQCB and Atlantic Richfield, 1999-present);
- Inline treatment of a portion of the flow from the channel underdrain (CUD);
- Treatment of water in the evaporation ponds using lime neutralization to reduce the overflow during the peak flow season (conducted by EPA in 1997);
- Enhanced evaporation of the pond water (conducted by ARCO Environmental Remediation, LLC [AERL] in 1998);
- Bi-phasic treatment of water in the evaporation ponds during the summer months, through a two-stepped, lime treatment process to neutralize and remove dissolved metals from the pond water and prevent pond overflow (conducted by RWQCB, 1999-present);
- Revegetation of the Site pursuant to the *Leviathan Mine 5-Year Work Plan* (RWQCB, 1995) conducted by the RWQCB (1995-present). These efforts are intended to reduce erosion of the waste and spoil piles, and reduce the quantity of water infiltrating through these piles; and
- Implementation of ERAs by AERL in 2001, including construction and operation of a lime treatment lagoon to treat flow from the CUD, as discussed further in Section 2.2.4.

In addition, the RWQCB has been conducting water quality sampling since approximately 1985. Water samples are tested for pH, heavy metals, major ions, turbidity, and total dissolved solids. The United States Geological Survey (USGS) has been conducting continuous surface water flow measurements since October 1998. In 1998 and 1999, Atlantic Richfield conducted site characterization activities, including surface water and groundwater monitoring; a controlled survey of the Site including placement of monuments in the landslide area; a geotechnical investigation; and a geochemical investigation (SRK, 1999).

Atlantic Richfield and the RWQCB are continuing corrective actions at the Site, as directed by EPA. Currently, equipment remains on Site to continue to conduct bi-phasic treatment of adit water in the evaporation ponds and lime treatment of the CUD during the summer months. Additionally, the bioreactor at the Aspen Seep continues to treat Aspen Seep water year-round.

2.2.4 2001 Early Response Actions and Other Site Activities

ERAs completed during the 2001 field season include lime lagoon treatment of the CUD and continued bioreactor treatment of the Aspen Seep (by UNR). In addition, the RWQCB continued bi-phasic treatment of pond water from the adit.

CUD Lime Lagoon Treatment System

A treatability study of the CUD flow was performed by Atlantic Richfield in the summer of 2001. The study was conducted in accordance with the *Early Response Action Work Plan* (MW, 2001) submitted to the EPA in June 2001.

The primary purpose of the ERA was to achieve short-term water quality improvement in Leviathan Creek. Another purpose was to demonstrate the effectiveness of continuous lime treatment of ARD

from the CUD source, using an applied technology that could be expanded to other sources and extended to year-round operations. Treatment system operational parameters were evaluated including lime dosage rate, lime application method, water movement through the system, solids movement through the system, solids composition and density, effectiveness of oxidation, power requirements, system operation/maintenance requirements, and solids management procedures. In addition, chemical and physical properties of solids produced during the test were analyzed to provide data regarding management of solids generated by CUD treatment.

For the CUD treatability study, raw CUD water was collected in a temporary storage tank, then pumped to reaction tanks where it was mixed with lime using an inline lime slurry supply system, and aerated using an ambient air supply and diffusers. From the reaction/aeration tanks, the water was gravity-fed to filter bags for solids filtration, prior to the entering Pond #4. Any generated solids remaining in the water after passing through the filter bag were settled out in Pond #4. This particle settling was facilitated by the routing of the treated water through three cells, defined by the placement of silt screens in the lined pond. Treated effluent was then returned to Leviathan Creek through the existing pond overflow/discharge structure.

Aspen Seep Bioreactor

UNR continued to operate the bioreactor at the Aspen Seep during 2001. UNR installed solar panels to drive the peristaltic pumps, which fed sodium hydroxide solution to the reactors, and continued to analyze the sludge to determine appropriate sludge management. UNR treated the entire seep during this period. Treatment resulted in elevating the pH to 6.0-7.4. Sulfate concentrations were decreased to 300-550 milligrams per liter (mg/l) and TDS decreased to 200-400 mg/l. Metals were removed in excess of 95% following filtration. Plans for 2002 are to scale up the reactors and replace the wood chip substrate with rocks, install flushing zones at the front of the reactors, and install settling/filtration ponds to remove particulate iron sulfide and evaluate elimination of, or substitution for, sodium hydroxide addition.

Pond Water Bi-phasic Treatment

The RWQCB continued bi-phasic treatment of pond water from the adit. The RWQCB summary report further describes 2001 operations and results (RWQCB, 2002a).

2.2.5 Proposed 2002 Early Response Actions

EPA is currently reviewing the *Draft Leviathan Mine Site 2002 Early Response Action Work Plan (MWH, 2002)*. The scope of year 2002 ERAs includes continued operation and optimization of the treatment lagoon system, addition of the Delta Seep flow to the treatment lagoon system, and enhancement and operational evaluation of the Aspen Seep bioreactor. Two potential additional components of the 2002 ERAs include a winter trial for the treatment lagoon system and/or addition of the adit flow to the treatment lagoon system.

2.3 PROJECT SETTING

This section provides general information regarding the project setting, including topography, geology, landslide activity, climate, and meteorology. Further detail pertaining to the initial evaluation of Site data is presented in Section 3.0, Initial Evaluation.

2.3.1 Topography

The terrain in the Leviathan Creek basin includes rugged mountains and high meadowlands. The immediate vicinity of the Site is steep and rugged, particularly to the south and west of the mine

(Skelly & Loy, 1979). The topography of the Site has been altered by the removal of overburden and waste rock from the open pit. This overburden and waste rock was placed to the north and west of the open pit, as shown in Figure 2-1, *Site Layout.* Anaconda reported that some overburden was originally placed on the pit slopes, but over time it has eroded into its current location. The overburden piles have now altered the courses of Aspen and Leviathan Creeks. Spoil Area A was regraded and compacted during the pollution abatement project to prevent water from pooling on, or leaching through, the rock. The waste pile to the west of the pit was also regraded and compacted to support the evaporation ponds and to reduce infiltration of surface water (Taxer et al., 1991). Since the original construction of the pollution abatement project, areas of the overburden have eroded resulting in gullies. The pit itself was partially filled using spoils from the overburden piles and regraded to divert surface water into Leviathan Creek. Groundwater infiltrating through the pit was directed to the evaporation ponds (Taxer et al., 1991).

2.3.2 Geology

The California State Water Resources Control Board, Division of Technical Services conducted detailed field mapping at the Leviathan Mine during the summer of 1982 (CSWRCB, 1982). The geologic units mapped include volcanic, sedimentary, and shallow intrusive igneous rocks. Generally, the sedimentary rocks consist of volcanoclastic sandstone, conglomerate, siltstone, and lahar. The volcanics and shallow intrusives are principally andesites, with some basalt. These flows and intrusions are complexly interbedded and intrude the sedimentary units. Because of the geologic history and due to the variable, but intense amount of alteration (which makes positive rock identification difficult) correlation between rock units over long distances was not generally feasible. This difficulty of determining the stratigraphic sequence at the mine and correlating data from one drill hole to another was also noted in work conducted by Wilson and Wells (1951).

Natural mineralization within the volcanic rock contributes to the background metal and sulfate loads in local water bodies. According to Wilson and Wells (1951), andesite and tuff have served as the host rocks for the deposition of elemental sulfur, although the two rock types respond differently to mineralization and accompanying alteration, thereby producing distinctive ore types. The principal ore body at Leviathan is a flat, northwest trending elliptical lens approximately 90 feet in maximum thickness and 2,400 feet in maximum length (Clark, 1977). Pyrite and marcasite occur throughout the ore body and also along the upper and lower contacts of the mineralized zone (Brown & Caldwell, 1983). Additionally, several secondary sulfate minerals occur within the host rock.

Local faults tend to strike northerly to northwesterly in conformance with regional structural fractures on the east flank of the Sierra Nevada and have variable dips to the east or west. Much of the faulting at the mine appears to predate the mineralization, and thus, controls the distribution of ore to some degree. The amount of displacement on most of these faults and their relative degree of activity are not known (Brown & Caldwell, 1983).

According to Brown & Caldwell (1983), four earthquakes of Richter magnitude 4.0 to 4.9 have occurred with epicenters within five miles of the mine between 1900 and 1974. During this same period, earthquakes of magnitude 5.0 to 5.9 occurred at distances between 11 and 17 miles. In the mid-1990s, an earthquake of approximate Richter magnitude 6.5 occurred (RWQCB, 2002b).

2.3.3 Landslide Activity

A landslide exists to the north of the pit, as shown in Figure 2-1. This historic landslide existed prior to mining activities on the property (Brown & Caldwell, 1983).

Mining activities removed a portion of the headwall scarp (by excavation of the open pit) and added weight to some of the remaining portion of the landslide (by placing fill on Spoil Area A) and the

failure continues to move northerly down slope. Brown & Caldwell (1983) presented three reasons for the continued movement of this landslide:

- The geologic structure of the area provides a weak layer that serves as the failure plane;
- Water infiltration from precipitation and Aspen Creek provide lubrication to the failure plane; and
- Debris at the toe of the slide is eroded away by Leviathan Creek.

Another, smaller landslide exists immediately south of the Delta Seep as shown in Figure 2-1. This failure is significantly smaller than the historic landslide, but could form a new source of contamination to Leviathan Creek should it contact the creek. The soils along this failure appear to be saturated. The RWQCB is currently conducting a geotechnical evaluation for this area and a draft report is anticipated in second quarter 2002.

2.3.4 Climate

The mean annual temperature at Markleeville (about 2,000 feet lower in elevation than the mine) is approximately 50 degrees F. The average growing season for the area is about 100 days. Large-scale airflow is from the southwest, with a secondary flow from the northwest in winter. Wind speeds increase with elevation. Dispersion of air is generally good in the project area due to active wind flow and high elevation (Brown & Caldwell, 1983).

Precipitation in the area around Leviathan Mine varies with elevation and distance from the crest of the Sierra Nevada. Annual precipitation on the eastern slope of the Sierra Nevada is less than that on the western slope and is less dependent on elevation. There is little precipitation data for the Leviathan Mine Site, and therefore, annual precipitation information was estimated at approximately 15 inches per year using local weather monitoring stations (Brown & Caldwell, 1983). SNOTEL data from Monitor Pass (refer to Figure 1.1) indicate that the precipitation for water year 2000 was 16.5 inches. This station is located approximately 2.5 miles southeast of the Site. Most of the precipitation is in the form of winter snowfalls, which typically result in the Site being inaccessible to vehicles between December and April. The RWQCB has recently installed a weather station on Site that is expected to be operational by field season 2002.

2.3.5 Land Use

Of the 656-acre Leviathan Mine property, approximately 253 acres were disturbed by the mining operations (EPA, 2000a). The disturbed area, with the exception of about 21 acres, is located on State of California land. The majority of the surrounding land is owned by the U.S. Forest Service (USFS). The Site is currently fenced to control access. Limited vegetation occurs on the Site and revegetation activities are ongoing.

3.0 INITIAL EVALUATION

3.1 GENERAL

This section includes an initial summary and evaluation of analytical data from prior and on-going investigations. In general, the focus of previous investigations and data collection activities concerning potential Site contamination has been on the impact to on-Site surface waters and groundwater, and on the subsequent transport of potential contamination off-Site via the surface water pathway. Accordingly, the focus of this initial evaluation is on surface water contamination at the Site.

Data and information presented include the following:

- Section 3.2: Previously Identified Sources of Water Contamination
- Section 3.3: Surface Water Hydrology
- Section 3.4: Surface Water Quality
- Section 3.5: Groundwater
- Section 3.6: Soils
- Section 3.7: Conceptual Site Model

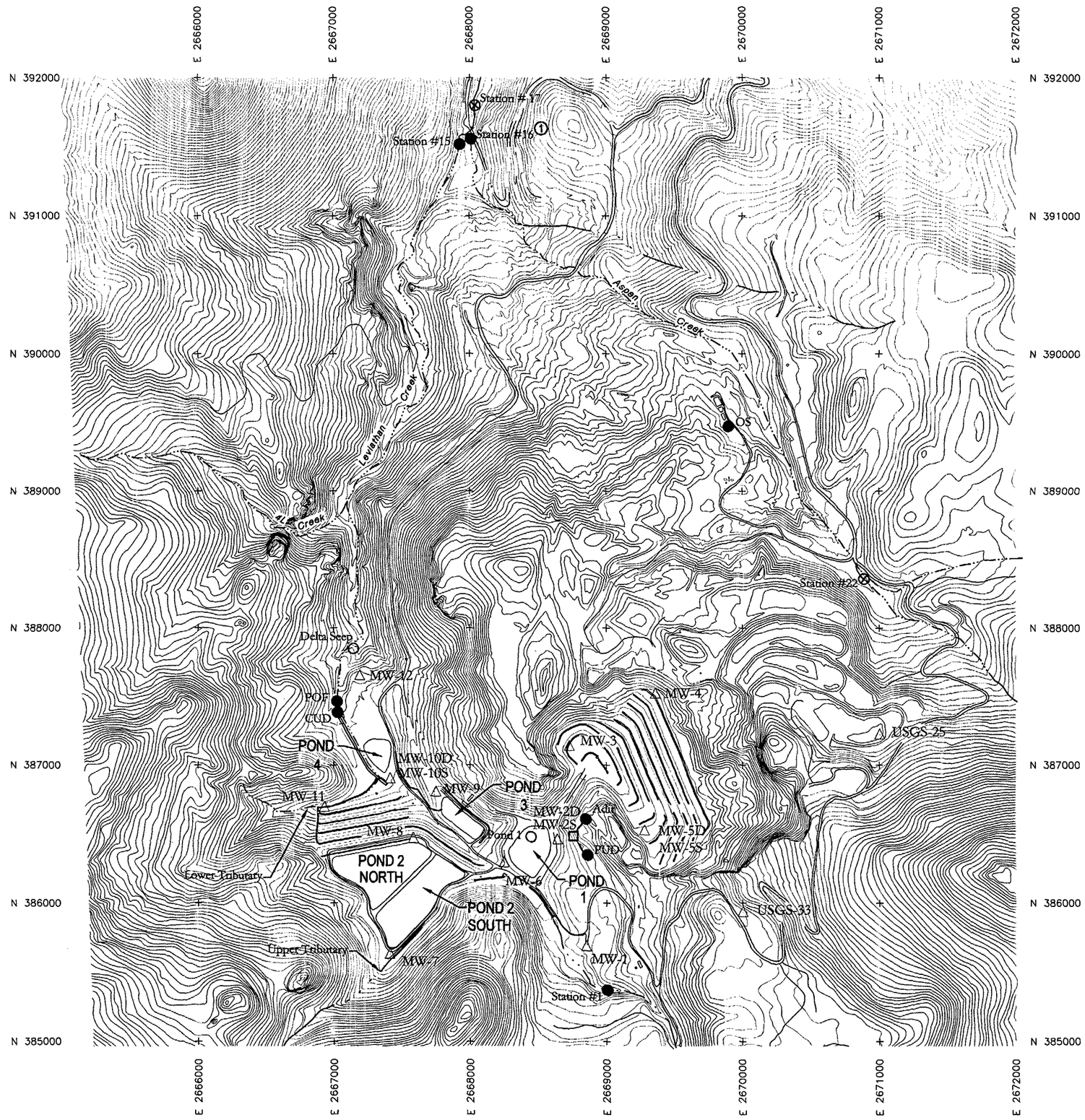
3.2 PREVIOUSLY IDENTIFIED SOURCES OF WATER CONTAMINATION

Based on prior investigations and analyses, and as outlined in the Administrative Order, there are four, identified sources of untreated ARD discharging into Leviathan and Aspen Creeks. The locations of these sources are shown in Figure 3-1, *Leviathan Site Water Monitoring Locations,* and are described below:

- CUD: The CUD was installed during the RWQCB pollution abatement project to collect water from seeps that emerged below the Leviathan channel diversion. CUD flow rates typically range from 15 to 30 gallons per minute (gpm) (RWQCB, 1995; EPA, 2000a). While the water from the CUD is not as acidic or as heavily contaminated with metals as the water from the adit or the pit underdrain, during periods of low flow it represents a primary source of contamination into Leviathan Creek.

- Pond Overflow (POF): Four retention/evaporation ponds are designed to contain acidic water collected from the Site (particularly the adit and pit underdrain flow) and to promote evaporation. Historically, during periods of high flow (primarily during the spring snowmelt), the evaporation ponds have periodically reached their maximum capacity and overflowed into Leviathan Creek. According to the RWQCB (1995), during these overflow events, overflow volumes have been on the order of 2.6 to 3.0 million gallons per year and have released evapo-concentrated acidic water into Leviathan Creek. High flow in Leviathan Creek during these periods, however, helped to dilute this discharge (RWQCB, 1995). Since 1997, the EPA and the RWQCB, and since 1998, AERL, have tried various active treatment systems during the summer and fall months in an effort to reduce or eliminate the pond overflow in the spring. No flow has been recorded from the pond overflow since October 2000, with only negligible flow since September 1999.

- Delta Seep: The Delta Seep is located at the lowest portion of the mine waste rock by Leviathan Creek. This seep flows at approximately 10 gpm into Leviathan Creek (EPA, 2000a) and contains sulfate concentrations approximately two times those observed in the creek above the mine. (Flow estimates from Delta Seep are variable; an instantaneous flow measurement of approximately 40 gpm has been reported [Tetra Tech, 2002].)



LEGEND

MW-2S
△ GROUNDWATER MONITORING STATION

● CURRENT SURFACE WATER QUALITY STATION WITH U.S.G.S. FLOW DATA ①

⊗ CURRENT SURFACE WATER QUALITY STATION WITHOUT FLOW DATA

○ OTHER SURFACE WATER STATION WITH PERIODIC FLOW AND/ OR WATER QUALITY DATA

□ FLOW CONTROL STRUCTURE

NOTE:

① CONTINUOUS FLOW DATA ARE AVAILABLE FOR ALL USGS STATIONS, EXCEPT STATIONS 16 AND 24 WHERE FLOW IS MEASURED MONTHLY (SEE TABLE 3.4)

② REFER TO FIGURE 3.2 FOR WATERSHED MONITORING LOCATIONS.

N

SCALE
500' 0 500' 1000'
CONTOUR INTERVAL 10 ft.

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued For Draft Review	4/02	JRay	JGates	JRay

ATLANTIC RICHFIELD COMPANY

PROJECT:
Leviathan Mine Site - Phase 1 RI/FS Work Plan

DRAWING TITLE:
LEVIATHAN SITE WATER MONITORING LOCATIONS

MWH
MONTGOMERY WATSON HARZA

Sheet 1 Of 1 Sheets
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- Aspen Seep: The Aspen Seep (designated as OS on Figure 3-1) flows into Aspen Creek from the spoils located north of the open pit at a rate of approximately 10 gpm (EPA, 2000a). Currently, a portion to all of the drainage from the seep is treated with an experimental bioreactor treatment system operated by UNR.

These known sources of ARD are the focus of the CSM, described herein, as well as the ERAs currently being conducted at the Site.

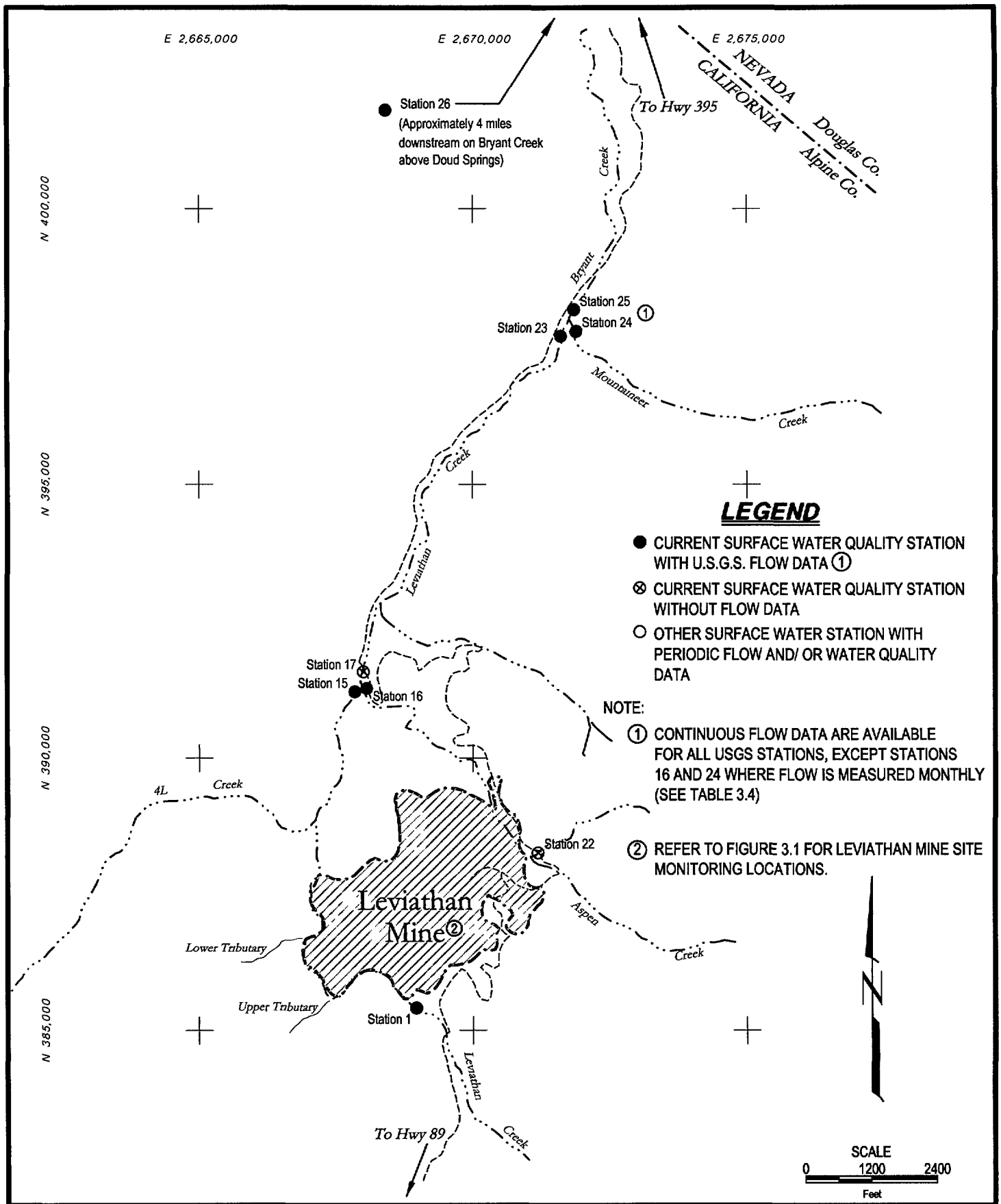
3.3 SURFACE WATER HYDROLOGY

Surface water from the Leviathan Mine Site drains west to Leviathan Creek and east to Aspen Creek (Figure 3-1, *Leviathan Site Water Monitoring Locations*). The confluence of these creeks is located less than ½ mile north of the Site, just north of the landslide on the mine property (Brown & Caldwell, 1983). From its headwaters, Leviathan Creek flows northward for approximately two miles before crossing through the Site along the western boundary. Aspen Creek, a key tributary of Leviathan Creek within the study area, flows northwesterly from its headwaters and along the eastern boundary of the mine property, for a distance of approximately 0.75-miles to its confluence with Leviathan Creek. Leviathan Creek joins Mountaineer Creek approximately 2½ miles downstream to form Bryant Creek (31.5 square mile watershed), which then flows four miles downstream to the California-Nevada border and another 3½ miles to its confluence with the East Fork Carson River (Figure 3-2, *Leviathan Watershed Water Monitoring Locations*).

As shown on Figure 3-1, several unnamed creeks and streams drain the project area. Only one of the unnamed tributaries to Leviathan Creek within the study area flows perennially and is commonly known as 4L Creek. This creek flows eastward into Leviathan Creek below the Delta Seep and above the confluence with Aspen Creek. The major sources of flow to Bryant Creek are shown schematically in Figure 3-3, *Surface Water Flow Schematic.*

The 10.5 square mile Leviathan Creek watershed ranges in elevation from 6,400 feet at the confluence of the Leviathan and Mountaineer Creeks to 8,963 feet at Leviathan Peak. This elevation range, in conjunction with the Site's location on the eastern slope of the Sierra Nevada Mountains, results in a wide variation of climatic conditions over the watershed area (Brown & Caldwell, 1983). Seasonal flow patterns of the creeks and streams in the project area are typical of Sierra streams with low flows in the summer and fall and high flows during the spring runoff and more intense winter storm events (Brown & Caldwell, 1983).

Flow data have been collected at the Site sporadically since 1989. In 1998, the USGS initiated 15-minute flow data collection at selected stations. The availability of flow data at frequently monitored stations, historically, is summarized in Figure 3-3 and Table 3.1, *Summary of Flow Data at Frequently Monitored Stations*, with brief location descriptions of these surface water monitoring locations. Selected locations within the Site boundaries (i.e. those representative of major components of the water balance and/or those with 15-minute flow data collection) are highlighted in Table 3.1, and are shown in Figures 3-1 and 3-2. These selected locations have been used for the surface water hydrologic analyses discussed in this section.



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0	Issued For Review Draft	4/02	J.Ray	J Gates	J Ray

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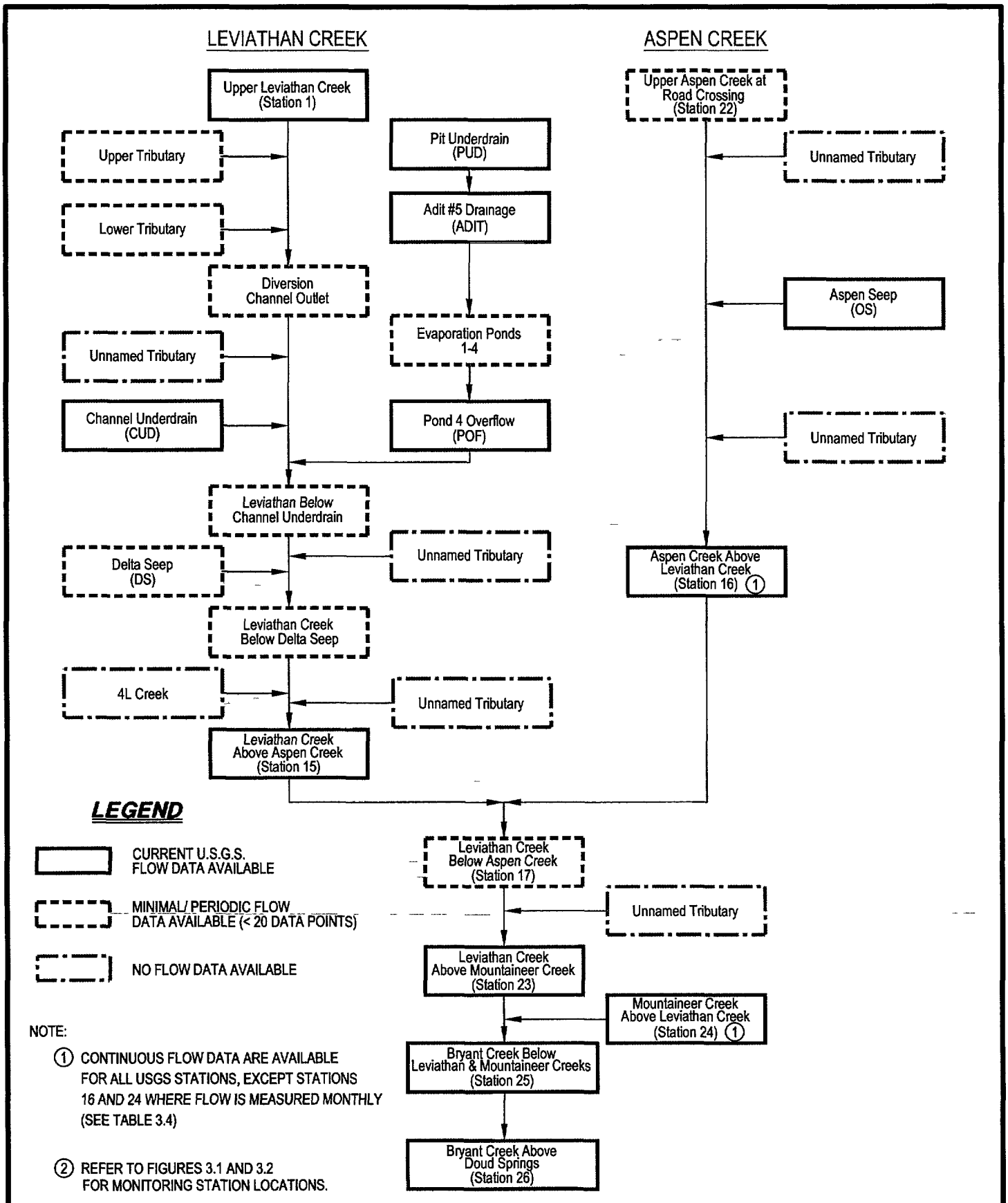
ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

LEVIATHAN WATERSHED WATER MONITORING LOCATIONS



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Leviathan Mine Site - Phase 1 RI/FS Work Plan

SURFACE WATER FLOW SCHEMATIC

TABLE 3.1
SUMMARY OF FLOW DATA AT FREQUENTLY MONITORED STATIONS

Station [3]	Location	Start	End	Frequency
Leviathan Creek Upper Drainage				
Station 1	**Upper Leviathan Creek above the mine Site**	**October-98**	**Present**	**15-minute [1]**
		September-90	September-01	periodic [2]
Upper Tributary	Located to North of Pond 2 upstream of confluence with Leviathan Creek Diversion	September 98	November-98	periodic
Lower Tributary	Located to North of Pond 2 upstream of confluence with Leviathan Creek Diversion	October-98	November-98	periodic
Channel Underdrain (CUD)	**Seepage from under Leviathan Channel, mixes with unimpacted flows above POF**	**October-99**	**Present**	**15-minute**
		September-89	November-99	periodic
Adit	**Flow from mine adit, currently flows into evaporation ponds**	**October-99**	**Present**	**15-minute**
		April-94	September-00	periodic
Station 2	Historically – Flow from adit; Currently – combined flow from adit and PUD	December-89	October-98	periodic
Pit Underdrain (PUD)	**Subsurface flows from open pit, currently flows into evaporation ponds**	**October-99**	**Present**	**15-minute**
		February-95	February-00	periodic
Pond 1	Upper pond southwest of pit	October-99	Present	15-minute
		February-00	September-00	periodic
Pond Overflow (POF)	**Overflow from evaporation ponds as measured from Pond 4**	**October-98**	**Present**	**15-minute**
		April-91	September-99	periodic
Delta Seep (DS)	ARD seep located at base of the delta spoils flows into Leviathan Creek	September-98	October-00	periodic
Station 8	Leviathan Creek at north end of delta (USGS pre-1985)	August-91	October-95	periodic
Station 15	**Leviathan Creek just upstream of Aspen Creek**	**October-98**	**Present**	**15-minute**
		February-91	March-01	periodic
Aspen Creek Drainage				
Station 22	Aspen Creek upstream of the mine Site	October-95	November-98	periodic
Overburden (Aspen) Seep (OS)	**Seep from waste rock pile, treated in UNR bioreactor.**	**October-98**	**Present**	**15-minute**
		August-95	September-99	periodic
Station 16	Aspen Creek just upstream of Leviathan Creek	October-98	Present	monthly
		May-93	March-01	periodic
Lower Leviathan and Bryant Creek Drainage				
Station 17	Leviathan Creek below confluence with Aspen Creek	April-93	April-94	periodic
Station 23	**Leviathan Creek just upstream of Mountaineer Creek**	**November-99**	**Present**	**15-minute**
		October-96	March-01	periodic
Station 24	Mountaineer Creek just upstream of Leviathan Creek	October-98	Present	monthly
		October-96	November-98	periodic
Station 25	**Bryant Creek just downstream of Mountaineer Creek**	**October-98**	**Present**	**15-minute**
		April-93	September-01	periodic
Station 26	Bryant Creek above Doud Springs Creek	August-01	present	15-minute
		April-94	June-98	periodic

Notes:
1. Source is USGS 15-minute flow data
2. Periodic flow data obtained from one or more of the following sources: Regional Water Quality Control Board (RWQCB). USGS periodic data, USGS flow calibrations, and SRK Consultants
3. Highlighted data have been used for the flow contribution analyses.

Site-wide surface water flow data are currently being assessed, under this Phase 1 Work Plan, for quality, usability, and completeness. Data are being compiled into a central database, as discussed further in Section 5.2. Based on a review of the current database and a preliminary data assessment, several data gaps have been identified resulting from either the sporadic nature of historic flow data collection or the fact that some data were not available in the database at the time of this evaluation. These data gaps can complicate associated data analyses and potentially limit the ability to draw specific conclusions regarding the CSM. The database will continue to be updated with historic and current data throughout the Phase 1 RI/FS, as described in Section 5.2. As the database continues to be updated and data are further evaluated, the CSM will be reviewed and refined. Data gaps will be identified, and supplemental data collection will be recommended for inclusion in the Long-term Response RI/FS Work Plan, as appropriate, as discussed further in Section 5.3.

As presented in Figure 3-3, the primary components of the surface water flow balance for upper Leviathan Creek are listed below.

- Upper Leviathan Creek (Station 1)– (USGS Station 10308783, 15 minute flow data)
- Upper Tributary (limited flow data)
- Lower Tributary (limited flow data)
- CUD (USGS Station 103087885, 15 minute flow data)
- POF (USGS Station 103087887, no flow recorded from this station September 22, 2000 to present)
- Delta Seep (limited flow data)
- 4L Creek (no flow data)
- Various unnamed tributaries (no flow data)

These flow components contribute to flow at Leviathan Creek above Aspen Creek (Station 15) (USGS Station 10308789, 15 minute flow data).

The primary components of the surface water flow balance for Aspen Creek are listed below.

- Upper Aspen Creek at the road crossing (Station 22) (limited flow data);
- An unnamed Tributary (no flow data); and
- Aspen Seep (OS) (USGS Station 103087892, 15 minute flow data).

These flows contribute to flow at Aspen Creek above Leviathan Creek (Station 16) (USGS Station 103087898, monthly flow data). Flow recorded at the Aspen Seep is measured as the seep emerges from the waste rock pile. The seep water is then treated in a bioreactor and discharged to the ground surface near Aspen Creek.

Below the confluence of Leviathan Creek with Aspen Creek, the following components contribute surface water flow to Bryant Creek.

- Leviathan Creek above Bryant Creek (Station 23) (USGS 10308792, 15 minute flow data);
- An unnamed Tributary (no flow data); and
- Mountaineer Creek (Station 24) (USGS monthly flow data).

These flows contribute to flow at Bryant Creek above the confluence of Leviathan and Mountaineer Creeks (Station 25) (USGS Station 10308794, 15 minute flow data).

3.3.1 Upper Leviathan Creek

Surface water flow data were analyzed at selected stations in Upper Leviathan Creek to develop a preliminary analysis of seasonal flow patterns at the Site. This analysis was conducted using stations with more than one year of available USGS 15-minute flow data (period of record, 1998 to present).

Figure 3-4, *Average Daily Flow Hydrograph*, presents the average daily discharge volumes in Leviathan Creek at Station 1 (upstream of the Site) and Station 15 (downstream of the Site). Data for the water year beginning in September 2000 and continuing through September 2001 are provisional USGS data. This chart indicates that peak daily flows occurred in the spring when flow volumes reached over 15 cubic feet per second (cfs) and 17 cfs at Stations 1 and 15, respectively. The high winter flows, depicted in Figure 3-4, were not included in the evaluation due to the likelihood that ice build-up may have affected gage readings at this time. Relatively low flows occurred throughout the summer and fall, with minimum discharge rates of approximately 0.03 and 0.11 cfs at Stations 1 and 15, respectively.

Average monthly flow values were calculated using the published USGS data for Stations 1 and 15, the CUD, and the POF using the data referenced above. The period of record used to calculate these average flows is noted for each station. The results of this analysis are presented in Table 3.2, *Mean Monthly Flow Summary for Upper Leviathan Creek.*

TABLE 3.2
MEAN MONTHLY FLOW SUMMARY FOR UPPER LEVIATHAN CREEK
(Period of record as shown at each station)

Station	Month	Mean Monthly Flow[1] (cfs)	Relative Percentage of Flow at Station 15
Station 1	January	0.220	58.9%
(10/98 – 09/00)[2]	February	0.233	30.5%
	March	0.604	41.7%
	April	1.826	49.6%
	May	3.228	62.8%
	June	0.474	37.9%
	July	0.128	32.9%
	August	0.073	25.9%
	September	0.085	27.4%
	October	0.127	37.7%
	November	0.155	56.1%
	December	0.200	68.2%
Channel Underdrain	January	0.062	16.7%
(11/99 – 09/00) [2]	February	0.075	9.9%
	March	0.074	5.1%
	April	0.081	2.2%
	May	0.080	1.6%
	June	0.078	6.2%
	July	0.067	17.2%
	August	0.055	19.5%
	September	0.034	11.0%
	October	0.040	11.9%
	November	0.062	22.5%
	December	0.060	20.5%

TABLE 3.2
MEAN MONTHLY FLOW SUMMARY FOR UPPER LEVIATHAN CREEK
(Period of record as shown at each station)

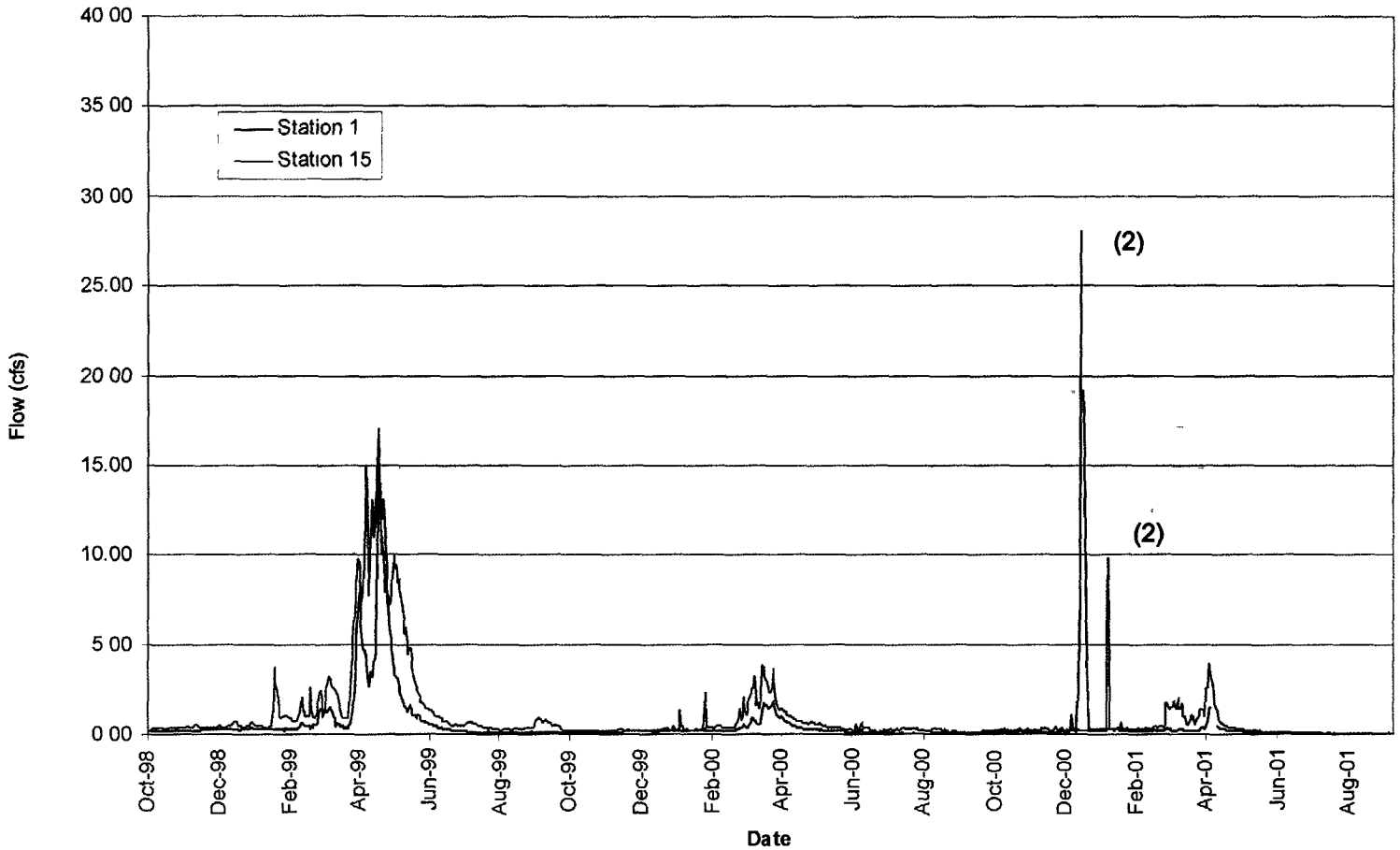
Station	Month	Mean Monthly Flow[1] (cfs)	Relative Percentage of Flow at Station 15
Pond Overflow	January	0.023	6.1%
(10/98 – 09/00)[2]	February	0.064	8.4%
	March	0.044	3.0%
	April	0.066	1.8%
	May	0.025	0.5%
	June	0.007	0.5%
	July	0.000	0.0%
	August	0.000	0.0%
	September	0.000	0.0%
	October	0.000	0.0%
	November	0.000	0.0%
	December	0.000	0.0%
Station 15	January	0.374	100%
(10/98 – 9/00)[2]	February	0.763	100%
	March	1.451	100%
	April	3.678	100%
	May	5.140	100%
	June	1.251	100%
	July	0.388	100%
	August	0.283	100%
	September	0.310	100%
	October	0.338	100%
	November	0.276	100%
	December	0.293	100%

Notes: [1] Source of data is published USGS daily average flow data
[2] Indicates period of record

Based on the average monthly flow data presented in Table 3.2, some observations may be made concerning the seasonal variability of the sources of flow within the Upper Leviathan Creek drainage. In general, higher average flows in this area occurred during the spring months (April and May), while low average flows occurred in the fall (August, September, and October). This general seasonal pattern is present at the upstream Leviathan Creek station (Station 1). At this station, over the period of record, the mean monthly high flow of 3.228 cfs occurred in May, and the mean monthly low flow of 0.073 cfs occurred in August.

A series of evaporation ponds have been constructed at the Site, as discussed in Section 2.0, for storage and treatment of impacted water from the adit and PUD. Following initial construction, and prior to active pond water treatment, these ponds were subject to overflow when inputs exceeded storage capacity. This intermittent, overflow of pond water has been monitored at the POF station. As such, the POF does not necessarily directly correspond to high and low flow periods in the drainage system. However, prior to active pond water treatment and discharge (within the period of record beginning in October 1998), the average flow at the POF station peaked at 0.066 cfs (30 gpm) in April (high flow period) and was negligible in July through December, due to containment in the ponds. In general, the flow data indicate that the POF had an appreciable discharge overlapping the relatively high flow period between January and June, and negligible discharge at low flow periods during the rest of the year. A bi-phasic treatment system for pond water has been in operation during the summer months since 1999, which has essentially eliminated pond overflow, replacing it with controlled discharge of treated water during the summer and fall.

AVERAGE DAILY FLOW AT STATIONS 1 AND 15 (1)
OCTOBER 1998 - SEPTEMBER 2001



NOTES:
1. Data after September 2000 are provisional.
2. Provisional data contains peaks that may be the result of ice dams.

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0	Issued For Review Draft	4/02	J Ray	J Gates	J Ray

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AutoCAD FILE average daily flow 4 02
SCALE N/A
FIGURE No 3.4

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AVERAGE DAILY FLOW HYDROGRAPH

Seasonal flow at the CUD station (CUD) and at the downstream, Leviathan Creek station (Station 15), appears to follow the seasonal flow pattern present in the drainage area. At the CUD station, the mean monthly peak flow of 0.081 cfs occurred in April (spring), and decreased to 0.034 cfs during low flow in September (fall). At Station 15, the highest, mean monthly flow rate occurred during May (5.140 cfs), and the lowest, mean monthly flow rates occurred in August through December (0.276 – 0.338 cfs).

Currently, there are no USGS 15-minute flow data for Delta Seep. However, based on periodic data collected between September 1998 and October 2000, the flow rate from the Delta Seep ranges from 0.019 to 0.026 cfs, and does not appear to have a strong seasonal pattern.

The upstream sources of flow in this area (Station 1, CUD, POF, and DS) were analyzed with regard to their relative contributions to downstream, Leviathan Creek flow (Station 15). Figure 3-5, *Comparison of Average Monthly Flow at Stations 23 and 15*, presents pie charts depicting the relative contribution of these sources to flow at Station 15 during the high- and low-flow periods. March and August data were used for this analysis based on the best available data sets. Flow from the Delta Seep was estimated in Figure 3-5 using flow data from February and September, respectively.

The flow at Station 1 represents the greatest percentage of the flow at Station 15 throughout the year (42% in March and 26% in August). The largest contribution of flow from Station 1 coincides with the mean peak flow months in the spring. Similarly, the highest period of contribution for the POF was in February, which correlated with its mean peak flow period. (The flow data for the POF was collected prior to pond water treatment. In the future, contributions from the POF should be negligible.) Conversely, unless intercepted and treated, as was the case during the summer 2001 CUD ERA, the relative contribution of the CUD is highest during the low-flow period and decreases during peak flow. Based on the available information, the Delta Seep appears to provide a larger contribution of flow during the fall.

Nearly half of the flow at Station 15 is unaccounted for in these charts. Potential sources of the unaccounted component of flow include unmonitored tributaries entering the stream, groundwater discharge, and flow unaccounted for due to measurement accuracy limitations. Some of the major, unmonitored flow components to Station 15 (shown on Figure 3-1) include:

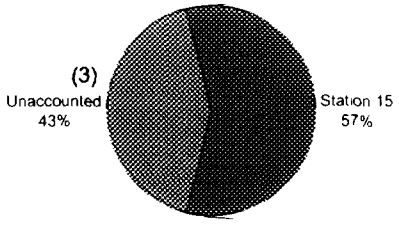
- The Upper Tributary;
- The Lower Tributary;
- 4L Creek; and
- An unnamed tributary (downstream of 4L Creek).

While these tributaries contribute to the unaccounted flow at Station 15, they emanate from off-Site, unimpacted areas and are not likely to contribute significant additional contaminant load to the creek.

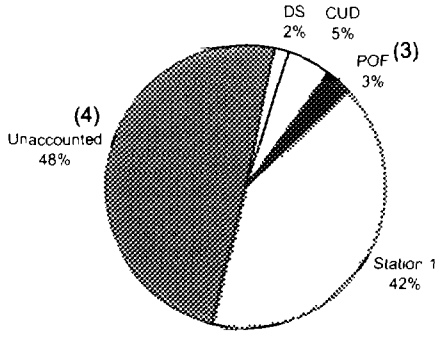
3.3.2 Aspen Creek

Of the three surface water monitoring stations within the Aspen Creek drainage, USGS 15-minute flow data are only available for the Aspen Seep (OS). Data obtained from the USGS for the upstream Aspen Creek station (Station 22) are sporadic and are insufficient to calculate monthly averages for use in comparison to other monitoring stations. Monthly flow data are available for the downstream Aspen Creek station (Station 16) from October 1998 to present; however, these data were not available at the time this analysis was performed and, therefore, flow from Aspen Creek is only considered qualitatively in this analysis. Future hydrologic analyses will incorporate quantitative data from Aspen Creek Station 16.

Leviathan Creek (1)
Average Flow in March

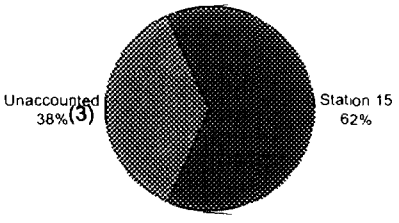


Percentage of Flow at Station 23

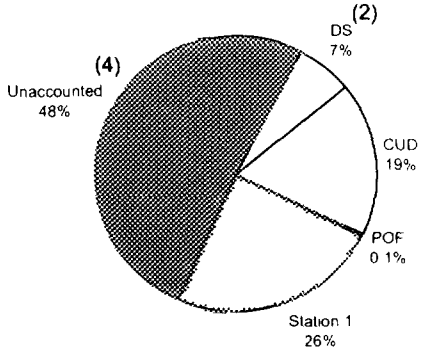


Percentage of Flow at Station 15

Leviathan Creek (1)
Average Flow in August



Percentage of Flow at Station 23



Percentage of Flow at Station 15

1. Period of Record for Station Average Flow Data is Reported on Tables 3.2 and 3.3
2. March and August Monthly Flow Data for the Delta Seep (S1) are estimated based on February and September Data Respectively
3. Flow Data at PCF Station prior to Pond Water Treatment
4. Unaccounted Flow at Station 23 includes the flow Contribution from Unmonitored Tributaries. The Primary Unmonitored Tributary is Asper Creek
5. Unaccounted Flow at Station 15 includes the flow Contribution from Unmonitored Tributaries. The Primary Unmonitored Tributary along this Reach is the 4 Creek

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AutoCAD FILE average month flow 4 02
SCALE N/A
FIGURE No 3.5

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COMPARISON OF AVERAGE MONTHLY FLOW AT STATIONS 23 AND 15

Based on the data used at the time the analysis was performed (which only included flow data from Station 15, but not from Station 16), approximately 38% of the flow at downstream Leviathan Creek Station 23, which is below the confluence of Leviathan Creek with Aspen Creek, is unaccounted for in Figure 3-5. Aspen Creek, monitored at Station 16, is the major tributary along this reach and is assumed to make up the majority of the unaccounted flow estimate. Future analyses will include data from Aspen Creek (Station 16). In addition to Aspen Creek, for which data exist (but were not included in the current evaluation), other unaccounted flow components could include an unnamed tributary and potentially groundwater discharge from unimpacted areas downgradient of the Site. These last two sources are not likely to contribute significant additional contaminant load to the creek.

Currently, the Aspen Seep is treated in a bioreactor system, which prevents untreated flow from directly entering into Aspen Creek. The contribution of Aspen Seep flow to Aspen Creek is presumed to be relatively small.

3.3.3 Lower Leviathan Creek

The calculated average, monthly flow rates for lower Leviathan Creek stations (see Figure 3-2 for locations) are shown below in Table 3.3, *Mean Monthly Flow Summary for Lower Leviathan Creek.* Note the period of record at Station 23 (lower Leviathan Creek) used in this evaluation was limited to data collected between December 1999 and September 2000. In addition, recent monthly flow data (1998 through present) from Mountaineer Creek (Station 24) were not available for this analysis. Future hydrologic analyses at the Site will incorporate these data.

TABLE 3.3
MEAN MONTHLY FLOW SUMMARY FOR LOWER LEVIATHAN CREEK
(Period of record as shown at each station)

Station	Month	Mean Monthly Flow[1] (cfs)	Relative Percentage of Flow at Station 25
Station 23	January	1.085	35.2%
(12/99 – 09/00)[2]	February	1.401	33.6%
	March	2.535	42.2%
	April	2.973	28.4%
	May	0.929	8.4%
	June	0.417	10.6%
	July	0.394	20.1%
	August	0.458	23.5%
	September	0.288	13.1%
	October	0.287	11.6%
	November	0.542	19.6%
	December	0.707	29.0%
Station 25	January	3.085	100%
(11/98 – 09/00)	February	4.163	100%
	March	6.013	100%
	April	10.455	100%
	May	11.081	100%
	June	3.920	100%
	July	1.960	100%
	August	1.953	100%
	September	2.207	100%
	October	2.468	100%
	November	2.759	100%
	December	2.437	100%

Notes: 1 Source of data is published USGS daily average flow data
2 Indicates period of record

Seasonal fluctuations in flow within lower Leviathan Creek are apparent in the data shown in Table 3.3. Station 23 is located on Leviathan Creek above the confluence with Mountaineer Creek, while Station 25 is located on Bryant Creek below this confluence (Figure 3-2). The high-flow period

occurs between March and April at Station 23, and between April and May at Station 25. The low-flow period occurs between September and October at Station 23, and between July and August at Station 25. Mean peak flow at Station 23 is 2.973 cfs (1334 gpm) in April and mean low flow is 0.287 cfs (129 gpm) in July. Mean peak flow at Station 25 is 11.80 cfs (5296 gpm) in May and mean low flow is 1.953 cfs (877 gpm) in August.

The relative contribution of the flow from Leviathan Creek (Station 23) to the flow at Bryant Creek (Station 25) is greatest during the spring (42%), and relatively lower during the fall (12 – 13%) when water quality in Leviathan Creek is most impacted.

Analysis of additional flow data at Leviathan Creek (Stations 23 and 25) with data from Mountaineer Creek (Station 24), primarily during water quality sampling, will provide further site characterization.

3.4 SURFACE WATER QUALITY

Anaconda began monitoring water quality in Leviathan Creek in 1954, concurrent with the initiation of open pit mining operations. The RWQCB published a summary of monitoring results from 1954 to 1962 in their 1975 report (RWQCB, 1975). Following the sale of the mine to Alpine in 1962, only sporadic water quality data were collected until 1982.

The RWQCB and the USGS have been monitoring surface water quality in Leviathan and Aspen Creeks since 1982. In 1982, the USGS began a hydrologic survey of the Leviathan Mine, which included monitoring surface water flow and water quality in Leviathan and Aspen Creeks. Following the USGS survey, a water quality monitoring program was initiated by the RWQCB. In 1998, the monitoring program was expanded with additional monitoring stations and the installation of continuous flow meters by the USGS. The locations of current surface water monitoring stations and water quality/flow monitoring schedules are described in Table 3.4, *Current Surface Water Quality Monitoring Stations.* Stations with USGS station identification numbers have continuous flow monitoring equipment. Station locations are shown on Figures 3-1 and 3-2.

3.4.1 General Surface Water Quality

Water samples are collected at the stations listed in Table 3.4 by the RWQCB and analyzed for total and dissolved metals (including aluminum, arsenic, copper, iron and nickel), major ions (including sulfate and calcium), and general parameters (including pH, conductivity, and total dissolved solids). Analytical surface water quality data collected from these stations during 1998 to 2001 are presented in Appendix A, *Leviathan Mine Site Surface Water Data,* for selected indicator parameters (Al, As, Fe, Ni, pH, SO_4, TDS). These indicator parameters are generally one to several orders of magnitude higher in the primary sources (i.e., adit, PUD, CUD, OS, DS) than in the background surface waters of Leviathan (Station 1) and Aspen (Station 22) Creeks (with the exception of pH, which is generally several orders of magnitude *lower* in the sources). Concentration trends of dissolved aluminum and iron at Station 15 (Leviathan Creek above Aspen Creek), Station 16 (Aspen Creek above Leviathan Creek), and Station 23 (Leviathan Creek below the confluence of Leviathan and Aspen Creeks) are presented in Figure 3-6, *Aluminum and Iron Surface Water Data (1998 – 2001).*

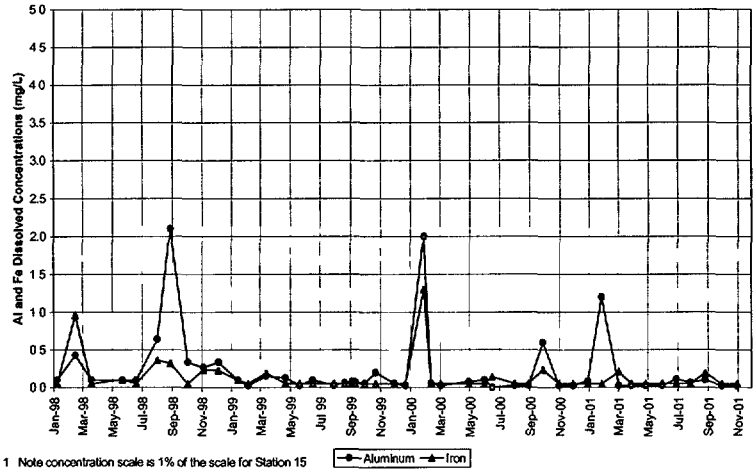
Similarly, dissolved arsenic and nickel concentrations at these stations are shown in Figure 3-7, *Arsenic and Nickel Surface Water Data (1998 – 2001).* Due to limitations of the current data set, specifically with regard to the relatively short period of record and lack of corresponding flow data at several stations at the time of this evaluation, any general interpretation of the time trends at these stations must be qualified. Additionally, water quality data are currently being assessed to determine its quality and usability. However, based on the available data as presented, it appears that water quality is improving over time at these stations, likely as a result of the response actions that have been implemented at the Site to date.

TABLE 3.4
CURRENT SURFACE WATER QUALITY MONITORING STATIONS

RWQCB Station ID	RWQCB Water Quality Sampling	USGS Flow Data	USGS Station	Site Description
Leviathan Creek Upper Drainage				
Station 1	Monthly	15-minute	10308783	Upstream of the mine Site
Channel Underdrain (CUD)	Monthly	15-minute	103087885	Groundwater from under the concrete diversion channel, which flows into Leviathan Creek
Adit	Monthly	15-minute	10308784	Drainage from Tunnel Number 5, diverted into evaporation ponds
Pit Underdrain (PUD)	Monthly	15-minute	10308785	Drainage from Pit collection system, diverted into evaporation ponds
Pond 1	Intermittent	15-minute	103087853	Upper Pond, southwest of pit. Stage height recorded only.
Pond Overflow (POF)	Monthly	15-minute	103087887	Discharge from Pond 4 into Leviathan Creek
Delta Seep	Intermittent	Intermittent	na	ARD Seep which flows into Leviathan Creek approximately 400 meters downstream of the CUD and upstream of the confluence with 4L Creek
Station 15	Monthly	15-minute	10308789	Leviathan Creek upstream of the confluence with Aspen Creek
Aspen Creek Drainage				
Station 22	Monthly	none	na	Aspen Creek upstream of the mine, just below road crossing
Aspen/Overburden Seep (OS)	Monthly	15-minute	103087892	ARD Seep, which flows into Aspen Creek (currently being treated by bioreactors)
Station 16	Monthly	monthly	103087898	Aspen Creek upstream of the confluence with Leviathan Creek
Lower Leviathan and Bryant Creek Drainage				
Station 17	Monthly	none	na	Leviathan Creek downstream of the confluence with Aspen Creek
Station 23	Monthly	15-minute	10308792	Leviathan Creek upstream of the confluence with Mountaineer Creek
Station 24	Monthly	monthly	na	Mountaineer Creek upstream of the confluence with Leviathan Creek
Station 25	Monthly	15-minute	10308794	Bryant Creek downstream of the confluence with Leviathan and Mountaineer Creeks
Station 26	Semi-annual	15-minute	10308800	Bryant Creek upstream of the confluence with Doud Springs

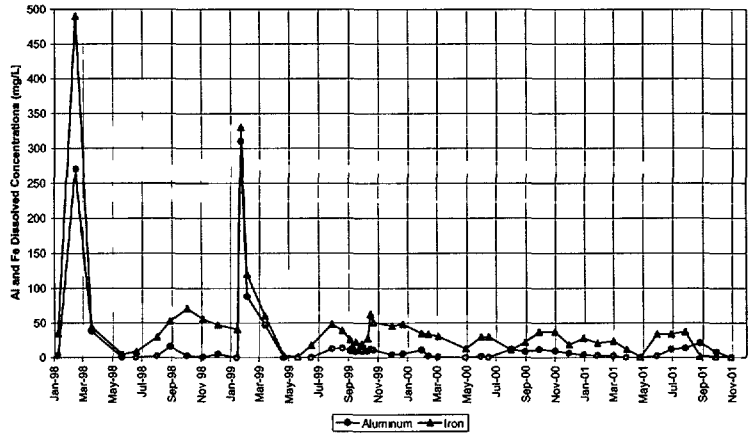
na – not applicable
tbd – to be determined

ASPEN CREEK (STATION 16)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001

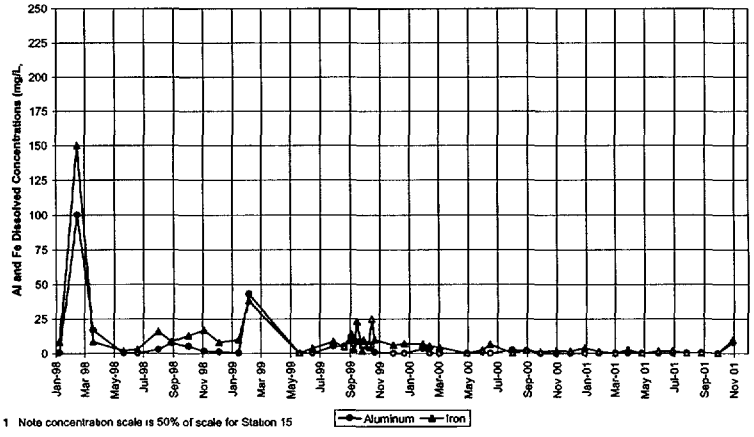


1 Note concentration scale is 1% of the scale for Station 15

LEVIATHAN CREEK (STATION 15)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001



LEVIATHAN CREEK (STATION 23)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001



1 Note concentration scale is 50% of scale for Station 15

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0	Issued for Draft Report	4/02	J Ray	J Gates	J Ray

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SCALE Not to Scale
FIGURE No 3.6

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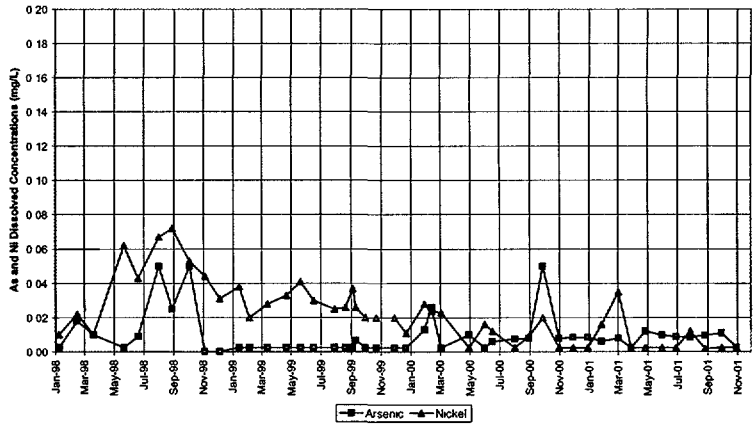
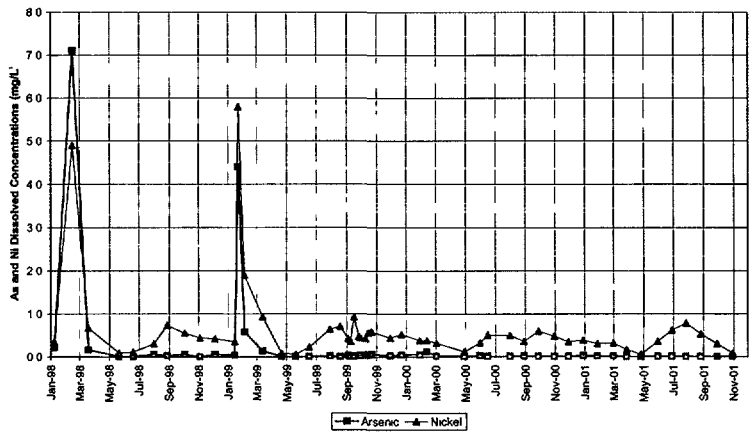
ALUMINUM AND IRON
SURFACE WATER DATA (1998 - 2001)

ASPEN CREEK (STATION 16)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001

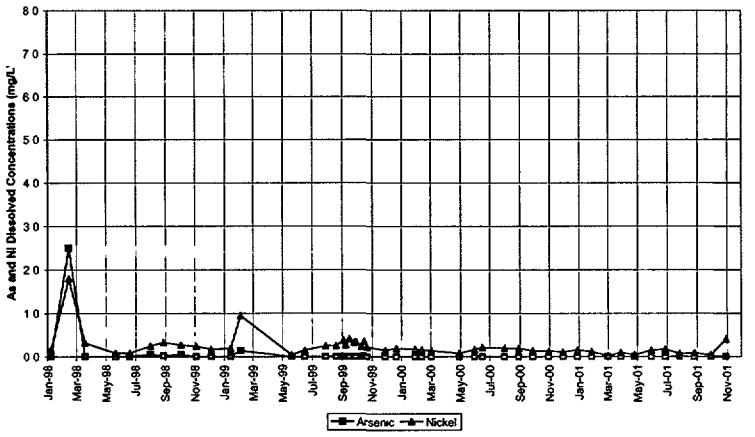


1 Note reduced concentration scale as compared to Stations 15 and 23

LEVIATHAN CREEK (STATION 15)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001



LEVIATHAN CREEK (STATION 23)
SURFACE WATER QUALITY DATA
JANUARY 1998 - OCTOBER 2001



REV No	REVISIONS	REV DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued for Draft Report	4/02	J Ray	J Gates	J Ray

MWH
MONTGOMERY WATSON HARZA

PROJECT No 5020047
AutoCAD FILE As and Ni 4 02
SCALE Not to Scale
FIGURE No 3.7

ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

ARSENIC AND NICKEL
SURFACE WATER DATA (1998 - 2001)

Table 3.5, *Data for Indicator Parameters During Spring and Fall (2000 and 2001),* presents the flow and indicator parameter concentration data for stations with available data during spring and fall of 2000 and 2001. Spring water quality data (April) correspond with the sampling date with the highest flow at Station 1 (Leviathan Creek above the mine Site). Fall data (August/September) correspond to the last sampling date before fall precipitation resulted in increased stream flow. Figure 3-8, *Concentrations of Indicator Parameters at Surface Water Stations, Spring and Fall 2000,* presents the water quality at selected water quality monitoring locations. The following discussion is based on these spring and fall 2000 and 2001 data.

Station 1, located on Leviathan Creek upstream of the mine workings, is representative of the background surface water quality for Leviathan Creek. Dissolved metals concentrations of aluminum, arsenic, iron, and nickel were relatively low to non-detectable, and the pH values were indicative of neutral to slightly alkaline waters. Water quality emanating from the adit and Pit Underdrain (PUD) exhibited low pH values and elevated dissolved metals concentrations that were from two to four orders of magnitude higher than the concentrations at Station 1. However, discharge from the adit and the PUD was, and currently is, being contained in a series of four settling and evaporation ponds (labeled Ponds 1 through 4, Figure 3-8) and treated. The discharge from Pond 4 (recorded at Station POF) has been negligible to non-existent since September 1999 due to bi-phasic treatment of the pond water. During 2000 and 2001, the CUD discharge contained concentrations of aluminum (ranging from 38 to 45 mg/l), arsenic (0.26 to 0.52 mg/l), iron (300 to 380 mg/l), and nickel (1.6 to 1.9 mg/l), and acidic pH values (4.55 to 4.68 s.u.). The data for the Delta Seep indicated slightly lower dissolved metals concentrations and slightly higher pH values than the CUD.

These sources, particularly the CUD and Delta Seep, appear to affect the water quality of Leviathan Creek (as measured at Station 15). The dissolved metals and sulfate concentrations increase from one to several orders of magnitude in Leviathan Creek between Stations 1 and 15, and pH values decreased at Station 15 to approximately 6.5 and 3.5 in the spring and fall, respectively. In addition, the data indicate seasonal fluctuations in the water quality at Station 15. In general, water quality at this location appears to be more highly impacted during the fall months, as opposed to the spring. Aluminum concentrations increased from non-detectable in the spring, to 12 and 21 mg/l in the 2000 and 2001 fall seasons, respectively. pH values exhibited a similar pattern, with pH decreasing from 6.86 and 6.71 during the fall events, to 3.20 and 3.63 during the spring events of 2000 and 2001, respectively. Sulfate and iron concentrations exhibited similar seasonal trends. As indicated in Table 3.2, the relative contribution by the CUD discharge to the flow at Station 15 is relatively high during July and August (approximately 20%). These data indicate that water quality at Station 15 is most affected by the CUD during the low-flow season, while during peak flow, dilution likely occurs from Leviathan Creek above Station 1 and the 4L Creek tributary. However, water quality and flow data are not available for the 4L Creek tributary to confirm this interpretation.

Water quality in Aspen Creek, upstream of the mine workings, (Station 22) is similar to the upstream Leviathan Creek station (Station 1, also upstream of the mine). Dissolved metals concentrations for aluminum, arsenic, iron, and nickel are low to non-detect, and the pH values are indicative of slightly alkaline water. During 2000 and 2001, water quality at the Aspen Seep (OS) exhibited high concentrations of dissolved aluminum (34 to 47 mg/l), iron (110 to 140 mg/l), and nickel (0.44 to 0.70 mg/l) relative to upstream Aspen Creek (Station 22). Acidic pH values, ranging from 3.07 to 3.27, were also recorded at the Aspen Seep. The discharge from this seep was, and currently is, being partially to entirely treated at the Aspen bioreactor. Water quality in Aspen Creek, downstream of the Aspen Seep, (Station 16) appears to be slightly impacted in comparison to water quality at the upstream Aspen Creek station (Station 22).

TABLE 3.5
DATA FOR INDICATOR PARAMETERS DURING SPRING AND FALL (2000 and 2001)

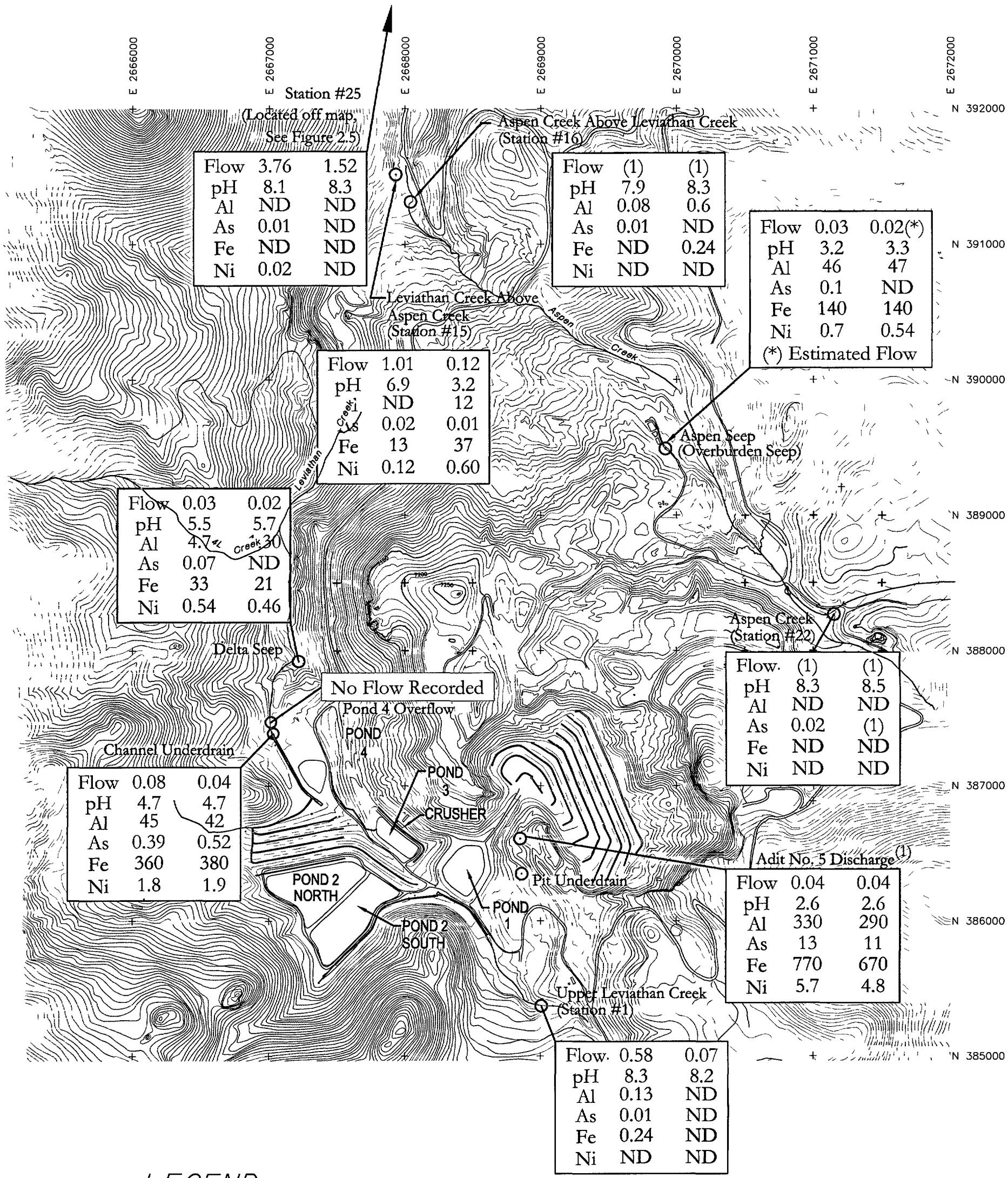
Station	Parameter	Units	4/28/00 Value	9/27/00 Value	4/25/01 Value	8/25/01 Value
Adit	Flow	cfs	0.044	0.035	0.032	0.031
	pH	s.u.	2.57	2.61	2.54	2.71
	Sulfate	mg/l	3600	4800	4200	3300
	Aluminum	mg/l	330	290	260	280
	Arsenic	mg/l	13	11	10	10
	Iron	mg/l	770	670	600	620
	Nickel	mg/l	5.7	4.8	4.4	4.6
CUD	Flow	cfs	0.084	0.040	0.074	-
	pH	s.u.	4.65	4.68	4.55	4.63
	Sulfate	mg/l	1800	2600	1900	2700
	Aluminum	mg/l	45	42	40	38
	Arsenic	mg/l	0.39	0.52	0.26	0.46
	Iron	mg/l	360	380	300	370
	Nickel	mg/l	1.8	1.9	1.6	1.8
Delta Seep	Flow	cfs	0.03	0.02	-	-
	pH	s.u.	5.45	5.71	-	-
	Sulfate	mg/l	1300	1400	-	-
	Aluminum	mg/l	4.7	1.3	-	-
	Arsenic	mg/l	0.07	-0.1	-	-
	Iron	mg/l	33	21	-	-
	Nickel	mg/l	0.54	0.46	-	-
OS	Flow	cfs	0.03	0.02[1]	0.032	-
	pH	s.u.	3.18	3.27	3.07	3.21
	Sulfate	mg/l	1700	1400	1800	2100
	Aluminum	mg/l	46	47	34	38
	Arsenic	mg/l	-0.1	-0.1	-0.1	-0.1
	Iron	mg/l	140	140	110	120
	Nickel	mg/l	0.7	0.54	0.44	0.47
PUD	Flow	cfs	0.003	0.001	0.002	0.001
	pH	s.u.	2.84	3.05	1.54	2.82
	Sulfate	mg/l	2800	8100	6800	6500
	Aluminum	mg/l	170	280	400	350
	Arsenic	mg/l	1.4	0.3	5.7	0.14
	Iron	mg/l	470	1200	1100	1300
	Nickel	mg/l	1.8	3.5	2.3	4.1
Sta 1	Flow	cfs	0.583	0.072	1.490	-
	pH	s.u.	8.26	8.21	7.76	7.82
	Sulfate	mg/l	6.4	9.5	8.1	8.8
	Aluminum	mg/l	0.13	-0.05	0.69	0.11
	Arsenic	mg/l	0.01	-0.005	-0.005	-0.001
	Iron	mg/l	0.24	-0.1	0.61	0.19
	Nickel	mg/l	-0.005	-0.001	0.015	0.0013
Sta 15	Flow	cfs	1.011	0.116	3.308	-
	pH	s.u.	6.86	3.2	6.71	3.63
	Sulfate	mg/l	220	1500	140	2800
	Aluminum	mg/l	-0.05	12	-0.05	21
	Arsenic	mg/l	0.02	0.0097	-0.005	0.0044
	Iron	mg/l	13	37	0.91	1.8
	Nickel	mg/l	0.12	0.6	0.06	0.53

TABLE 3.5
DATA FOR INDICATOR PARAMETERS DURING SPRING AND FALL (2000 and 2001)

Station	Parameter	Units	4/28/00 Value	9/27/00 Value	4/25/01 Value	8/25/01 Value
Sta 16	Flow	cfs	-	-	-	-
	pH	s.u.	7.88	8.26	8.25	8.38
	Sulfate	mg/l	240	84	170	60
	Aluminum	mg/l	0.08	0.6	-0.05	0.099
	Arsenic	mg/l	0.01	-0.1	0.012	0.0096
	Iron	mg/l	-0.1	0.24	-0.1	0.19
	Nickel	mg/l	-0.005	-0.04	-0.005	0.002
Sta 17	Flow	cfs	-	-	-	-
	pH	s.u.	7.15	6.16	7.34	7.5
	Sulfate	mg/l	210	370	150	180
	Aluminum	mg/l	3.2	0.21	-0.05	0.18
	Arsenic	mg/l	0.01	-0.005	-0.005	0.0058
	Iron	mg/l	17	6.1	0.28	0.23
	Nickel	mg/l	0.12	0.16	0.06	0.031
Sta 22	Flow	cfs	-	-	-	-
	pH	s.u.	8.29	8.48	8.46	8.44
	Sulfate	mg/l	1.2	1.3	2.3	1.1
	Aluminum	mg/l	-0.05	-0.05	0.14	0.07
	Arsenic	mg/l	0.02	-	-0.005	-0.001
	Iron	mg/l	-0.1	-0.1	0.4	-0.1
	Nickel	mg/l	-0.005	-0.04	-0.005	-0.001
Sta 23	Flow	cfs	1.719	0.284	3.955	-
	pH	s.u.	7.05	6.68	7.46	7.41
	Sulfate	mg/l	200	420	150	680
	Aluminum	mg/l	-0.05	0.061	-0.05	0.42
	Arsenic	mg/l	0.01	-0.005	-0.005	-0.001
	Iron	mg/l	-0.1	1.3	-0.1	0.5
	Nickel	mg/l	0.08	0.14	0.04	0.089
Sta 25	Flow	cfs	3.760	1.515	6.383	-
	pH	s.u.	8.05	8.26	8.16	8.21
	Sulfate	mg/l	89	67	94	98
	Aluminum	mg/l	-0.05	-0.05	0.11	0.073
	Arsenic	mg/l	0.01	-0.005	-0.005	-0.001
	Iron	mg/l	-0.1	-0.1	-0.1	0.11
	Nickel	mg/l	0.02	-0.001	0.0024	0.013

Notes: [1] Flow at OS estimated using value for 9/28/00

General: Negative values represent concentrations below the detection limit.
Half the detection limit was used to determine the load.
"-" represents that no data available
Concentrations reflect dissolved fraction



LEGEND

O Surface Water Monitoring Station
ND - Non Detect

KEY

⊙ Pond 4 Overflow ← Sample Name & Location

0.03	0.02	4/28/00 & 9/27/00	Flow (cfs)
5.5	5.7	4/28/00 & 9/27/00	pH (s.u.)
4.70	1.30	4/28/00 & 9/27/00	Aluminum concentration (mg/l)
0.07	ND	4/28/00 & 9/27/00	Arsenic concentration (mg/l)
33	21	4/28/00 & 9/27/00	Iron concentration (mg/l)
2.5	1.75	4/28/00 & 9/27/00	Nickel concentration (mg/l)

NOTE (1) Currently Captured in Pond System

N

SCALE
400' 0 400' 800'
CONTOUR INTERVAL 10 FT

SOURCE PROVISIONAL RWQCB AND USGS 2000 DATA

REV No	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued for Draft	4/02	J Ray	J Gates	J Ray

ATLANTIC RICHFIELD COMPANY

PROJECT
Leviathan Mine Site - Phase 1 RI/FS Work Plan

DRAWING TITLE
CONCENTRATIONS OF INDICATOR PARAMETERS AT SURFACE WATER STATIONS SPRING AND FALL 2000

MWH
MONTGOMERY WATSON HARZA

Sheet 1 Of 1 Sheets
SCALE See Scale Bar
DRAWING No 3.8

AutoCAD FILE Indicator parameters 4 02 PROJECT NUMBER 5030047

This indicates that the Aspen Seep and/or other potential sources (including groundwater discharge) are affecting the water quality of Aspen Creek. However, based on the dissolved metals concentration trends at Station 16 from January 1998 to present (Figures 3-6 and 3-7), it appears that water quality in Aspen Creek may be improving, possibly due to treatment of the Aspen Seep during this period. In addition, an alkaline seep reportedly enters Aspen Creek just above Station 16 may be helping to improve water quality in the creek (RWQCB, 2002b).

Station 17 is located on Leviathan Creek just below the confluence with Aspen Creek. The seasonal change in water quality between high- and low-flow periods observed at Station 15 is not apparent at Station 17. Additionally, reductions in the aluminum, iron, and nickel concentrations and an overall increase in the pH during both the peak flow and low-flow periods indicate that the water quality improves between these two monitoring locations. These data suggest that the higher quality Aspen Creek is improving the overall water quality in Leviathan below its confluence via dilution during both the peak-flow and low-flow periods and/or that precipitation of metals out of solution may be occurring in response to the increase in pH. Dissolved metals concentrations and pH values are similar between Station 17 and Station 23, located along Leviathan Creek just above the confluence with Mountaineer Creek. At Station 25, located along Bryant Creek below the confluence of Leviathan Creek and Mountaineer Creek, dissolved metals concentrations and pH values indicate a return to water quality similar to that observed upstream of the mine during this period (based on 2000 and 2001 data).

3.4.2 Dissolved Metals and Sulfate Loading Analysis

Dissolved metals and sulfate loads were calculated for each of the stations in Table 3.5 where both water quality and flow data were available during the spring and fall 2000. Table 3.6, *Loading Comparison for Upper Leviathan Creek,* presents the results of the loading analysis for stations in the upper Leviathan Creek drainage area (Station 15 and above), and Table 3.7, *Loading Comparison for Lower Leviathan Creek*, presents the results for stations downstream.

Conclusions based on this analysis should be qualified due to several factors related to the limitations of the data set currently available in the database. First, this analysis was run on data from two, specific sampling events in 2000. Any interpretations based on these data must therefore be understood as reflecting conditions at the Site during two, synoptic events. In addition, because several water quality stations did not include the associated flow data, loading calculations could not be made at several stations. Inclusion of this information in the future will significantly improve the current understanding of source loading at the Site.

Upper Leviathan Creek

Table 3.6 compares the dissolved metals and sulfate loads from Station 1, the CUD, and the Delta Seep (i.e. monitoring stations upstream of Station 15) to the loads at Station 15. At each station, flow values and analytical results obtained during the 2000 high- and low-flow sampling events were used to calculate loads (lbs/day) and reduction percentages for each parameter. Flow and water quality data are insufficient to determine the potential loads from other inputs in this drainage, including but not limited to the upper and lower tributaries, 4L tributary, and groundwater. These "unknown" sources limit the interpretations that may be made regarding the potential impacts of the "known" sources in this area.

TABLE 3.6
LOADING COMPARISON FOR UPPER LEVIATHAN CREEK
(2000 High and Low Flow)

Date	Parameter	Station 1 (lbs/day)	CUD (lbs/day)	Delta Seep (lbs/day)	Station 1 + CUD + Delta Seep (lbs/day)	Station 15 (lbs/day)	Change in Mass between Station 1 and Station 15[1] (lbs/day)	% Reduction[2]
4/28/00	Aluminum	0 4	20.4	0.8	21 5	0.3	-21.3	98.7%
	Arsenic	0 03	0.18	0 01	0.22	0.11	-0.11	50.2%
	Iron	1	163	5	169	71	-98	58.1%
	Nickel	0 03	0.82	0.09	0.93	0 65	-0.28	29.8%
	Sulfate	20	815	208	1043	1200	157	-15.0%
9/27/00	Aluminum	0.0	9.1	0.1	9.2	7.5	-1.7	18.5%
	Arsenic	0 00	0.11	0.01	0.12	0.01	-0.12	95.1%
	Iron	0	82	2	84	23	-61	72.5%
	Nickel	0 00	0.41	0 05	0.46	0.38	-0.08	17.8%
	Sulfate	4	561	141	706	939	233	-33.0%

Note: [1] Negative values indicate net reduction in stream load, while positive values indicate net increase.
[2] Positive values represent a reduction in stream load and negative values represent a gain.
General:
Parameters which increase are highlighted
Loads determined using dissolved fraction of parameters

TABLE 3.7
LOADING COMPARISON FOR LOWER LEVIATHAN CREEK
(2000 High and Low Flow)

Date	Parameter	Station 15 (lbs/day)	Station 23 (lbs/day)	Station 25 (lbs/day)	Change in Mass Between Stations 15 and 23[1] (lbs/day)	% Reduction	Change in Mass Between Stations 23 and 25[1] (lbs/day)	% Reduction
4/28/00	Aluminum	0 3	0.5	1.0	0.2	-70 0%	0 6	-118 8%
	Arsenic	0.11	0 09	0 20	-0 02	15.0%	0.11	-118.8%
	Iron	71	1	2	-70	98 7%	1	-118 8%
	Nickel	0 65	0 74	0 41	0 09	-13 3%	-0.34	45 3%
	Sulfate	1200	1854	1805	654	-54.5%	-49	2.6%
9/27/00	Aluminum	7 5	0.1	0.4	-7 4	98 8%	0.3	-337.8%
	Arsenic	0 01	0 01	0 04	0 00	0 00%	0.03	-434.1%
	Iron	23	2	1	-21	91 4%	-1	58.9%
	Nickel	0 38	0 21	0 01	-0 16	43.0%	-0.21	96 2%
	Sulfate	939	643	547	-296	31.6%	-95	14.8%

Note: [1] Negative values indicate net reduction in stream load, while positive values indicate net increase.
General
Parameters which increase are highlighted
Loads determined using dissolved fraction of parameters

The data indicate a net reduction in metal loads, but a net increase in the sulfate load, between the upstream sources and Station 15. Maximum reduction in the metal loads occurs during peak flow, while the increase in the sulfate load is highest during the low-flow period. In addition, the comparison of the percent reduction (or increase) between the high- and low-flow events indicates significant seasonal fluctuation for certain parameters Aluminum load decreases by 98.7% and 18.5% during the high- and low-flow events, respectively Iron load decreases by 58.1% and 72.5% over the

same period. As sulfate is the most conservative parameter in the loading analysis, the sulfate data may be interpreted to indicate that there are additional, "unknown" sources (i.e., unmonitored tributaries and/or groundwater) of loading to Station 15 other than those quantified (i.e., Station 1, CUD, Delta Seep). The reduction in metals loads at Station 15 (compared to the combined loads from Station 1, the CUD and Delta Seep) is likely due to mineral precipitation/adsorption reactions occurring in the stream, as higher quality water enters Leviathan Creek. Seasonal variations in flow may, therefore, have a significant effect on the metals loads at Station 15.

Lower Leviathan/Bryant Creeks

Table 3.7 compares the metals and sulfate loads between Stations 15, 23, and 25. Consistent with Table 3.6, flow values and analytical results obtained during the 2000 high- and low-flow sampling events were used to calculate loads (lbs/day) and reduction percentages for each parameter. The major tributary between Leviathan Creek Stations 15 and 23 is Aspen Creek (Station 16). Flow data were not available for Aspen Creek at the time this analysis was performed and, therefore, loads were not calculated for this source. In addition, an unmonitored tributary enters Leviathan Creek below the Aspen Creek confluence and Station 23. Leviathan Creek Station 17 is located above this tributary and just below the confluence with Aspen Creek; however, flow data are not collected at this station and therefore loads at this location could not be determined. Further downstream, Mountaineer Creek joins Leviathan Creek (Station 23) to form Bryant Creek (Station 25). Flow data were not available for Mountaineer Creek (Station 24) at the time this analysis was performed, and therefore the loads were not calculated. However, water quality data from this location in 2000 indicate metals concentrations were near non-detectable and sulfate concentrations were two orders of magnitude less than Leviathan Creek at the confluence. Therefore, the loading from Mountaineer Creek may be assumed to be relatively small.

Between Leviathan Creek Stations 15 and 23, during peak flow, iron and arsenic loads decreased, while aluminum, nickel, and sulfate loads increased. During low flow, the loads for all parameters decreased, with the exception of arsenic (unchanged). Iron loads decreased significantly during both high and low flow, with reduction percentages of 98.7% and 91.4%, respectively.

Between Stations 23 and 25 during peak flow, nickel and sulfate loads decreased, while aluminum, arsenic, and iron loads increased. During low flow, iron, nickel, and sulfate loads decreased, while aluminum and arsenic concentrations increased. Iron load increased by approximately 120% during peak flow, but decreased by 60% during low flow. Aluminum and arsenic loads both increased by approximately 120% during peak flow, and increased by 338% and 434%, respectively, during low flow. Nickel load decreased by 45% and 96% during peak and low flows, respectively.

Table 3.8, *Relative Contributions of Known Sources,* shows the relative loads from each of the known sources (CUD, Delta Seep, and Aspen Seep) to Leviathan Creek. Dissolved metals loads at each source were calculated using water quality and flow data during spring and fall 2000 flow periods. Spring flow data are from April 28, 2000, which is the closest sampling event to the recorded maximum flow at Station 1 in 2000. The fall flow data used in the analysis are from September 27, 2000, which is approximately 10 days after the RWQCB stopped discharging water from their treatment system and before flows increased again due to fall weather events. The data indicate that the CUD is the major contributing source, providing between 63 and 91% of the metals load, relative to the other sources. Aspen Seep makes up between 5 and 36% of the relative load, and Delta Seep contributes less than 10% of the relative load.

TABLE 3.8
RELATIVE CONTRIBUTIONS OF KNOWN SOURCES

Date	Parameter	CUD		Delta Seep		Aspen Seep	
		Load (lbs/day)	%	Load (lbs/day)	%	Load (lbs/day)	%
Sep 27, 00	Aluminum	9.06	63%	0.13	1%	5.24	36%
	Arsenic	0.11	91%	0.01 [1]	4%	0.01 [1]	5%
	Iron	81.98	82%	2.12	2%	15.61	16%
	Nickel	0.41	79%	0.05	9%	0.06	12%
Apr 28, 00	Aluminum	20.38	71%	0.75	3%	7.42	26%
	Arsenic	0.18	87%	0.01	5%	0.02	8%
	Iron	163.02	85%	5.27	3%	22.57	12%
	Nickel	0.82	80%	0.09	9%	0.11	11%

Note: [1] Parameter concentration was below detection limit. Half detection limit was used to calculate load
Loads determined using dissolved fraction of parameters.

3.5 GROUNDWATER

In 1982, Brown and Caldwell prepared an initial evaluation of groundwater conditions at the Site based on data collected during a piezometer installation and groundwater sampling program (Brown and Caldwell, 1983). The piezometers were installed by the USGS in 1982 in the area upgradient of the mine area, within the mine area, and to the north of the mine in the area of the landslide. As a result of the 1984 abatement projects and continued movement of the landslide, most of the piezometers no longer exist or are currently inaccessible. Groundwater samples were collected from 36 piezometers and were analyzed for dissolved metals concentrations and major ion chemistry. These data are currently being evaluated for quality and usability under this Phase 1 Work Plan.

According to the analysis by Brown and Caldwell, groundwater is first encountered from just below the ground surface (bgs) (within the pit) to over 300 feet bgs at the topographically higher areas of the Site (just northeast of the pit). Groundwater immediately upgradient (south) of the Site occurs within the volcanic bedrock and generally flows in a northwesterly direction toward the Site. Groundwater flow directions within the mine Site are affected by the presence of the open pit (i.e., the pit acts as a groundwater sink). Consequently, groundwater near the pit generally flows toward the middle of the pit. Northwest of the pit, within the spoils piles and the landslide, groundwater flows northwesterly toward Leviathan Creek. Groundwater gradients within the mine Site vary according to which mine feature the groundwater is flowing through and range from 0.06 feet per foot (ft/ft) to 0.6 ft/ft (Brown and Caldwell, 1983).

Groundwater conditions were reevaluated subsequent to implementation of the pollution abatement project (SRK Consulting, 1999). SRK installed 15 new monitoring wells in the area of the mine, and utilized two of the existing, USGS piezometers for their analysis. Locations of these wells and piezometers are shown on Figure 3-1. These new wells were screened across first-encountered groundwater, with the exception of the "deep" wells. Each of the deep wells was paired with one of the other wells and was installed to evaluate deeper groundwater, apparently without regard to the presence of aquitards or hydraulically separate groundwater zones. The paired wells are labeled with an "s" (shallow) or "d" (deep) on the figures and tables.

Two rounds of groundwater samples were collected from these wells and piezometers in October and November 1998, respectively. Field parameters were measured on the groundwater samples, and the samples were analyzed for metals concentrations and major ion chemistry. A summary of selected, indicator parameter data is included in Appendix B, *Summary of 1998 Groundwater Chemical Data.* Groundwater data are also presented on Figure 3-9, *Groundwater Quality Data, Fall 1998.* In general,

shallow groundwater quality data indicate similar concentrations and patterns to the nearby surface water stations in the upper Leviathan Creek drainage. With regard to the paired wells, groundwater quality in Wells 2s and 2d is similar, while groundwater quality in Well 10d is of notably higher quality than the more shallow Well 10s. A slightly downward flow gradient is observed at both of the paired well locations.

A potentiometric surface map was constructed using the November 1998 field data. This map is presented in Figure 3-10, *November 1998 Potentiometric Surface Map.* Based on the available data, shallow groundwater flow in the area of these wells mimics the surface water drainage pattern of Leviathan Creek, flowing generally north-northwest with Leviathan Creek.

3.6 SOILS

The RWQCB has collected data pertaining to the physical and chemical properties of the soils at the Site, as part of their ongoing revegetation efforts. These data are available from the RWQCB.

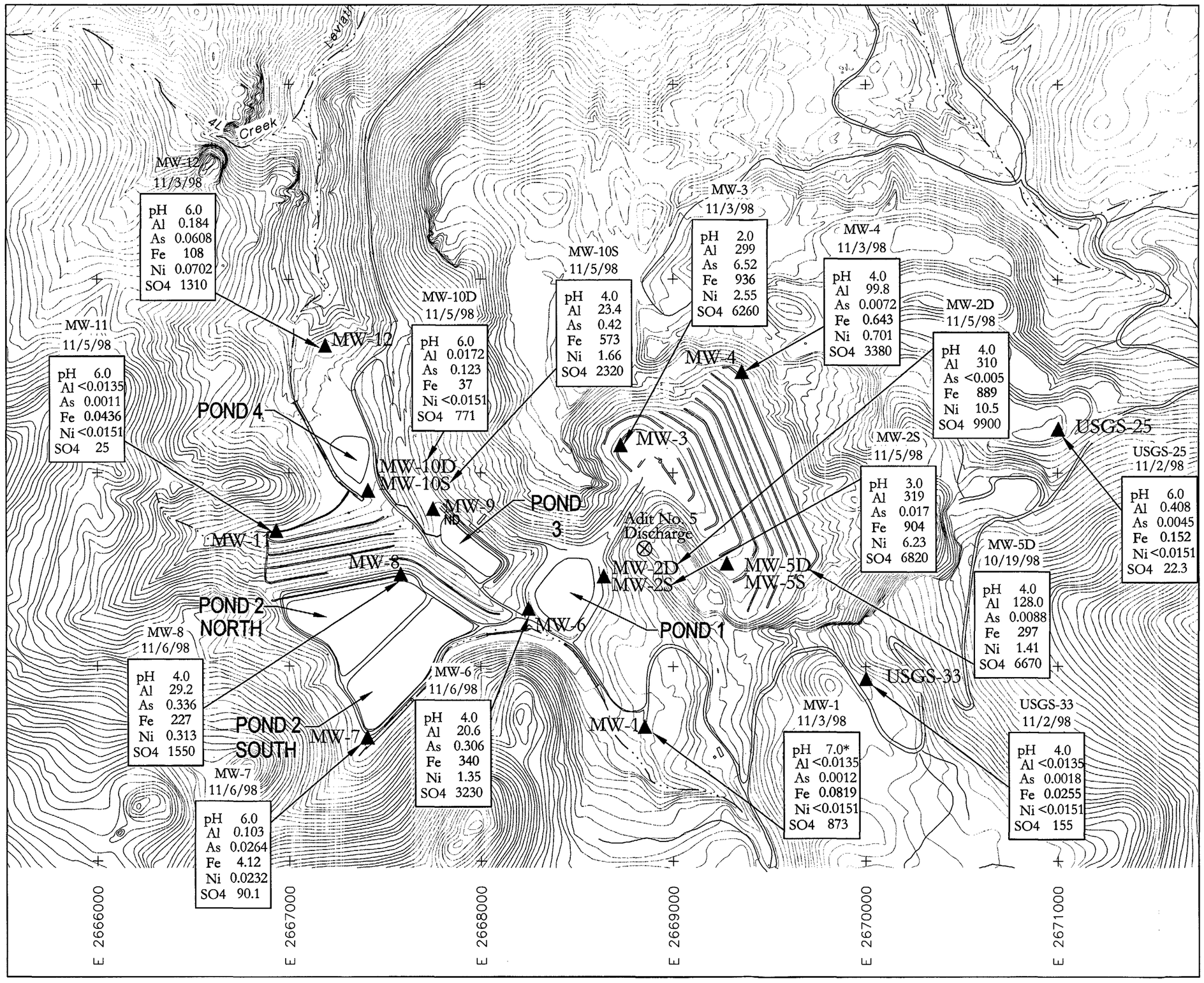
3.7 CONCEPTUAL SITE MODEL

The CSM presented in this section is general in nature and is based upon current data, as outlined above in Sections 3.2 through 3.6 of this Phase 1 Work Plan. It should be noted that the CSM is a work-in-progress and will continue to be reviewed and updated as the database and GIS are populated with historic data, and as new data continue to be evaluated for the Site. The complete list of available Site information has recently been received by EPA and is currently under review by Atlantic Richfield, as discussed further in Section 5.2. Database update with historic information is anticipated to be completed under the Phase 1 RI/FS. New data will continuously be reviewed, evaluated, and entered into the database as it is collected. As data are evaluated and as the ERA and RI/FS activities proceed, the preliminary CSM will be further defined and updated, as appropriate.

Based on the data presented in Sections 3.2 through 3.6, a general CSM for the Leviathan Mine has been developed, as shown schematically in Figure 3-11, *Conceptual Site Model Exposure Schematic.* As indicated in the schematic, potential sources, release mechanisms, pathways, and receptors have been identified.

Mineralized material (e.g., waste rock and open pit material) presents the source of elevated metals and sulfate concentrations at the Site, as shown in the schematic. (The mine adit system is another potential source of ARD drainage, though most of the mine workings were eliminated during open pit mining, and the only expression of surface flow is from the adit. Flow from the adit is currently collected in the evaporation ponds and treated by the RWQCB.)

The mineralized material may exist and/or be transported on Site directly via the direct contact or wind erosion release mechanisms. This material may also produce ARD (elevated metals and sulfate concentrations and low pH) in the presence of water, oxygen and biological activity through a series of geochemical reactions that is subject to transport via runoff, erosion and infiltration/percolation. The primary release mechanisms at the Site have been identified as runoff/erosion (to surface water) and infiltration/percolation (to groundwater), especially during the snowmelt period. Other release mechanisms (direct contact and wind erosion), affecting solid phase material, are not expected to be significant at this Site.



LEGEND

MW-2S
▲ GROUNDWATER MONITORING WELL LOCATION

MW-7	WELL IDENTIFICATION
11/6/98	SAMPLE DATE
pH 6.0	FIELD PH (SU)
Al 0.103	ALUMINIUM (mg/l)
As 0.0264	ARSENIC (mg/l)
Fe 4.12	IRON (mg/l)
Ni 0.0232	NICKEL (mg/l)
SO4 90.1	SULFATE (mg/l)

NOTES:
1. Metals and Sulfate Concentrations are Dissolved Portion in mg/L.
2. Groundwater Data Collected November 2-6, 1998.
3. < Represents Concentrations below the Detection Limit. Valve Shown is Detection Limit.
4. Paired Wells are Designated with an "s" Suffix for Shallow Well and a "d" Suffix for Deep Well.

* Field pH of Groundwater Sample from MW-1 was Measured in October 1998.

ND = NO DATA

N

SCALE
500' 0 500' 1000'
CONTOUR INTERVAL 10 ft.

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0	Issued For Draft Review	4/02	J.Ray	J.Gates	J.Ray

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PROJECT:
Leviathan Mine Site - Phase 1 RI/FS Work Plan

DRAWING TITLE:
GROUNDWATER QUALITY DATA
FALL 1998

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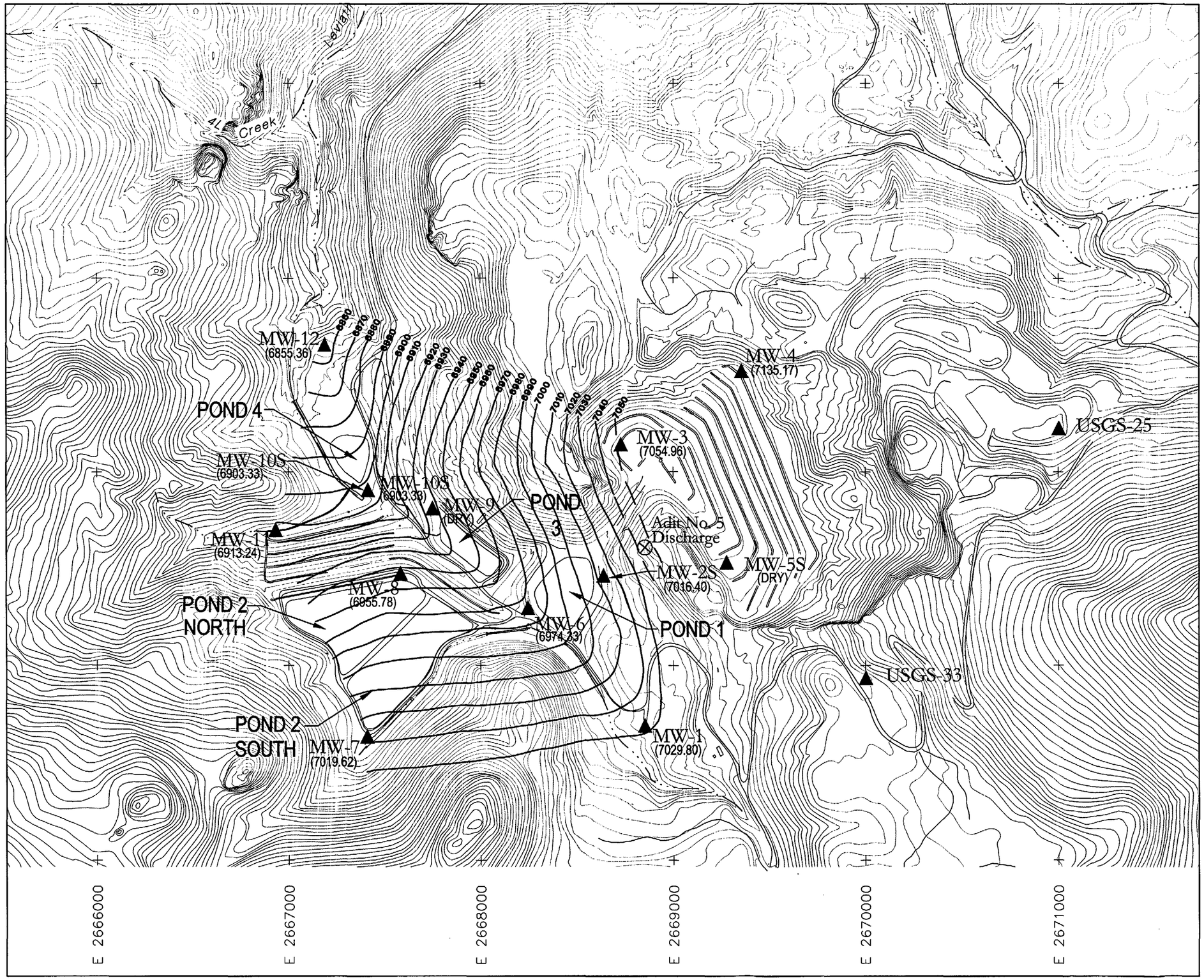
Sheet 1 Of 1 Sheets
SCALE: See Scale Bar
DRAWING No. 3.9

AutoCAD FILE: G-W data 4-02 PROJECT NUMBER: 5030047



LEGEND

MW-2S (7016.40) ▲ GROUNDWATER MONITORING WELL LOCATION (GROUNDWATER ELEVATION IN FEET ABOVE SEA LEVEL)

6860 GROUNDWATER EQUIPOTENTIAL CONTOUR (IN 10 Ft. INTERVAL)

NOTE:

1. HYDRAULIC GRADIENT - 0.045 Ft./Ft. NORTH - NORTHWEST

N

SCALE

500' 0 500' 1000'

CONTOUR INTERVAL 10 ft.

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0	Issued For Draft Review	4/02	J.Ray	J.Gates	J.Ray

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PROJECT: Leviathan Mine Site - Phase 1 RI/FS Work Plan

DRAWING TITLE: NOVEMBER 1998 POTENTIOMETRIC SURFACE MAP

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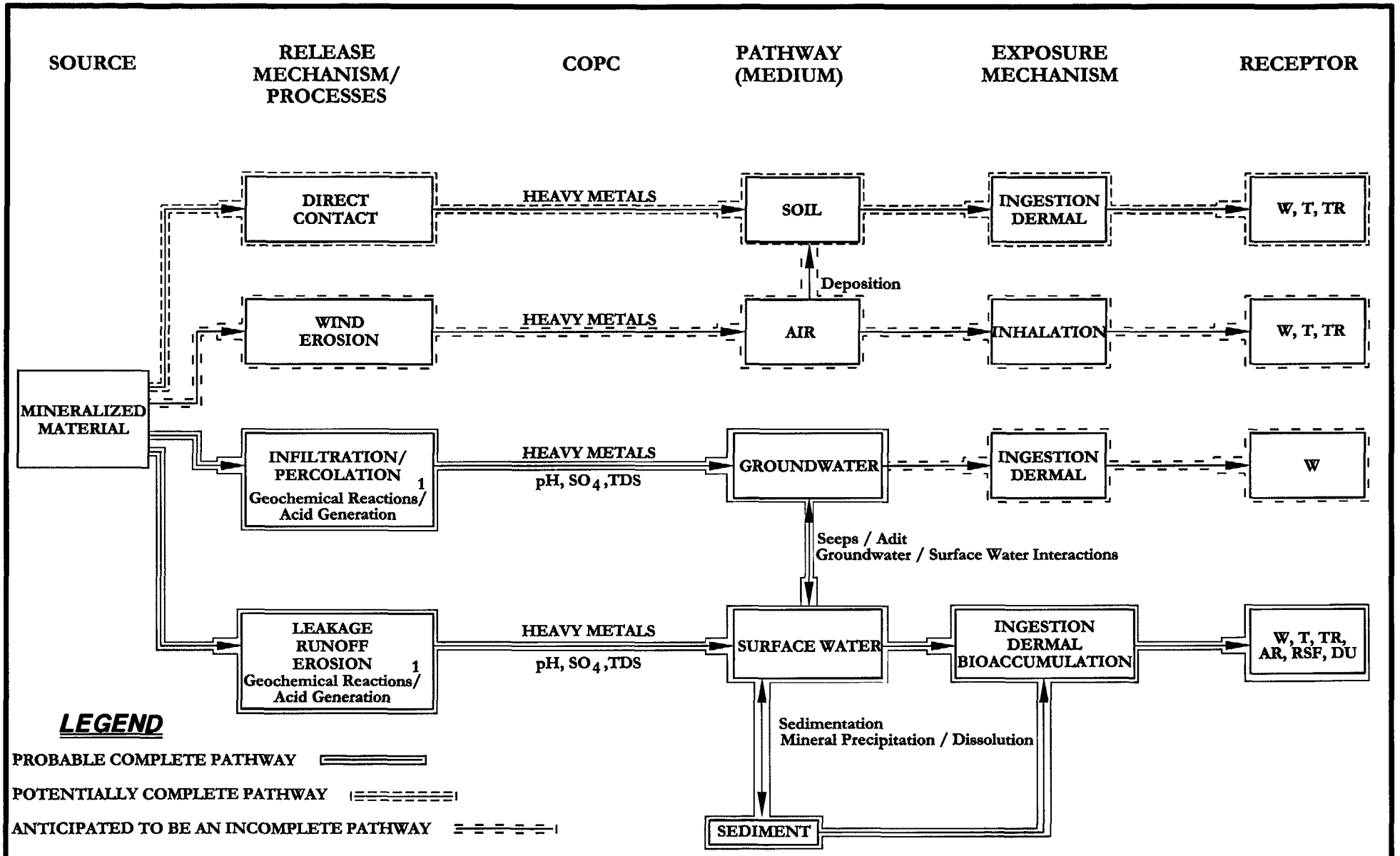
Sheet 1 Of 1 Sheets

SCALE: See Scale Bar

DRAWING No. 3.10

AutoCAD FILE: pot_surface 4.02 PROJECT NUMBER: 5030047



LEGEND

PROBABLE COMPLETE PATHWAY

POTENTIALLY COMPLETE PATHWAY

ANTICIPATED TO BE AN INCOMPLETE PATHWAY

W = WORKER / VISITOR: ADDRESSED IN SITE-SPECIFIC HEALTH AND SAFETY PLAN
T = TRESPASSER
TR = TERRESTRIAL RECEPTOR
AR = AQUATIC RECEPTOR
RSF = RECREATIONAL SWIMMER / FISHER
DU = DOWNGRADIENT USERS

1. In Presence of Sulfide Material, Water, Oxygen, and Biological Activity

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PROJECT No 5030047
AutoCAD FILE site model exp 4 02
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FIGURE No 3.11

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Leviathan Mine Site - Phase 1 RI/FS Work Plan

CONCEPTUAL SITE MODEL EXPOSURE SCHEMATIC

The potentially-affected mediums (or pathways) are identified as soil, air, sediment, groundwater, and surface water. Groundwater and surface water, and their associated interactions with sediments, have been identified as potentially complete pathways (i.e., affected mediums). Groundwater will not be included as a potential human health exposure pathway in the streamlined risk evaluation because of the lack of current or anticipated future uses, as discussed further in Section 5.5.1.

As discussed previously in Section 3.2, identified areas of untreated ARD at the Site include the CUD, pond overflow, Delta Seep, and Aspen Seep. Flow from these areas can subsequently result in ARD to Leviathan and Aspen Creeks. As mentioned, these known areas of ARD have been, and will likely continue to be, the focus of ERAs at the Site.

Potential receptors include workers, trespassers, aquatic and terrestrial biota, recreational users and other downstream users. No residents live in the area. Site workers and visitors are covered under the Site-specific Health and Safety Plan and will not be addressed within the streamlined risk evaluation, as discussed further in Section 5.5.

As the database is updated, as new information becomes available, and as the Technical Advisory Committee (TAC) begins to view information from differing perspectives, the CSM may be modified.

4.0 WORK PLAN RATIONALE

4.1 GENERAL WORK PLAN APPROACH

As discussed in Section 1.0, the purpose of this Phase 1 Work Plan is to outline the tasks to be completed during the Phase 1 RI/FS, as specified in the SOW. These tasks, described in Section 5.0, Phase 1 RI/FS Tasks, include the following:

- Assessment and Management of Existing Data;
- Site Characterization;
- East Fork Carson River Risk Assessment;
- Streamlined Risk Evaluation; and
- QA/QC Plan, Sampling and Analysis Plan.

As discussed previously, this work plan is structured in accordance with guidelines included in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988).

The focus of the Phase 1 RI/FS is to review existing Site data, complete the database, reevaluate data based upon a more complete database, refine the CSM, and proceed with streamlined risk assessment/risk evaluation. Additional field data will not be collected under this work plan. However, this work plan outlines an approach for establishing DQOs and presents Site-wide SAP and QAPP requirements for additional data collected at the Site under future work plans (e.g. – ERA Work Plans, Long-term Response RI/FS Work Plan, RWQCB Work Plans).

4.2 DATA QUALITY OBJECTIVES

Field investigation and monitoring activities will be conducted in support of the ERAs and RI/FS investigations. The primary purposes of these activities are to characterize the Site, determine the effectiveness of passive and active treatment technologies in removing contaminants from the source water, and determine the effect of removal of contaminant load on the water quality in Leviathan Creek and Aspen Creek.

DQOs consistent with the CSM and EPA guidance are required to focus Site activities such as ERAs and investigation methods. DQOs are statements that identify the objectives of the proposed work. They specify the quality, quantity, and analytical level of data required to make decisions relative to these objectives.

DQOs for proposed field investigation and monitoring activities will be established in the work plans prepared by Atlantic Richfield, RWQCB, and other parties collecting data at the Site. The DQOs will assure that the data collected under the specified work plans are of sufficient quantity and quality for the "intended use" of the data. In general, data collected will be used to:

- Characterize the Site;
- Conduct the Risk Assessment;
- Evaluate ERAs and treatment alternatives; and
- Assess the water quality of Aspen Creek and Leviathan Creek.

<u>Data Quality Objectives Process</u>

Any work plan specifying data collection at the Leviathan Site must develop DQOs using the EPA 7-step DQO process (EPA, 2000c) for establishing data quality and developing data collection designs. This includes Atlantic Richfield ERA Work Plans and the Long-term Response RI/FS Work Plan, as

well as the RWQCB Work Plans prepared annually. The work plans must be reviewed and approved by EPA.

The 7-step process will follow the protocol outlined in *Data Quality Objectives Process for Hazardous Waste Site Investigations – EPA QA/G-4HW* (EPA, 2000c). The use of this process will assure that the type, quantity, and quality of data collected will provide the information needed to make decisions regarding treatment effectiveness and optimization in treating source water, and for improving water quality in Leviathan Creek and Aspen Creek.

In general, the 7-step process includes the following tasks:

- **Step 1 - State the problem**: Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem; develop CSM.
- **Step 2 – Identify the decision**: Identify the decision that requires new environmental data to address the contamination problem.
- **Step 3 – Identify inputs to the decision**: Identify the information needed to support the decision and specify which inputs require new environmental measurements.
- **Step 4 – Define the study boundaries**: Specify the spatial and temporal aspects of the environmental media that the data must represent to support the decision.
- **Step 5 – Develop a decision rule**: Develop a logical "if…then…" statement that defines the conditions that would cause the decision-maker to choose among alternative actions.
- **Step 6 – Specify limits on decision errors**: Specify the decision-makers acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data
- **Step 7 – Optimize the design for obtaining data**: Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy DQOs.

Further details can be found in the aforementioned EPA guidance document (EPA, 2000c).

Atlantic Richfield used the 7-step process to develop the 2001 and 2002 ERA field programs. Attachment 1, *Leviathan Mine Site – Site-wide Sampling and Analysis Plan,* presents the DQO process used for the Leviathan Site 2002 ERA Work Plan. DQOs were developed for use in evaluating a treatment system designed to treat source water and reduce contaminant load to Site surface water, thus improving water quality. Data collected during ERA field investigations will be used to assess the effectiveness of potential ERAs in reducing contaminant load to Leviathan Creek and Aspen Creek.

The RWQCB also used the 7-step process to develop DQOs for ongoing water monitoring being conducted at the Site, also included in Attachment 1.

As shown in these two examples, there are two general categories of data being collected at the Site: process-related data and ongoing site characterization data. Process-related data will be used to evaluate and optimize various treatment systems at the Site. While this data is important for evaluation/optimization of alternative treatment processes, it is screening-level data and will not be used for EPA decision-making at the Site. Site characterization data, however, will be used in the CSM and Site risk assessments and will be used in the evaluation and selection of alternatives in the

FS. These data, therefore, must meet the most stringent EPA quality assurance/quality control (QA/QC) standards, as outlined in the QAPP, discussed in the following section.

5.0 PHASE 1 RI/FS TASKS

5.1 GENERAL

5.1.1 Phased RI/FS Approach

As specified in the SOW and described in the SMP (Section 3.0), a phased approach will be followed in conducting the ERAs and the RI/FS at the Site. The two project phases include:

- ERAs and Phase 1 RI/FS
- Long-term Response RI/FS

The initial phase entails the development and implementation of ERAs and the Phase 1 RI/FS. After implementation and assessment of the ERAs and completion of the Phase 1 RI/FS, the Long-term Response RI/FS, will be conducted. Using this approach, ERAs will be conducted concurrently with the Phase 1 RI/FS and data collected for ERA evaluation can be used in the RI/FS process to aid in selection of proven, effective and comprehensive remedies for the Site. Figure 5-1, *Project Tasks*, outlines the general tasks associated with this phased approach.

5.1.2 Phase 1 RI/FS Tasks

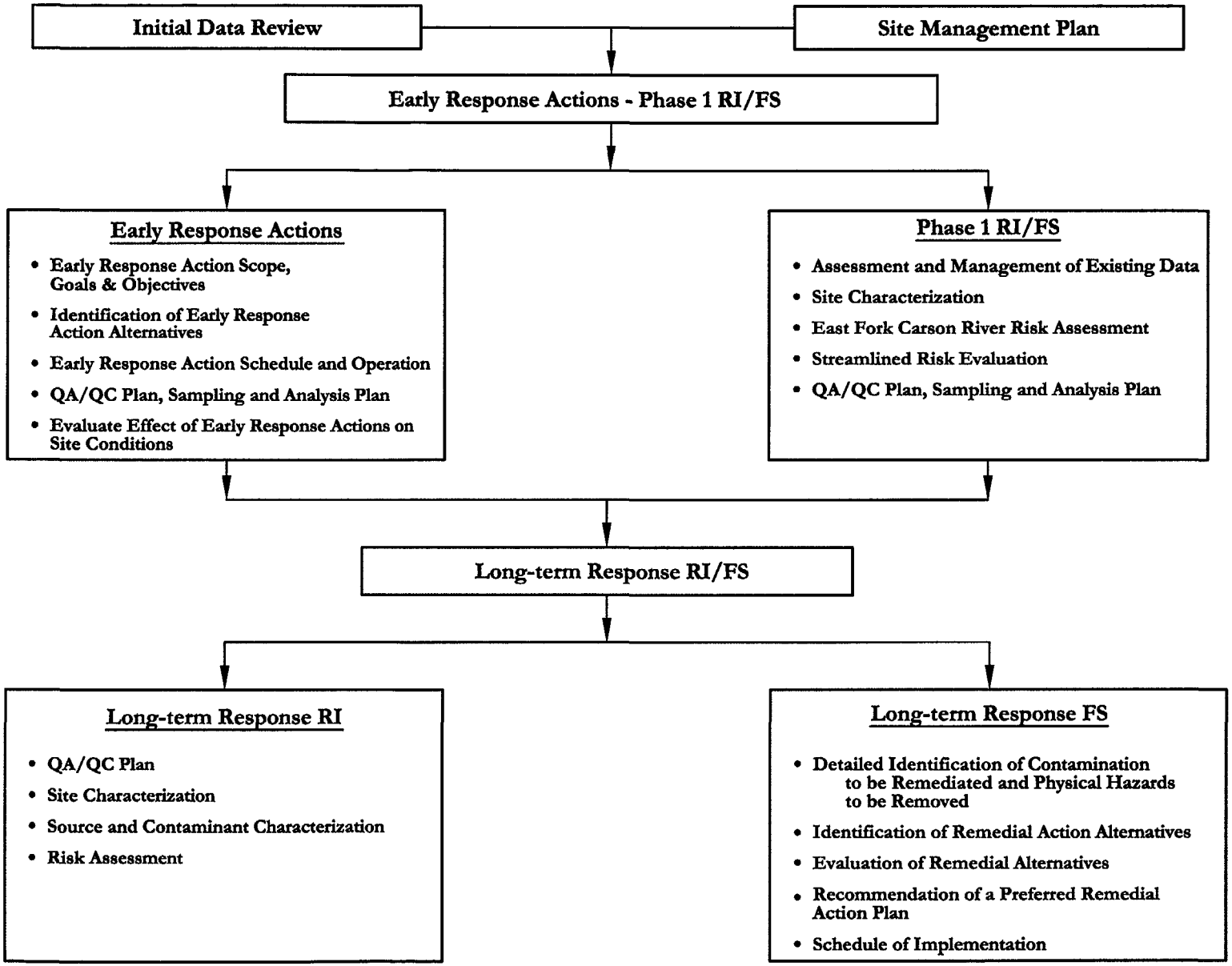
The specific tasks to be addressed in the Phase 1 RI/FS, as outlined in the SOW and updated per subsequent TAC meetings and conference calls, include the following:

- **Assessment and Management of Existing Data:** Atlantic Richfield will compile and assess existing data, along with other monitoring data collected during implementation of the ERAs.. The data will be compiled into a central document and electronic data management system compatible with EPA data systems and GIS. The information will be assessed for data quality, potential data gaps, and improvements to the CSM presented in the SMP.

- **Site Characterization:** Under the Phase 1 RI/FS, Atlantic Richfield will characterize the Site, summarizing available data on the physical, demographic, and other characteristics of the Site and surrounding areas, including background engineering information for analysis of ERA alternatives. Site characterization will include a Site description and background, a description of previous response actions at the Site, information characterizing the source, nature, and extent of contamination at the Site, and protocols for collection of groundwater and surface water data consistent with EPA protocols.

- **East Fork Carson River Risk Assessment:** Atlantic Richfield will submit a Risk Assessment (human health and ecological) for the East Fork of the Carson River as an early phase of the RI/FS to be implemented in parallel with ERAs.

- **Streamlined Risk Evaluation:** Atlantic Richfield will submit a streamlined risk evaluation for the Site upstream of the East Fork Carson River, intermediate in scope between the limited risk evaluation undertaken for emergency removal actions and the conventional baseline assessment normally conducted for remedial action. Site sampling data for various media will be reviewed to identify COCs, and provide an estimate of how and to what extent people or ecological receptors may be exposed to these COCs. The risk evaluation may also be used as a tool to define appropriate interim treatment levels.



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0	Issued For Draft Review	4/02	J Ray	J Gates	J Ray

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FIGURE No 5.1

ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

PROJECT TASKS

- **QA/QC Plan, Sampling and Analysis Plan:** The Phase I Work Plan will include a Site-wide SAP and QAPP for EPA approval. The Site-wide SAP and QAPP will set forth the minimum requirements that must be followed in the project-specific QAPPs and SAPs included within future work plans being prepared by Atlantic Richfield, RWQCB, and any other parties collecting data at the Site. Site investigations specified in the SAPs and QAPPs of future work plans (including ERA Work Plans, the Long-term Response RI/FS Work Plan, and RWQCB Work Plans) must be consistent with the Site-wide SAP and QAPP. The Site-wide SAP and QAPP will ensure that future data collected at the Site are of sufficient technical quality to support the Human Health and Ecological Risk Assessments and/or the development and evaluation of the response action during the FS.

These tasks are further defined in the following subsections.

5.2 ASSESSMENT AND MANAGEMENT OF EXISTING DATA

5.2.1 General

In accordance with the SOW, assessment and management of existing data will be conducted during the Phase 1 RI/FS. This task entails the following general activities:

- Compile and assess available historic data, along with other monitoring data collected during implementation of the ERAs;
- Compile data into a central document and electronic data management system compatible with EPA data systems and GIS; and
- Assess information for data usability, potential data gaps, and improvements to the CSM presented in the SMP. Potential data gaps will be addressed under the Long-term Response RI/FS.

Atlantic Richfield is in the process of compiling and evaluating available historic Site data, along with other monitoring data collected during implementation of the ERAs. Data are being compiled into a central electronic data management system (database) using Access software. The purpose of the database is to provide the efficient management of, and access to, normalized Leviathan Mine Site-related environmental data. The database is structured to be compatible with EPA data systems and GIS. Database information is being assessed for data quality, data gaps, and potential improvements to the CSM presented in Section 2.0 of the SMP, and updated in Section 3.0 of this Phase 1 Work Plan.

Data assessment and management activities, further discussed in the following subsections, will continue throughout the Phase 1 RI/FS.

5.2.2 Historic Data Inventory

Data currently within the database include surface water quality, surface water flow, groundwater quality, well construction details, soils pH, and climate. These data are currently organized by general source (e.g., USGS, RWQCB, SRK, etc.) to facilitate management of historical data entry. In addition, the database contains administrative tables, which include information such as the database index, parameter and quality control code definitions, usability code descriptions, data source references, and sampling station descriptions and identification aliases. Tables are linked based on common fields, such as location identification, sample identification, date, and source code. These relationships allow for custon data queries. Data currently contained within the database are listed in Table 5.1, *Database Index.*

TABLE 5.1
DATABASE INDEX
ENVIRONMENTAL DATABASE
LEVIATHAN MINE, ALPINE COUNTY, CALIFORNIA

Index No.	Data Type	Description	Date Range	EPA List Ref Code	Reference Date	Author	Data Source Reference1	SAP REFERENCE
1	Surface water quality	Surface water quality & flow	3/19/81 to 8/1/84	45889	1/1/85	D.P. Hammermeister, S.J. Walmsley, USGS	Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, CA, 1981-1983	None - methods summarized in data source report.
2	Surface water quality	Surface water quality	9/23/98 to 11/5/98		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Draft Leviathan Mine 1998 Work Plan
3	Surface water quality	Surface water quality & flow	8/1/84 to 10/29/01			RWQCB	Surface Water Sampling Results - electronic data deliverables	Leviathan Mine 5-Year Work Plan
4	Surface water quality	Surface water sampling events	1/7/98 to 10/29/01			RWQCB	Surface Water Sampling Results - electronic data deliverables	Same as #3.
5	Surface water flow	Surface water flow	9/23/98 to 11/5/98		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
6	Surface water flow	15' flow & pond stage heights	11/1/98 to 10/31/01			USGS	USGS provisional 15' flow data - internet download	None.
7	Surface water flow	Daily average of 15 min flow	10/16/98 to 10/31/01			USGS	USGS provisional 15' flow data - internet download	None.
8	Surface water flow	Monthly average of 15 minute flow	10/16/98 to 10/31/01			USGS	USGS provisional 15' flow data - internet download	None.
9	Surface water flow	Periodic flow calibrations	10/15/98 to 9/28/01			USGS	USGS provisional 15' flow data - internet download	None.
10	Surface water flow	Periodic surface water flow measurements	9/11/89 to 12/4/98			USGS	USGS provisional 15' flow data - internet download	None.
11	Surface water flow	Published USGS flow and stage data	10/17/98 to 9/30/00			USGS	USGS published flow data - internet download	None.
12	Soils	Test pit coordinate data	1998		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
13	Soils	Field paste pH and conductivity data	1998		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
14	Soils	Geotechnical data	1998		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
15	Groundwater quality	Groundwater quality (piezometers)	11/16/82 to 4/8/83	45889	1/1/85	D.P. Hammermeister, S.J. Walmsley, USGS	Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, CA, 1981-1983	Same as #1.
16	Groundwater levels	Groundwater elevations	11/12/82 to 4/8/83	45889	1/1/85	D.P. Hammermeister, S.J. Walmsley, USGS	Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, CA, 1981-1983	Same as #1.
17	Groundwater levels	Groundwater elevations	8/29/98 to 9/9/99		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
18	Groundwater	Monitor well construction details & coordinate data	1998		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
19	Groundwater	Groundwater quality (monitoring wells)	10/13/98 to 11/6/98		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.
20	Construction	Piezometer construction details & coordinate data	1982	45889	1/1/85	D.P. Hammermeister, S.J. Walmsley, USGS	Hydrologic Data for Leviathan Mine and Vicinity, Alpine County, CA, 1981-1983	Same as #1.
21	Climate data	Climate data	11/4/98 to 9/9/99		1/1/99	SRK Consulting	1998-1999 Data Summary Report, Administrative Order on Consent, Leviathan Mine, Alpine County, CA	Same as #2.

Note: 1. For example: final data summary report, investigation report, internet URL, etc.

Additional Site information, not yet contained within the database, but under review is listed in Appendix C, *List of Documents to be Reviewed.* This list is a subset of EPA's document inventory inlcuded in Appendix D, *EPA Site File Index.* Both the List of Documents to be Reviewed and the Site File Index are currently being reviewed by EPA and project stakeholders. The purpose of the review is to give project stakeholders the opportunity to submit documents/data not currently included within EPA's Site File Index to EPA for inclusion. In addition, this review provides stakeholders with the opportunity to indicate whether any additional documents in EPA's Site File Index should be added to the List of Documents to be Reviewed. Through this review process, additional data to be included within the database will be identified by the stakeholders and provided to EPA.

A meeting to discuss the status of the database was held in Reno, Nevada on February 27, 2002. Meeting minutes are included in Appendix E, *Database Meeting Minutes.* During the meeting, the following information was noted as missing from the database:

- EPA and the USFS noted that biological (macroinvertebrate) data are available for inclusion in the database (Herbst collected data from 1995 – 2000);
- RWQCB further noted that sediment data were collected in conjunction with the Herbst study;
- Nevada Department of Environmental Protection (NDEP) noted that they had collected data on Bryant Creek and the Carson River, which was not included in the database;
- USFS indicated that they had geotechnical data from the 1970s;
- RWQCB indicated that they did an exhaustive research review when they acquired the Site in 1983, and they do not recall data from the early 1960s and 1970s;
- RWQCB noted that SRK did a file review in 1998, and they were not certain whether the file review information was in the Site File Index or database;
- EPA stated that they would double check with their Office of Research and Development (ORD) and Las Vegas files for data that might be missing from the Site File Index; and
- UNR stated that Aspen Seep data are not currently included in the database. For Aspen Seep and other treatment data, it was agreed that only influent and effluent data would be included within the Site-wide database; process data would be kept separate from the Site-wide database, since DQOs on process management are different than DQOs on stream data.

Stakeholders agreed to provide this, as well as any additional information not included within the Site File Index, to EPA in March 2002. EPA will then update the Site File Index and provide Atlantic Richfield with any additional information to be added to the List of Documents to be Reviewed (see Appendix C). Atlantic Richfield will subsequently, under the Phase 1 RI/FS, update the database with input from project stakeholders. The database will continue to be updated throughout the RI/FS process, as additional data are provided. At the time of submittal of this Phase 1 Work Plan, EPA had not yet provided the updated List of Documents to be Reviewed or Site File Index to Atlantic Richfield.

5.2.3 Data Usability

Existing data will be screened and classified based upon its general usefulness in making decisions at the Site, as indicated in Figure 5-2, *Historical Data Usability*. Where applicable, the database will include the input of a data qualifier field that indicates what level of review the data has undergone. Screening-level data will be used primarily to identify the presence or absence of a chemical or compound, while more definitive data will be used to support site characterization, risk assessment and engineering design. Continued data evaluation will provide an indication of how the data can be used for decision-making at the Site.

Data usability was a topic of discussion during the February 27, 2002 database meeting. It was determined that the following three general categories of data usability would be applied to existing Site data:

- High documentation;
- Low documentation; or
- Rejected.

To be classified as either high or low documentation, data must, at a minimum, include the matrix sampled, analytes, sample location, sample date, results, and units. Data that do not include this minimum information set will be classified as rejected. Rejected data will then be placed in a separate "graveyard" database.

For data to be considered high documentation, it must also include the following additional information:

- Documented source;
- SAP documented and on file;
- Accurate x, y and z coordinates and time, if applicable; and
- Documented laboratory analytical method.

While it is preferable that the high documentation data be final data, data from some draft data summary reports may still be considered high documentation provided that the data have met specified quality assurance protocol and are not provisional in nature. Provisional USGS data, however, will not be classified as high documentation data until finalized.

In addition, if SAPs and QAPPs are not available on some historic data, but both the sampling and laboratory methods are known and documented (i.e., in the data summary report or in the laboratory reports), these data may also be considered as high documentation data.

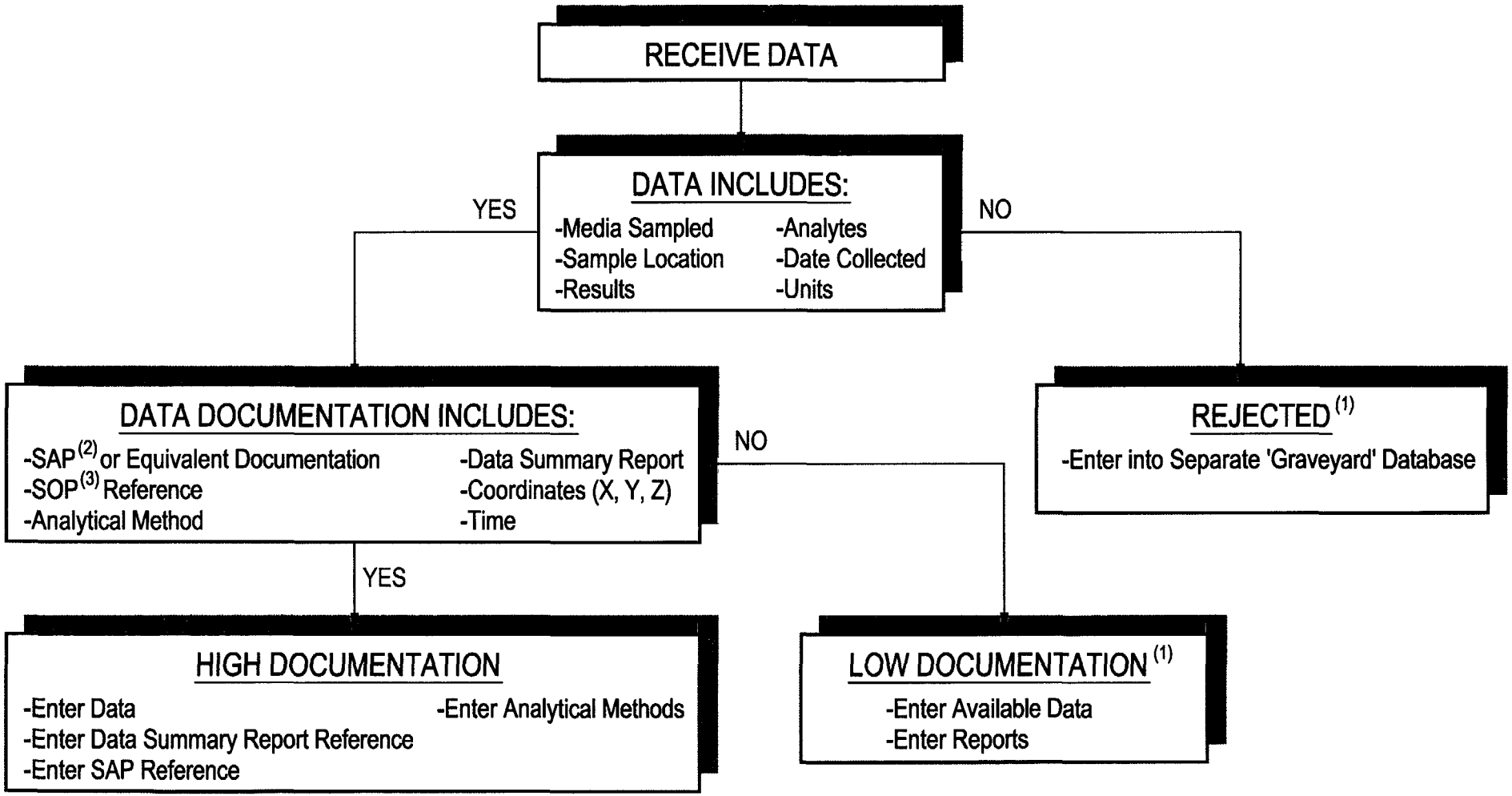
Both high and low documentation data will be maintained in the central database and may be used, as appropriate, in site characterization, discussed further in Section 5.3.

5.2.4 Data Management

Historic data will continue to be reviewed and entered into the Access database, and data usability will be determined, as specified above. Additional data collected at the Site will be in accordance with the Site-wide SAP and QAPP described herein. As such, all new data will be considered high documentation and receive data qualifiers described in the QAPP, as necessary.

The database is currently being updated on a monthly basis, primarily with USGS flow data and water quality data provided by the RWQCB. Monthly data updates will continue throughout the RI/FS

HISTORICAL DATA USABILITY



NOTES

1. Information will be solicited on Rejected and Low Documentation Data. If additional information is received, data usability will be reassessed.
2. SAP = Sampling and Analysis Plan
3. SOP = Standard Operating Procedures

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0	Issued for Draft Review	4/02	J.Ray	N.Gonzalez	J.Ray

MWH
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PROJECT No.: 5020047
AutoCAD FILE: Historical data 4-02
SCALE: Not to Scale
FIGURE No.: 5.2

ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

HISTORICAL DATA USABILITY

process. The database will be placed on the Atlantic Richfield FTP site quarterly. Given the size of the database, downloading from the FTP site has been an issue for some users. As an interim measure, Atlantic Richfield will also provide a CD version of the database biannually to EPA for use and distribution.

As specified previously, future data collected at the Site must be in accordance with the Site-wide SAP and QAPP, from sample collection in the field to data quality evaluation to data entry. Each entity collecting data under their EPA-approved Work Plans is responsible for their own data quality evaluation and data entry. Data must be formatted in accordance with the electronic template provided by Atlantic Richfield (a hard copy is included in Attachment 1 for reference). It is the responsibility of the entity collecting data to acquire a copy of the electronic template from Atlantic Richfield. After the responsible entity has performed the appropriate data quality evaluation and data entry, it will then forward the data to Atlantic Richfield electronically (via email or CD). Atlantic Richfield will then incorporate the new data into the central database.

5.3 SITE CHARACTERIZATION

Initial Site characterization has been performed and a CSM prepared, as described previously in Section 3.0 of this Phase 1 Work Plan.

The Site will be further characterized during the Phase 1 RI/FS, as the database is made current with the addition of documented historical data and new data collected under EPA-approved Work Plans. Available data on the physical, demographic, and other characteristics of the Site and surrounding areas will be summarized. Site characterization will include the following:

- Site description and background;
- Discussion of previous response actions at the Site; and
- Evaluation of the source, nature, and extent of contamination at the Site.

As the database continues to be updated and data are further evaluated, the CSM will be reviewed and refined. Data gaps will be identified, and supplemental data collection will be recommended for inclusion in the Long-term Response RI/FS Work Plan, as appropriate.

It is not anticipated that additional data will be collected under this Phase 1 Work Plan. During 2002, routine data collection currently being performed at the Site by the RWQCB and USGS will continue and supplemental data will be collected under the EPA-approved ERA and RWQCB 2002 Work Plans. Any additional data gaps identified during the data management (Section 5.2) and site characterization (Section 5.3) tasks described in this Phase 1 Work Plan will be addressed in the Long-term Response Work Plan currently scheduled to be submitted to EPA in April 2003. A major objective of the Phase 1 RI/FS, therefore, is to complete the database and data evaluation, such that the Site can be adequately characterized, an accurate CSM can be prepared, and appropriate technologies can be identified for consideration in the Long-term Response RI/FS.

5.4 EAST FORK CARSON RIVER RISK ASSESSMENT

Under the Phase 1 RI/FS, a Risk Assessment for the East Fork of the Carson River (EFCR) will be conducted. The EFCR Risk Assessment will encompass human health, as well as ecological risk, as described in the following paragraphs.

The EFCR Risk Assessment will be conducted along the EFCR in the vicinity of Bryant Creek near Dresslerville, Nevada. Available data will be reviewed and screening mechanisms will be proposed to identify contaminants of potential concern (COPCs) to be included in the Long-term Response RI/FS and the baseline human health risk assessment.

The evaluation will focus on surface water, sediments, and biota in the EFCR and selected lower Bryant Creek stations. Screening level evaluations will be conducted using a combination of conventional risk assessment benchmarks (i.e., water quality criteria/standards) and Site-specific analyses (e.g., sediment quality triad) when possible. Relevant exposure scenarios will be identified and draft CSMs will be developed to identify major and minor exposure pathways for each scenario.

The human health risk evaluation will include the following:

- Exposure Assessment
  - CSM for human health risks
  - Statistical evaluation of sampling data
  - Sediment screening criteria
- Effects Assessment
  - Sediment screening criteria
  - Surface water screening concentrations
  - Fish tissue screening concentrations
- Risk Characterization
  - Sediment concentrations
  - Water concentrations
  - Fish tissue concentrations

The ecological risk evaluation will include the following:

- Problem Formulation
- Exposure Assessment
- Effects Assessment
- Risk Characterization
  - Predictive Risk Characterization for Aquatic Biota
  - Predictive Risk Characterization for Wildlife
  - Site-Specific Risk Characterization for Aquatic Biota

To the extent practicable, evaluation methodologies for the EFCR human health risk evaluation and ecological risk evaluation will be consistent with those described below in Section 5.5.

5.5 STREAMLINED RISK EVALUATION

Under the Phase 1 RI/FS, a streamlined risk evaluation for the Site will be conducted. The streamlined risk evaluation for the Site will encompass the area upstream of the area covered by the EFCR Risk Assessment. The streamlined evaluation will be intermediate in scope between the limited risk evaluation undertaken for emergency removal actions and the conventional baseline risk assessment normally conducted for remedial action. Site sampling data for various media will be reviewed to identify COCs, and provide an estimate of how, and to what extent, people or ecological receptors may be exposed to these COCs. The risk evaluation may also be utilized as a tool to define appropriate interim treatment levels.

These streamlined risk assessments will help to scope and focus final baseline human health and ecological risk assessments to be completed as part of the Long-term Response RI/FS. The next two sections describe the proposed approach for the human health and ecological streamlined risk assessments.

5.5.1 Streamlined Human Health Risk Assessment

The streamlined human health risk assessment (HHRA) will focus on potential exposures to the area surrounding the mine Site, including surface water and sediments in Bryant Creek and the irrigation diversion from Bryant Creek. Potential exposure pathways evaluated will include surface waters, sediment, and soils in terrestrial areas potentially impacted by runoff or sediment transport from Leviathan Mine. Groundwater will not be included as a potential exposure pathway because of the lack of current or anticipated future uses. Exposure scenarios will be based on the identification of sensitive receptors, primarily limited to recreational users in the areas below the mine Site and trespassers on the secured mine Site. While the Washoe Tribe's cultural use of the resources in the area will be incorporated into the final baseline risk assessment, as appropriate, little data on cultural uses is expected to be available on a schedule that will allow it to be incorporated into the streamlined HHRA. Site workers and visitors at the secured mine Site are covered under the Site-specific Health and Safety Plan, and therefore, will not be addressed within the streamlined HHRA.

The streamlined HHRA will generally be conducted in accordance with EPA's *Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual* (Interim Final, December 1989, EPA 540-1-89-002). EPA's *RAGS Part D: Standard Planning, Reporting and Review of Superfund Risk Assessments* will be used as the guide for table format and other reporting elements to the extent that these formats are adaptable to a streamlined risk assessment.

The primary elements of the streamlined HHRA are anticipated to include:

- The CSM, with identification of exposure pathways and exposed populations. As described above and presented in the CSM included as Figure 3.11 of this Phase 1 Work Plan, exposed populations are expected to be limited to recreational users and trespassers. Building upon the existing CSM, exposure pathways will be identified as major or minor, with only major exposure pathways being quantified. Major pathways and routes of exposure are expected to include contact with soil, sediment, and surface water, primarily *via* incidental ingestion. Dermal contact exposures will be quantified only for selected metals (e.g., arsenic) for sediment and soil, and metals expected to contribute more than 10% of exposures for surface water. The COPCs are assumed to be limited to metals, therefore, inhalation exposures will not be quantified. Exposure *via* fish consumption will be quantified. Exposures *via* consumption of terrestrial plants or animals are assumed to be minor pathways, and will be discussed qualitatively. The discussion will address identification of species harvested and their abundance at the Site.

- A description of the data to be used in the risk assessment, and a description of the process followed to select the data.

- A list of COPCs for each exposure medium and route quantified, expected to include soil, sediment, surface water, and fish. For this assessment, the COPC list will begin with those associated with acid mine drainage from the Site as listed in the Administrative Order, namely arsenic, iron, aluminum, chromium, cobalt, copper, nickel, zinc, and pH. pH is not typically considered to be a COPC for HHRA. Only metals with site concentrations in excess of regional background values will be considered as COPCs. EPA Region 9 PRGs will be used to further screen the list of likely COPCs and COPCs not of concern for human health will be excluded.

- Exposure units: The Site will be subdivided into exposure units based on consideration of the nature and extent of likely exposures. Four units are currently envisioned, including the mine Site, Leviathan and Aspen Creeks below the mine boundary, Bryant Creek, and the Bryant Creek Irrigation Diversion.

- Exposure algorithms and exposure parameters for each exposure pathway in each scenario.

- Exposure point concentrations: To streamline the HHRA, maximum sediment and soil concentrations in each exposure unit will be selected for initial screening. For surface water, recent monthly concentrations during the warmer half of the year will be averaged for each station, and the highest average in each exposure unit will be selected for initial screening.

- Toxicity values for each COPC. EPA's Integrated Risk Information System (IRIS) will be the primary source of these values.

- Risk algorithms for use in characterizing cancer risks and non-cancer hazard quotients, and the approach to be used in assessing uncertainty. Uncertainty will be addressed in a qualitative or semiquantitative manner if risks are within or below EPA's acceptable risk range. A more detailed, quantitative uncertainty assessment may be proposed if any risks exceed the acceptable risk range.

The streamlined HHRA report will also include identification of any data gaps that need to be addressed prior to completion of the baseline HHRA.

5.5.2 Streamlined Ecological Risk Assessment

The streamlined ecological risk assessment (SERA) will be focused on quantifying risks from those potential exposure pathways uninfluenced by ERAs, while identifying appropriate risk-based interim treatment levels, and facilitating development of the final baseline risk assessment to be conducted following the ERAs.

ERAs at the Site are in response to known risks to aquatic receptors so the SERA will not quantify risks driving ERAs but will help define risk-based interim treatment levels and help establish Site ecological risk assessment methods. For example, available biomonitoring data collected by Herbst may be used to establish site-specific risk-based criteria to document the relative success of interim treatment levels and the recovery of downstream water quality to conditions biologically similar to reference sites. Risks to the terrestrial ecosystem components of the mine Site including revegetated areas, the areas that have historically received irrigation diversion water from Bryant Creek, and riparian areas potentially impacted by historic runoff or sediment transport from Leviathan Mine, will also be evaluated in the SERA to the extent possible with available data.

The SERA will be conducted in accordance with U.S. EPA's 1992 *Framework for Ecological Risk Assessment.* EPA/630/R-92/001, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. and EPA's 1997 *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ).

Following the EPA risk assessment framework, the SERA will be conduced in three phases: problem formulation, analysis, and risk characterization. During problem formulation, existing data will be used to define the source and characteristics of the stressors such that a CSM relevant to the ecosystems at risk will be further refined and developed. The ecological exposure CSM will build upon the existing CSM (refer to Figure 3.11) and will be used to:

- Identify potential sources of contamination;
- Identify the release pathways from the contaminant sources to affected environmental media (*e.g.*, soil, surface water, sediment and prey or forage tissues);
- Identify potential routes of ecological exposure (*e.g.*, immersion in water, ingestion of water, prey, and forage and incidental ingestion of sediment and soil); and
- Identify potential receptors (*i.e.*, selected surrogates for the ecological receptors likely to be exposed and any special species of concern).

For each exposure media, contaminants of potential ecological concern (COPECs) will be preliminarily identified though evaluation of existing data that includes comparison to background, evaluation of contaminant bioavailability and comparison of media concentrations with appropriate screening ecological effects thresholds. The SERA will likely focus on the COPECs associated with acid mine drainage from the Site as listed in the Administrative Order, namely arsenic, iron, aluminum, chromium, cobalt, copper, nickel, zinc, and pH. The CSM linking the stressors to specific endpoints representing receptors of concern will be defined and utilized as a depiction of the working hypothesis to be evaluated in the risk assessment. For the SERA, the CSM will illustrate the role of ERAs in interrupting exposure pathways and altering COPEC bioavailability between stressor sources and receptors. Those complete exposure pathways not affected by the ERAs will be identified and risks from these pathways will be characterized in the SERA to the extent possible with the available data.

Assessment and measurement endpoints used to evaluate the management goals will be defined for each significant exposure pathway identified in the CSM. A small subset of ecological receptors will be selected to represent the assessment and measurement endpoints. Critical Site habitats, (i.e. wetlands) and resident species deemed as threatened or endangered by Federal or State agencies will be identified.

The final stage of problem formulation is the analysis plan where risk hypotheses are evaluated to determine how they will be assessed using available and any new data. The plan will include the assessment design, data selection criteria, data needs, and measures of exposure and effects to be used to conduct the analysis and risk characterization phases of the assessment.

The SERA will include identification of any data gaps that need to be addressed prior to completion of the baseline ecological risk assessment. In this way, the SERA can complete as much assessment as practical while assessment gaps can be filled in time for inclusion in the final baseline risk assessment after ERAs are completed and any identified data gaps are filled.

5.6 QA/QC PLAN, SAMPLING AND ANALYSIS PLAN

5.6.1 General

This section describes and outlines the Site-wide QAPP and SAP, to be used throughout the project. The Site-wide SAP and QAPP set forth the minimum requirements that must be followed in the project-specific QAPPs and SAPs included within future work plans being prepared by Atlantic Richfield, RWQCB, and any other parties collecting data at the Site. Site investigations specified in future work plans (including ERA Work Plans, the Long-term Response RI/FS Work Plan, and RWQCB Work Plans) must be consistent with the Site-wide SAP and QAPP described herein.

5.6.2 Site-wide SAP

The purpose of the Site-wide SAP is to ensure that sampling and analysis are conducted in a consistent and appropriate manner and that, as specified in the SOW, sampling locations are documented in a log and the locations are identified on detailed maps of appropriate scale. The SAP is presented in Attachment 1, *Leviathan Mine Site – Site-wide Sampling and Analysis Plan.* All Site work plans must include a SAP that meets the minimum requirements set forth in the Site-wide SAP.

A SAP typically includes the following two major components:

- A Field Sampling Plan (FSP); and
- A Quality Assurance Project Plan (QAPP).

Future work plans prepared for the Site will include SAPs, consistent with the requirements of the Site-wide SAP in Attachment 1. The FSP will be project-specific in nature and outline the specific sampling being conducted under the work plan and the data being collected.

5.6.3 Site-wide QAPP

The purpose of the Site-wide QAPP is to ensure that future data collected at the Site are of sufficient technical quality to support the Human Health and Ecological Risk Assessments and/or the development and evaluation of the response action during the Feasibility Study. The QAPP is presented in Attachment 1, Leviathan Mine Site – *Site-wide Sampling and Analysis Plan.* All Site work plans must include a QAPP that meets the minimum requirements set forth in the Site-wide QAPP.

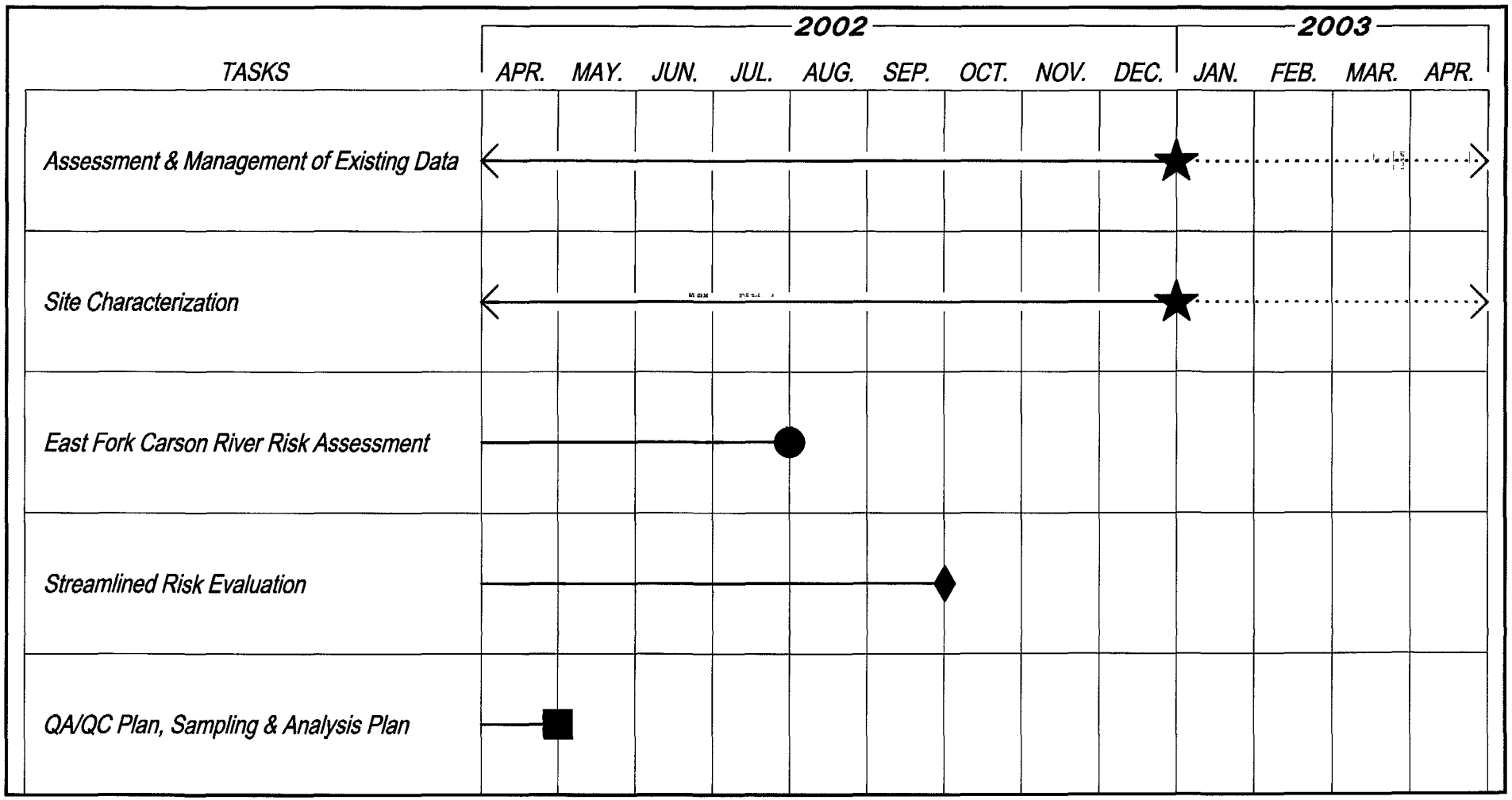
6.0 SCHEDULE

EPA and Atlantic Richfield have developed a schedule for the implementation of ERAs and RI/FS activities, as discussed in Sections 3.3 and 4.3 of the SMP. As indicated in the SMP, this Phase 1 Work Plan is being submitted to EPA for approval in April 2002. Figure 6-1, *Task Schedule*, provides further detail pertaining to the tasks outlined in this Phase 1 Work Plan.

As illustrated in the figure, ongoing data review and evaluation and database updates will continue throughout the RI/FS process. It is anticipated that the review of historic data will be completed by the end of 2002, providing a more complete data set for Site characterization and CSM refinement. Updated Site evaluation discussions will be presented in the 2003 SMP, scheduled to be submitted to EPA in December 2002. At that time, data gaps will be identified for inclusion in the Long-term Response RI/FS Work Plan, scheduled to be submitted to the EPA for approval in April 2003. In addition, modifications to the Site-wide SAP and QAPP (included within this Phase 1 Work Plan as Attachment 1) will also be included in the 2003 SMP, if required.

The EFCR Risk Assessment will continue through early 2002 and be submitted to EPA in July 2002. The Streamlined Risk Evaluation will be initiated upon approval of the work scope, provided herein. It is anticipated to be submitted to EPA in September 2002, assuming timely approval of the scope.

Upon completion of the Phase 1 RI/FS, data gaps will be identified for inclusion in the Long-term Response RI/FS Work Plan, scheduled to be submitted to the EPA for approval in April 2003. Subsequent years focus on filling in data gaps, completing the risk assessment, identifying remedial action alternatives, and completing the Long-term Response RI/FS. A Record of Decision (ROD) is anticipated from EPA in approximately 2005.



KEY DELIVERABLE DATES

- ■ APRIL 2002: PHASE 1 RI/FS WORK PLAN - QA/QC PLAN AND SAMPLING AND ANALYSIS PLAN INCLUDED WITHIN ATTACHMENT 1
- ● JULY 2002: EAST FORK CARSON RIVER RISK ASSESSMENT
- ♦ SEPTEMBER 2002: STREAMLINED RISK EVALUATION
- ★ DECEMBER 2002: 2003 SITE MANAGEMENT PLAN - WILL INCLUDE UPDATE ON ASSESSMENT AND MANAGEMENT OF EXISTING DATA AND SITE CHARACTERIZATION (INCLUDING A REVISED CONCEPTUAL SITE MODEL) CONTINUES

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued for Draft Report	4/02	J.Ray	J.Gates	J.Ray

MWH
MONTGOMERY WATSON HARZA

PROJECT No.: 8020047
AutoCAD FILE: task schedule 4-02
SCALE: Not to Scale
FIGURE No: 6.1

ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

TASK SCHEDULE

7.0 PROJECT MANAGEMENT

7.1 GENERAL PROJECT ACTIVITIES

Phase 1 RI/FS activities will be conducted concurrently with ongoing ERAs and Site remediation. The primary entities with defined Site activities and tasks include Atlantic Richfield, RWQCB, and EPA.

Atlantic Richfield's primary 2002 activities include the following:

- Conduct the Phase 1 RI/FS (including data management, site characterization, EFCR risk assessment, and streamlined risk evaluation of areas above the EFCR); and

- Conduct 2002 ERAs (as defined in the 2002 ERA Work Plan).

Atlantic Richfield's Project Manager and Project Coordinator is:

- Mr. Steve M. Ferry
  Atlantic Richfield Company
  307 East Park Street, Suite 400
  Anaconda, Montana 59711
  TL: 406-563-5211, ext. 453
  FX: 406-563-8269
  E-mail: ferrysm1@bp.com

Mr. Ferry will manage all phases of the project and oversee project schedule and deliverables.

RWQCB activities, to be coordinated with Phase 1 RI/FS and other Site activities include the following:

- Continue monthly stream water quality monitoring;
- Continue evaporation pond water treatment; and
- Continue Site maintenance, revegetation, and erosion control activities.

The RWQCB coordinator is:

- Mr. Christopher Stetler
  California Regional Water Quality Control Board
  Lahontan Region
  2501 Lake Tahoe Boulevard
  South Lake Tahoe, CA 96150
  TL: 530-542-5461

EPA activities, to be coordinated with Phase 1 RI/FS and other Site activities include the following:

- Provide Site oversight; and
- Continue compilation of existing Site reports, evaluations, and data.

EPA's Remedial Project Manager (RPM) and Alternate RPM include:

- Kevin Mayer, RPM
  75 Hawthorne Street SFD 7-2
  San Francisco, CA 94105
  TL: 415-744-2448
  E-mail: mayer.kevin@epa.gov

- Kathi Moore, Alternate RPM
  75 Hawthorne Street SFD 7-2
  San Francisco, CA 94105
  TL: 415-744-2221
  E-mail: moore.kathi@epa.gov

7.2 PROJECT COORDINATION

Given the number of entities involved at the Site, success of the project is dependent on successful coordination. Coordination activities are briefly summarized below, by entity, and avenues of communication are shown schematically in Figure 7-1, *Leviathan Project Team Organization/ Coordination.* This summary will continue to be revised and updated, based upon input from the RWQCB and EPA.

Atlantic Richfield

Atlantic Richfield will perform the following:

- Distribute monthly progress reports;

- Distribute database/GIS updates (with information from RWQCB, USGS, and others, as appropriate);

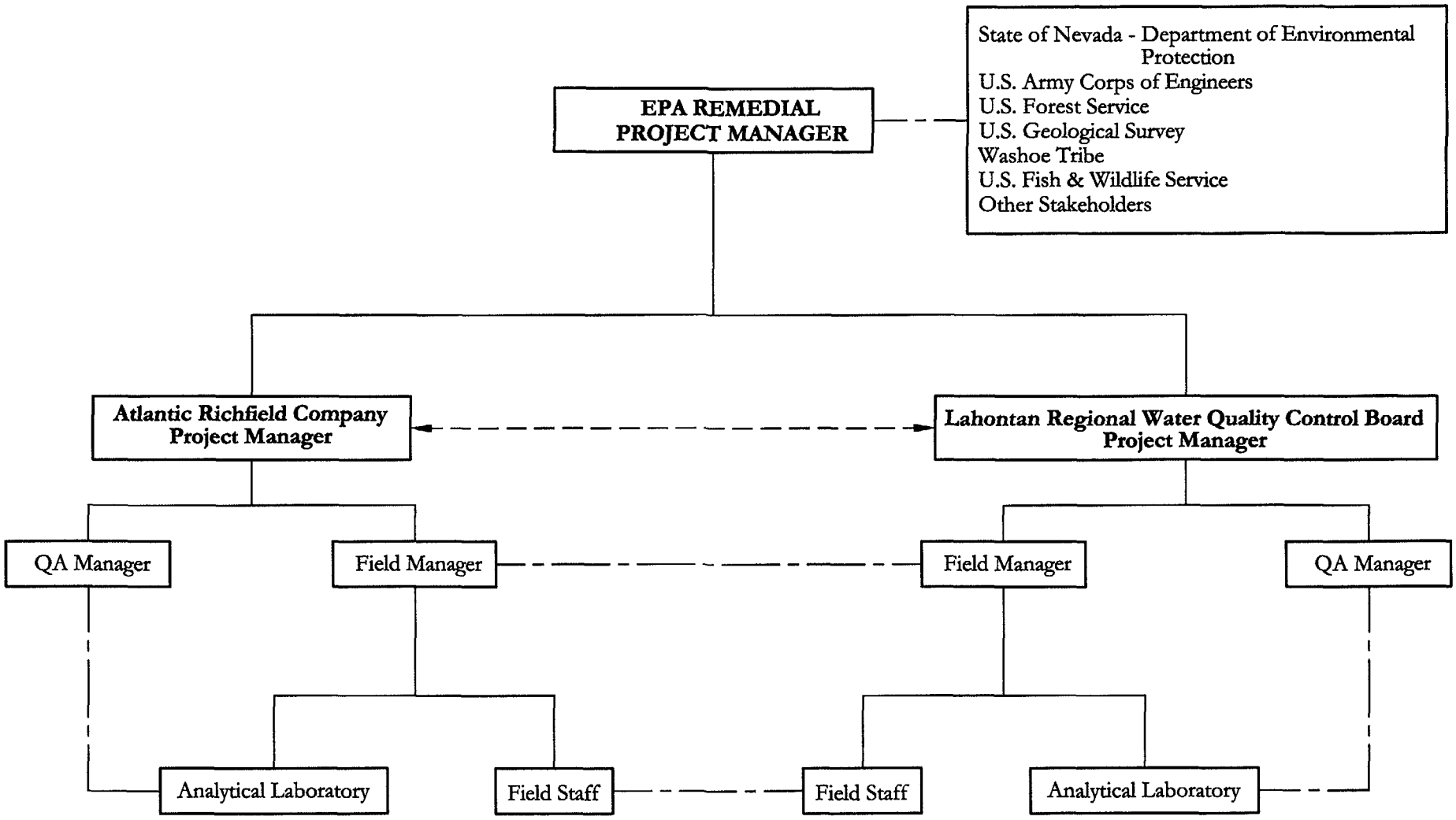
- Distribute RI/FS and ERA work plans, data and summary reports;

- Conduct 2002 ERAs and Phase 1 RI/FS activities;

- Participate in stakeholder, agency, and TAC meetings, as requested by EPA;

- Coordinate planning meetings/teleconferences during ERA design/construction/operation and other on-Site activities, as appropriate, with participants dependent on the topic and activities at the Site. Coordination issues will be defined and action items established for involved entities. An assigned individual will be responsible for preparing summary notes and an updated schedule after each meeting/call (notes will be distributed to the larger group by email). Planning meetings/teleconferences will be scheduled to provide verbal notification to EPA at least 15 days prior to conducting significant field events; and

- Coordinate on-Site kick-off meetings prior to initiating new on-Site activities.



Authority
Primary Communication
Communication

REV No	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued For Review Draft	4/02	J.Ray	J.Gates	J.Ray

MWH
MONTGOMERY WATSON HARZA

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ATLANTIC RICHFIELD COMPANY
Leviathan Mine Site - Phase 1 RI/FS Work Plan

LEVIATHAN PROJECT TEAM ORGANIZATION/COORDINATION

EPA

EPA will perform the following:

- Schedule and coordinate stakeholder, agency, and TAC meetings, and distribute meeting minutes.

RWQCB

The RWQCB will perform the following:

- Coordinate on-Site maintenance, construction, operation, and monitoring activities (by any party) to minimize safety concerns;
- Schedule and coordinate USGS monitoring with other field activities;
- Continue bi-phasic treatment system operation, stream monitoring, Site maintenance, revegetation, and erosion control activities; and
- Distribute work plans and data/summary reports for evaporation pond/adit bi-phasic water treatment, Site maintenance, revegetation, and erosion control activities.

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APPENDIX A

LEVIATHAN MINE SITE SURFACE WATER DATA

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Adit									
	1/7/1998	260	14	670	4.9	-	2.65	3300	5000
	2/13/1998	270	16	690	5	-	2.64	3500	5100
	3/18/1998	260	13	660	4.9	2.55	2.66	4600	5300
	4/20/1998	-	-	-	-	-	2.31	5400	6700
	7/31/1998	-	-	-	-	2.27	-	-	-
	11/3/1998	280	15	770	6	2.56	2.65	3500	4820
	12/4/1998	250	13	660	5.1	2.73	2.65	3300	-
	1/13/1999	290	12	680	5.6	2.39	2.67	3600	4670
	1/21/1999	300	13	690	5.8	-	2.7	3800	5200
	2/3/1999	310	12	710	5.9	-	2.64	3900	5080
	3/12/1999	300	13	680	5.4	2.73	2.64	3100	5200
	4/20/1999	340	13	730	5.8	-	-	4300	5820
	5/19/1999	370	16	890	8	-	2.21	4800	6910
	6/16/1999	310	15	750	6.1	-	-	4400	5300
	7/29/1999	290	18	770	6.6	2.22	-	3500	5300
	9/9/1999	280	15	720	5.9	2.42	-	3600	5250
	10/21/1999	270	15	630	5.5	2.53	-	3100	4700
	11/28/1999	280	11	620	5.1	2.73	-	1600	4840
	12/21/1999	270	13	650	5.3	2.57	-	3600	4800
	1/28/2000	270	13	650	5.1	2.64	-	7000	4930
	2/11/2000	300	14	690	5.5	2.54	-	4200	4970
	3/2/2000	290	12	660	5.1	-	-	3300	4800
	4/28/2000	330	13	770	5.7	2.57	-	3600	5400
	5/5/2000	-	-	-	-	2.6	-	-	-
	5/30/2000	280	11	640	4.9	2.67	-	3500	4900
	6/16/2000	270	11	640	5.1	2.57	-	5000	5000
	7/31/2000	280	14	650	5	-	-	5900	5200
	8/28/2000	270	11	180	4.8	2.61	-	4300	5200
	9/27/2000	290	11	670	4.8	2.61	-	4800	10000
	10/30/2000	290	12	700	5	2.54	-	3000	65000
	11/28/2000	300	11	780	5	2.65	-	9300	4800
	12/28/2000	270	11	670	4.9	2.78	-	3500	4700
	1/26/2001	260	11	582	4.8	2.66	-	3100	4700
	2/28/2001	260	11	630	4.7	2.69	-	6500	4500
	3/27/2001	240	10	610	4.5	2.67	-	3400	4900
	4/25/2001	260	10	600	4.4	2.54	-	4200	4600
	5/29/2001	260	10	630	4.6	2.44	-	4000	300
	6/27/2001	250	9.6	600	4.3	2.46	-	3600	4300
	7/26/2001	270	9.6	600	4.3	2.56	-	3200	4300
	8/25/2001	280	10	620	4.6	2.71	-	3300	4400
	9/27/2001	290	11	640	4.7	2.67		3000	4700
	10/29/2001	240	9.2	560	4.2	2.87		3200	4700
	No. of Samples	35	35	36	35	29	11	36	35
	Minimum	240	9.6	180	4.3	2.22	2.21	1600	300
	Maximum	370	18	890	8.0	2.78	2.70	9300	65000
	Mean	283	12	664	5.3	2.57	2.58	4039	6757
	Median	280	12	665	5.1	2.57	2.65	3600	4930
	Standard Deviation	26	2	103	0.7	0.13	0.15	1317	10070
	No. of non-detects	0	0	0	0	0	0	0	0
	% non-detect	0%	0%	0%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(11/1999 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Pit Underdrain									
	11/28/1999	-	-	-	-	2.98	-	-	-
	2/11/2000	300	0.73	790	3.6	2.75	-	6300	7080
	3/2/2000	210	-0.1	610	2.8	-	-	3800	5100
	4/28/2000	170	1.4	470	1.8	2.84	-	2800	4100
	5/30/2000	200	1.4	520	2	2.99	-	3200	4500
	6/16/2000	200	0.82	600	2.3	2.81	-	5700	4900
	7/31/2000	230	-0.1	950	2.9	-	-	7900	6700
	8/28/2000	250	0.83	1100	3.1	3.03	-	6300	7500
	9/27/2000	280	0.3	1200	3.5	3.05	-	8100	7700
	10/30/2000	280	0.4	1200	3.6	3	-	4700	8000
	11/30/2000	300	0.35	1400	4.1	-	-	7000	7800
	12/28/2000	270	0.46	1200	4.2	2.9	-	6400	8400
	1/26/2001	270	0.58	1300	4.4	2.73	-	5700	8000
	2/28/2001	260	-0.1	1200	4.1	2.72	-	9700	8100
	3/27/2001	210	1.6	420	1.8	2.78	-	6300	4800
	4/25/2001	400	5.7	1100	2.3	1.54	-	6800	7900
	5/29/2001	330	1.5	1200	3.4	2.28	-	5600	4300
	6/27/2001	340	1	1200	3.6	2.47	-	8200	8700
	7/26/2001	320	0.35	1300	3.7	2.68	-	5900	9400
	8/25/2001	350	0.14	1300	4.1	2.82	-	6500	8700
	9/27/2001	330	-0.5	1300	4.5	2.86		6300	9600
	10/29/2001	310	-0.1	1500	4.8	3.24		6500	10000
	No. of Samples	19	19	19	19	17	0	19	19
	Minimum	170	-0.10	420	1.8	1.54	0	2800	4100
	Maximum	400	5.70	1400	4.4	3.05	0	9700	9400
	Mean	272	0.93	1003	3.2	2.73	N/A	6153	6931
	Median	270	0.58	1200	3.5	2.81	N/A	6300	7700
	Standard Deviation	59	1.23	316	0.8	0.36	N/A	1676	1681
	No. of non-detects	0	3	0	0	0	0	0	0
	% non-detect	0%	16%	0%	0%	0%	N/A	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values
N/A = Not Applicable

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Channel Underdrain									
	1/7/1998	41	0.49	360	1.8	-	4.5	2200	3200
	2/13/1998	39	0.37	340	1.8	-	4.65	2200	3300
	3/18/1998	43	0.2	290	1.6	4.7	4.76	2500	3000
	4/20/1998	-	-	-	-	-	4.35	2100	4600
	5/20/1998	63	0.48	420	2.2	4.44	4.35	3400	3500
	6/18/1998	55	0.8	400	2.1	-	-	4000	3700
	7/31/1998	56	0.34	440	2.3	4.57	4.51	2200	3200
	8/27/1998	54	0.55	430	2.3	4.63	4.29	2300	3250
	10/2/1998	50	0.57	420	2.2	4.65	4.54	2200	3200
	11/3/1998	47	0.6	430	2.3	4.41	4.66	2100	3000
	12/4/1998	42	0.49	330	1.8	-	4.66	1900	-
	1/13/1999	42	0.51	370	2.2	5.17	4.88	1900	2810
	2/3/1999	41	0.44	360	2	-	4.57	2100	3120
	3/12/1999	47	0.5	340	1.9	4.71	4.57	1800	2760
	4/20/1999	51	0.5	330	1.9	-	-	1800	2730
	5/19/1999	68	0.53	450	2.5	4.33	4.32	2500	3370
	6/16/1999	61	0.72	430	2.5	-	-	2300	3120
	7/29/1999	54	0.63	450	2.5	4.45	-	2000	3400
	9/4/1999	54	0.68	420	2.3	4.63	-	2100	3080
	9/9/1999	50	0.56	380	2.1	4.67	-	2300	3160
	10/21/1999	45	0.66	380	2.1	4.68	-	1800	3300
	11/28/1999	42	0.53	370	1.8	4.8	-	2500	3330
	12/21/1999	43	0.75	380	2.1	4.72	-	2300	3100
	1/28/2000	40	0.69	370	1.9	4.72	-	2300	3000
	2/11/2000	45	0.66	380	2	4.73	-	2200	3110
	3/2/2000	43	0.5	360	2	-	-	1900	2985
	4/28/2000	45	0.39	360	1.8	4.65	-	1800	2900
	5/5/2000	-	-	-	-	4.69	-	-	-
	5/30/2000	42	0.46	340	1.8	4.78	-	1900	2900
	6/16/2000	-	0.54	360	2	4.75	-	3000	2800
	7/31/2000	36	0.5	330	1.7	-	-	3000	3000
	8/28/2000	35	0.47	340	1.7	4.71	-	2300	3100
	9/27/2000	42	0.52	380	1.9	4.68	-	2600	3100
	10/30/2000	41	0.62	370	1.9	4.61	-	1800	3200
	11/28/2000	-0.05	0.54	370	1.8	4.68	-	2500	3200
	12/28/2000	40	0.6	360	1.9	4.8	-	2300	3000
	1/26/2001	39	0.66	360	1.9	4.63	-	2000	3100
	2/28/2001	37	0.3	360	1.7	4.7	-	2900	3000
	3/27/2001	43	0.52	320	1.7	4.65	-	5200	2800
	4/25/2001	40	0.26	300	1.6	4.55	-	1900	2100
	5/29/2001	38	0.47	330	1.7	4.5	-	2100	1900
	6/27/2001	37	0.56	350	1.7	4.56	-	2300	2900
	7/26/2001	36	0.46	360	1.7	4.62	-	2600	2900
	8/25/2001	38	0.46	370	1.8	4.63	-	2700	2900
	9/27/2001	39	0.53	390	1.9	4.62		2600	3100
	10/29/2001	35	0.41	350	1.7	4.47		3000	3100
	10/29/01 (dup)	34	0.39	350	1.7	4.47		2800	2800
	No. of Samples	38	39	39	39	32	14	40	39
	Minimum	0	0.20	290	1.6	4.33	4.29	1800	1900
	Maximum	68	0.80	450	2.5	5.17	4.88	5200	4600
	Mean	45	0.53	373	2.0	4.65	4.54	2348	3075
	Median	45	0.53	370	2.0	4.68	4.56	2200	3120
	Standard Deviation	11	0.13	39	0.2	0.14	0.17	636	403
	No. of non-detects	1	0	0	0	0	0	0	0
	% non-detect	3%	0%	0%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(2/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Pond Over Flow									
	2/13/1998	960	43	1700	17	-	2.36	12000	18000
	3/18/1998	650	18	1200	12	2.5	2.49	10000	1100
	4/20/1998	-	-	-	-	-	2.61	3100	4100
	5/20/1998	320	9.3	600	5.3	2.69	2.69	5800	5700
	6/18/1998	520	16	950	8.3	-	-	-	-
	7/31/1998	990	26	1400	17	2.24	2.32	12000	16600
	8/27/1998	1200	35	1800	22	2.18	2.3	15000	21000
	1/21/1999	1200	18	1300	20	-	2.6	12000	16100
	2/3/1999	840	18	1200	15	-	2.43	10000	12000
	3/12/1999	560	18	1000	9.3	2.61	2.48	6000	9050
	4/20/1999	220	5.8	380	3.8	-	-	3000	3660
	5/19/1999	320	6.9	530	5.2	2.58	2.7	4600	5770
	6/16/1999	480	11	710	7.9	-	-	5300	7120
	7/29/1999	980	20	1300	17	2.21	-	10000	15000
	9/4/1999	1600	38	1700	26	2.19	-	16000	19500
	9/9/1999	-	-	-	-	2.21	-	-	-
	No. of Samples	14	14	14	14	9	10	14	14
	Minimum	220	5.8	380	3.8	2.18	2.30	3000	1100
	Maximum	1600	43.0	1800	26.0	2.69	2.70	16000	21000
	Mean	774	20.2	1126	13.3	2.38	2.50	8914	11050
	Median	745	18.0	1200	13.5	2.24	2.49	10000	10525
	Standard Deviation	388	11.1	437	6.6	0.20	0.14	4123	6377
	No. of non-detects	0	0	0	0	0	0	0	0
	% non-detect	0%	0%	0%	0%	0%	0%	0%	0%
Delta Seep									
	11/28/1999	2	0.059	20	0.51	5.66	-	850	1620
	12/21/1999	1.4	0.094	21	0.52	5.67	-	1100	1600
	1/28/2000	2.4	0.056	20	0.55	5.62	-	3100	1560
	2/11/2000	1.9	-0.1	21	0.56	5.62	-	1100	157
	3/2/2000	1.5	-0.1	20	0.52	-	-	1000	1500
	4/28/2000	4.7	0.069	33	0.54	5.45	-	1300	1600
	5/30/2000	1.8	0.064	20	0.5	5.68	-	1500	1600
	6/16/2000	-	0.066	21	-	5.6	-	1700	1600
	7/31/2000	1.2	0.086	21	0.51	-	-	1200	1600
	8/28/2000	1.2	0.079	19	0.44	5.65	-	1100	1600
	9/27/2000	1.3	-0.1	21	0.46	5.71	-	1400	1500
	10/30/2000	1.6	0.07	21	0.48	5.7	-	1300	1600
	9/27/2001	1.1	0.063	22	0.49	5.82		1200	1500
	10/29/2001	0.98	0.052	18	0.41	5.7		1100	1600
	No. of Samples	7	9	8	11	7	0	8	8
	Minimum	1.4	-0.10	20	0.4	5.45	0	850	157
	Maximum	4.7	0.094	33	0.6	5.68	0	3100	1620
	Mean	2.2	0.062	22	0.5	5.61	N/A	1456	1405
	Median	1.9	0.059	21	0.5	5.62	N/A	1200	1600
	Standard Deviation	1.0	0.013	4	0.0	0.07	N/A	672	473
	No. of non-detects	0	3	0	0	0	0	0	0
	% non-detect	0%	33%	0%	0%	0%	N/A	0%	0%

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Mean and Standard Deviation calculated using half of the detection limit for non-detect values
N/A = Not Applicable

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(4/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Overburden Seep									
	4/20/1998	-	-	-	-	-	2.91	4000	2500
	6/19/1998	46	-0.005	80	0.46	-	3	3300	3100
	7/31/1998	64	-0.1	120	0.69	2.85	2.97	2100	2880
	8/27/1998	60	-0.05	110	0.67	2.73	2.79	2400	2880
	10/2/1998	57	-0.1	130	0.65	3.18	3.18	1900	2740
	11/3/1998	53	-0.0005	120	0.6	2.96	3.21	1800	2920
	12/4/1998	51	-0.0005	110	0.55	3.56	3.21	1900	-
	1/13/1999	51	-0.005	100	0.61	3.27	3.17	1800	2620
	2/3/1999	50	-0.005	100	0.65	-	3.02	1800	2360
	7/28/1999	54	-0.1	170	0.71	3.22	-	1800	2600
	9/9/1999	55	-0.1	160	0.62	3.36	-	1900	2810
	10/21/1999	52	-0.1	150	0.64	3.31	-	1600	2300
	11/28/1999	50	0.0089	130	0.52	3.28	-	2700	2670
	12/21/1999	45	0.064	140	0.58	3.3	-	1800	2400
	1/28/2000	0.073	-0.005	0.11	-0.04	3.21	-	1800	2430
	2/11/2000	56	-0.005	150	0.66	3.18	-	1900	2390
	4/28/2000	46	-0.1	140	0.7	3.18	-	1700	2500
	5/30/2000	47	-0.1	140	0.57	3.3	-	2200	2500
	6/16/2000	-	-0.1	140	0.59	3.32	-	2900	2500
	7/31/2000	42	-0.005	130	0.54	-	-	2900	2400
	8/29/2000	42	-0.1	130	0.53	3.42	-	1900	2600
	9/27/2000	47	-0.1	140	0.54	3.27	-	1400	2300
	10/30/2000	41	-0.1	130	0.51	3.26	-	1400	2300
	11/28/2000	39	-0.1	120	0.49	3.32	-	4300	3300
	12/28/2000	39	-0.1	130	0.51	3.39	-	1600	2200
	1/26/2001	37	-0.1	110	0.48	3.27	-	1700	2100
	2/28/2001	37	-0.1	120	0.47	3.28	-	2600	2100
	3/27/2001	36	-0.1	110	0.46	3.17	-	2400	2100
	4/25/2001	34	-0.1	110	0.44	3.07	-	1800	2100
	5/29/2001	36	-0.1	120	0.48	2.98	-	1800	1400
	6/27/2001	38	-0.1	130	0.5	3.06	-	2200	2200
	7/26/2001	36	-0.1	120	0.47	3.11	-	2000	2300
	8/25/2001	38	-0.1	120	0.47	3.21	-	2100	2100
	9/27/2001	42	-0.1	140	0.53	3.4		2100	2300
	10/29/2001	34	-0.1	110	0.44	3.26		1900	2200
	No. of Samples	27	32	28	28	26	9	29	28
	Minimum	0.073	-0.10	0.11	-0.04	2.73	2.79	1600	1400
	Maximum	64	0.06	170	0.71	3.56	3.21	4300	3300
	Mean	45	0.04	121	0.55	3.20	3.05	2200	2464
	Median	46	-0.10	120	0.56	3.22	3.02	1900	2465
	Standard Deviation	12	0.02	30	0.13	0.17	0.14	663	376
	No. of non-detects	0	30	0	1	0	0	0	0
	% non-detect	0%	94%	0%	4%	0%	0%	0%	0%

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Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(6/1998 - 6/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Pond 1									
	6/18/1998	340	11	780	5.4	-	-	-	7500
	7/31/1998	630	17	1300	11	2.32	2.48	-	11400
	3/20/2000	10	0.087	16	0.18	-	-	160	160
	4/18/2001	230	3.5	370	4.1	2.74	-	3200	3000
	6/7/2001	450	2.2	500	9	2.54	-	5100	-
	No. of Samples	5	5	5	5	3	1	3	4
	Minimum	10	0.087	16	0.18	2.32	2.48	160	160
	Maximum	630	17.00	1300	11.0	2.74	2.48	5100	11400
	Mean	332	6.76	593	5.9	2.53	2.48	2820	5515
	Median	340	3.50	500	5.4	2.54	2.48	3200	5250
	Standard Deviation	208	6.31	430	3.8	0.17	0	2035	4289
	No. of non-detects	0	0	0	0	0	0	0	0
	% non-detect	0%	0%	0%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values
N/A = Not Applicable

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 1									
	1/7/1998	-0.2	0.0076	0.25	-0.02	-	7.63	9.2	130
	4/20/1998	-	-	-	-	-	6.33	14	140
	6/19/1998	-0.2	-0.005	-0.1	-0.02	-	7.11	3.4	140
	7/31/1998	-0.05	-0.1	0.16	-0.04	8.33	7.4	6	68
	8/27/1998	0.14	-0.05	0.25	-0.04	7.33	7.57	7	129
	10/2/1998	0.032	-0.0165	-0.1	-0.04	8.02	7.45	7	116
	11/3/1998	0.19	-0.0005	0.76	-0.02	7.36	7.51	6.4	116
	12/4/1998	-0.025	-0.0005	-0.05	-0.02	-	7.51	8	-
	1/13/1999	-0.05	-0.005	-0.1	-0.005	8.32	7.34	7.9	48
	2/3/1999	-0.05	-0.005	-0.1	-0.04	-	7.71	9.2	114
	3/12/1999	0.062	-0.005	0.11	-0.005	7.49	7.57	9.2	106
	4/20/1999	2.1	-0.005	1.1	-	-	-	4.6	119
	5/19/1999	-0.05	-0.005	0.48	-	-	-	2.9	104
	6/15/1999	0.13	-0.005	0.16	-0.005	8.03	-	4	120
	7/28/1999	-0.05	-0.005	0.1	-0.005	8.06	-	6.5	140
	8/16/1999	-	-	-	-	8.1	-	-	-
	8/18/1999	-	-	-	-	8.18	-	-	-
	8/19/1999	-	-	-	-	8.19	-	-	-
	8/20/1999	-0.05	-0.005	-0.1	-0.005	7.88	-	6.6	130
	9/4/1999	-0.05	-0.005	0.24	-0.005	7.89	-	6.7	126
	9/8/1999	-0.05	-0.005	-0.1	-0.005	8	-	7.5	126
	9/15/1999	-0.05	-0.005	-0.1	-0.005	7.95	-	7.6	110
	9/25/1999	-0.05	-0.005	0.11	-0.001	7.94	-	6.6	220
	9/29/1999	-0.05	-0.005	-0.1	0.26	8.02	-	6.4	130
	10/9/1999	-0.05	-0.005	-0.1	-0.005	7.95	-	6.3	89
	10/21/1999	-0.05	-0.005	-0.1	-0.005	7.88	-	7.1	130
	11/28/1999	-0.05	-0.005	-0.1	-0.005	7.95	-	6.3	116
	12/21/1999	-0.05	-0.005	-0.1	-0.005	7.65	-	10	190
	1/28/2000	0.27	-0.005	0.29	-0.005	7.39	-	9.4	118
	2/11/2000	-0.05	-0.005	-0.1	-0.005	7.59	-	10	100
	3/2/2000	-0.05	-0.005	-0.1	-0.005	-	-	11	100
	4/28/2000	0.13	0.013	0.24	-0.005	8.26	-	6.4	110
	5/30/2000	0.08	-0.005	-0.1	-0.005	7.67	-	7.6	110
	6/16/2000	-	-0.005	-0.1	-0.005	8.1	-	8	120
	7/31/2000	-0.05	-0.005	-0.1	-0.005	-	-	10	170
	8/28/2000	-0.05	-0.005	0.15	-0.005	8.2	-	8	150
	9/7/2000	-	-	-	-	8.15	-	-	-
	9/27/2000	-0.05	-0.005	-0.1	-0.001	8.21	-	9.5	140
	10/30/2000	-0.05	-0.005	0.16	-0.005	8.13	-	9.3	110
	11/28/2000	0.13	-0.005	-0.1	-0.005	7.89	-	8.5	87
	12/28/2000	-0.05	-0.005	-0.1	-0.005	7.7	-	8.7	130
	1/26/2001	0.19	-0.005	-0.1	-0.005	7.68	-	8.6	120
	2/28/2001	0.26	-0.005	-0.1	-0.005	7.4	-	9.2	140
	3/27/2001	0.46	-0.005	0.58	-0.005	7.45	-	8.6	130
	4/25/2001	0.69	-0.005	0.61	0.015	7.76	-	8.1	77
	5/29/2001	-0.05	-0.005	0.14	-0.005	7.84	-	8.7	100
	6/27/2001	0.098	-0.005	0.16	-0.005	7.75	-	8.6	150
	7/26/2001	-0.05	-0.005	0.2	-0.005	7.9	-	7.9	130
	8/8/2001	-0.05	-0.005	-0.1	-0.005	-	-	8.9	160
	8/16/2001	-	-	-	-	-	-	8.2	140
	8/22/2001	-	-0.005	-	-0.005	-	-	7.7	140
	8/25/2001	0.11	-0.001	0.19	0.0013	7.82	-	8.8	170
	8/29/2001	-0.05	-0.005	-0.1	0.0075	-	-	9.7	140
	9/6/2001	-0.05	-0.005	-0.1	-0.005	-	-	8.2	140
	9/12/2001	-0.05	-0.005	-0.1	-0.005	-	-	7.4	130
	9/27/2001	-0.05	-0.005	-0.1	-0.005	7.93		4	120
	10/29/2001	-0.05	-0.005	-0.1	-0.005	7.63		7.7	130
	No. of Samples	47	49	46	47	36	11	47	46
	Minimum	-0.20	-0.100	-0.10	-0.040	7.33	6.33	2.9	48
	Maximum	2.10	0.013	1.10	0.260	8.33	7.71	14.0	220
	Mean	0.13	0.004	0.16	0.010	7.85	7.38	7.8	124
	Median	-0.05	-0.005	-0.10	-0.005	7.89	7.51	7.9	126
	Standard Deviation	0.32	0.008	0.21	0.037	0.27	0.36	1.9	28
	No. of non-detects	31	47	27	43	0	0	0	0
	% non-detect	66%	96%	59%	91%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 15									
	1/7/1998	3	0.21	35	0.35	-	4.87	560	700
	2/13/1998	270	7.1	490	4.9	-	2.85	3000	4500
	3/18/1998	38	0.16	44	0.67	3.14	3.27	880	1100
	4/20/1998	-	-	-	-	-	4.56	170	300
	5/20/1998	-0.2	0 0064	4.6	0.089	6.14	5.81	200	210
	6/18/1998	-0.2	-0.005	8.6	0.11	6.65	-	230	300
	7/31/1998	2.4	-0.1	30	0.3	5.42	5.35	390	627
	8/27/1998	16	-0.05	53	0.73	3.17	3.32	800	1090
	10/2/1998	2.7	-0.1	71	0.55	4.8	5.08	670	944
	11/3/1998	0 69	-0.0005	56	0.44	5.78	4.87	610	815
	12/4/1998	4.9	0.051	47	0.42	5.48	4.87	630	-
	1/13/1999	0 084	0.035	41	0.35	6.65	6.61	470	667
	1/21/1999	310	4.4	330	5.8	-	2.9	3400	4680
	2/3/1999	88	0.58	120	1.9	-	3.01	1300	1770
	3/12/1999	47	0.13	60	0.93	3.52	3.14	860	1030
	4/20/1999	0 063	-0.005	2.1	0.077	-	-	100	186
	5/19/1999	0.15	-0.005	1.2	0.058	-	6.56	69	77
	6/15/1999	-0.05	0.0058	18	0.22	6.5	-	220	388
	7/28/1999	13	0.019	48	0.64	3.46	-	630	990
	8/12/1999	-	-	-	-	3.24	-	-	-
	8/16/1999	-	-	-	-	3.21	-	-	-
	8/18/1999	14	0.0068	39	0.71	3.19	-	780	1030
	9/3/1999	9.9	0.024	26	0.42	3.75	-	1900	2670
	9/8/1999	9.2	0.014	17	0.36	3.56	-	2300	3480
	9/15/1999	9.2	0.012	23	0.93	3.61	-	2200	3200
	9/25/1999	10	0 023	19	0.47	4.6	-	2000	3200
	9/28/1999	9.4	0.025	20	0.44	4	-	1900	3200
	10/9/1999	9.7	0.027	28	0.43	3.89	-	2100	3100
	10/15/1999	13	0.04	63	0.56	4.13	-	1200	1800
	10/21/1999	11	0.056	51	0.58	4.29	-	690	1000
	11/28/1999	4.1	0.026	46	0.44	5.04	-	710	906
	12/21/1999	5.5	0.045	48	0.52	4.71	-	720	950
	1/28/2000	11	0.048	35	0.38	5.17	-	600	737
	2/11/2000	2.4	0.12	34	0.38	5.24	-	570	746
	3/2/2000	0.79	0.023	31	0.32	-	-	470	650
	4/28/2000	-0.05	0.016	13	0.12	6.86	-	220	330
	5/30/2000	1.5	0.026	30	0.33	4.92	-	450	660
	6/15/2000	-	0.016	30	0.51	3.72	-	720	880
	7/31/2000	12	0.013	11	0.5	-	-	2500	2700
	8/29/2000	8.2	0.023	22	0.36	3.7	-	1900	2500
	9/7/2000	-	-	-	-	4.31	-	-	-
	9/27/2000	12	0.0097	37	0.6	3.2	-	1500	1200
	10/30/2000	9.6	0.015	37	0.48	4.1	-	680	1100
	11/28/2000	6.3	0.015	19	0.35	4.06	-	630	840
	12/28/2000	3.7	0.024	28	0.39	4.44	-	580	870
	1/26/2001	3	0.019	21	0.31	4.43	-	520	800
	2/28/2001	2.1	0.019	24	0.32	4.8	-	680	750
	3/27/2001	0.18	-0.005	12	0.17	6.2	-	390	460
	4/25/2001	-0.05	-0.005	0.91	0.06	6.71	-	140	230
	5/29/2001	2.2	0.017	34	0.36	4.89	-	520	710
	6/27/2001	12	0.012	34	0.62	2.92	-	990	1200
	7/26/2001	14	0.0054	37	0.78	2.85	-	1300	1600
	8/25/2001	21	0.0044	1.8	0.53	3.63	-	2800	3000
	9/28/2001	8.1	-0.005	2	0.3	4.44		1400	1700
	10/29/2001	-0.05	-0.005	-0.1	0.075	2 92		340	560
	No. of Samples	44	45	45	45	40	15	46	45
	Minimum	-0.2	-0.10	1	0.06	2.85	2.85	69	77
	Maximum	310.0	7.10	490	5.80	6.86	6.61	3400	4680
	Mean	22.3	0.30	49	0.67	4.57	4.47	941	1319
	Median	5 2	0.02	31	0.42	4.44	4.87	650	880
	Standard Deviation	60.5	1.21	82	1 06	1.17	1.27	802	1160
	No. of non-detects	5	9	0	0	0	0	0	0
	% non-detect	11%	20%	0%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
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Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 16									
	1/7/1998	-0.2	-0.005	-0.1	-0.02	-	7.07	230	360
	2/13/1998	0.43	0.018	0.96	0.022	-	5.79	230	410
	3/18/1998	-0.2	0.01	-0.1	-0.02	7.11	6.38	230	420
	4/20/1998	-	-	-	-	-	6.14	250	430
	5/20/1998	-0.2	-0.005	-0.2	0.062	6.13	5.99	590	520
	6/18/1998	-0.2	0.0091	-0.1	0.043	6.53	-	630	500
	7/31/1998	0.64	-0.1	0.36	0.067	4.86	5.66	300	481
	8/27/1998	2.1	-0.05	0.32	0.072	4.82	4.71	300	464
	10/2/1998	0.34	-0.1	-0.1	0.053	6.25	5.73	260	429
	11/3/1998	0.27	-0.0005	0.24	0.044	6.48	6.43	250	368
	12/4/1998	0.34	-0.0005	0.23	0.031	7.11	6.43	220	-
	1/13/1999	0.099	-0.005	0.1	0.038	6.65	6.65	230	356
	2/3/1999	-0.05	-0.005	-0.1	-0.04	-	7	180	225
	3/12/1999	0.15	-0.005	0.19	0.028	7.03	6.58	210	331
	4/20/1999	0.13	-0.005	-0.1	0.033	-	-	260	428
	5/19/1999	-0.05	-0.005	-0.1	0.041	-	6.86	250	412
	6/15/1999	0.097	-0.005	-0.1	0.03	7.3	-	210	366
	7/28/1999	-0.05	-0.005	-0.1	0.025	7.77	-	200	360
	8/16/1999	-	-	-	-	7.65	-	-	-
	8/19/1999	0.061	-0.005	-0.1	0.026	7.87	-	190	327
	9/3/1999	0.078	-0.005	-0.1	0.037	7.86	-	190	330
	9/9/1999	0.073	0.0066	-0.1	0.026	7.96	-	180	334
	9/29/1999	0.054	-0.005	-0.1	-0.04	7.95	-	170	310
	10/21/1999	0.2	-0.005	-0.1	-0.04	7.74	-	170	340
	11/28/1999	0.056	-0.005	-0.1	-0.04	7.69	-	190	331
	12/21/1999	-0.05	-0.005	-0.1	0.011	7.33	-	130	260
	1/28/2000	2	0.013	1.3	0.028	7.68	-	190	345
	2/11/2000	0.056	0.026	-0.1	0.024	7.7	-	170	325
	3/2/2000	-0.05	-0.005	-0.1	0.023	-	-	200	400
	4/28/2000	0.076	0.01	-0.1	-0.005	7.88	-	240	310
	5/30/2000	0.1	-0.005	-0.1	0.016	8.01	-	200	310
	6/15/2000	-	0.006	0.14	0.012	7.91	-	130	250
	7/31/2000	-0.05	0.0075	-0.1	-0.005	-	-	130	210
	8/29/2000	-0.05	0.008	-0.1	0.0091	7.73	-	130	270
	9/7/2000	-	-	-	-	8.27	-	-	-
	9/27/2000	0.6	-0.1	0.24	-0.04	8.26	-	84	220
	10/30/2000	-0.05	0.0079	-0.1	-0.005	8.04	-	120	270
	11/28/2000	-0.05	0.0086	-0.1	-0.005	8.06	-	140	210
	12/28/2000	0.089	0.0086	-0.1	-0.005	7.9	-	100	240
	1/26/2001	1.2	0.0062	-0.1	0.016	7.87	-	150	320
	3/1/2001	-0.05	0.008	0.21	0.035	7.08	-	210	400
	3/27/2001	-0.05	-0.005	-0.1	-0.005	8.15	-	230	410
	4/25/2001	-0.05	0.012	-0.1	-0.005	8.25	-	170	310
	5/29/2001	-0.05	0.0098	-0.1	-0.005	8.07	-	48	150
	6/27/2001	0.11	0.0089	-0.1	-0.005	8.26	-	68	180
	7/26/2001	0.065	0.0087	-0.1	0.012	8.2	-	57	170
	8/25/2001	0.099	0.0096	0.19	0.002	8.38	-	60	200
	9/28/2001	-0.05	0.011	-0.1	-0.005	8.2		73	210
	10/29/2001	-0.05	-0.005	-0.1	-0.005	7.56		1.2	120
	No. of Samples	42	41	44	44	35	14	41	40
	Minimum	-0.20	-0.100	-0.2	-0.04	4.82	4.71	48	150
	Maximum	2.10	0.026	1.3	0.07	8.38	7.07	630	520
	Mean	0.23	0.010	0.1	0.02	7.41	6.24	210	341
	Median	0.06	-0.005	-0.1	0.02	7.74	6.41	200	337
	Standard Deviation	0.46	0.013	0.2	0.02	0.86	0.61	109	89
	No. of non-detects	17	24	32	16	0	0	0	0
	% non-detect	40%	59%	73%	36%	0%	0%	0%	0%

Notes: "-" denotes no data available
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Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 17									
	1/7/1998	0.36	0.013	14	0.15	-	5.85	360	540
	2/13/1998	120	3.8	210	2.1	-	2.98	1800	2700
	3/18/1998	27	0.059	26	0.48	3.32	3.41	660	890
	4/20/1998	-	-	-	-	-	5.02	180	290
	5/20/1998	-0.2	-0.005	3.8	0.088	6.13	5.62	250	250
	6/18/1998	-0.2	0.0058	5.5	0.084	6.58	-	250	340
	7/31/1998	2.2	-0.1	51	0.45	4.55	5.09	470	752
	8/27/1998	7.5	-0.05	20	0.33	3.37	3.63	560	735
	10/2/1998	-0.05	-0.1	33	0.29	5.5	5.08	530	672
	11/3/1998	0.47	-0.0005	26	0.24	6.12	5.24	440	560
	12/4/1998	3.2	-0.0005	28	0.28	5.4	5.24	480	-
	1/13/1999	0.11	0.014	18	0.19	6.75	6.45	350	514
	2/3/1999	47	0.18	51	1	-	3.21	830	1070
	7/28/1999	5.2	0.0069	19	0.28	4.5	-	390	600
	10/21/1999	1.2	0.013	19	0.25	5.67	-	380	630
	11/28/1999	0.36	0.011	17	0.18	6.48	-	390	582
	12/21/1999	0.55	0.0095	15	0.19	6.34	-	370	520
	1/28/2000	6.5	0.019	19	0.23	6.1	-	420	570
	2/11/2000	0.39	0.012	15	0.18	6.59	-	400	549
	3/2/2000	-0.05	0.012	15	0.18	-	-	-	560
	4/28/2000	3.2	0.0055	17	0.12	7.15	-	210	320
	5/30/2000	0.1	0.013	16	0.19	6.55	-	370	490
	6/15/2000	-	0.0059	11	0.21	5.76	-	400	500
	7/31/2000	1.1	-0.005	1.3	0.18	-	-	1100	1000
	8/29/2000	0.3	0.01	7.9	0.17	5.72	-	920	1200
	9/7/2000	-	-	-	-	7.12	-	-	-
	9/27/2000	0.21	-0.005	6.1	0.16	6.16	-	370	490
	10/30/2000	0.52	0.007	14	0.2	6.04	-	370	570
	11/28/2000	0.35	0.058	5.9	0.14	6.53	-	400	490
	12/28/2000	0.41	0.09	10	0.16	6.57	-	300	500
	1/26/2001	0.56	0.0077	8.3	0.14	6.37	-	320	510
	3/1/2001	0.48	0.0098	0.66	0.13	6.62	-	360	570
	3/27/2001	-0.05	-0.005	7.6	0.12	7.07	-	310	480
	4/25/2001	-0.05	-0.005	0.28	0.06	7.34	-	150	280
	5/29/2001	-0.05	0.0086	7.6	0.087	6.6	-	300	440
	6/27/2001	0.11	-0.005	4.8	0.14	6.59	-	260	390
	7/26/2001	0.073	-0.005	2	0.098	6.93	-	200	360
	8/25/2001	0.18	0.0058	0.23	0.031	7.5	-	180	360
	9/28/2001	0.11	-0.005	0.2	0.045	7.28		240	410
	10/29/2001	-0.05	-0.005	-0.1	-0.04	6.24		68	210
	No. of Samples	31	34	34	32	28	12	32	32
	Minimum	-0.2	-0.1	0	0.03	3.32	2.98	150	250
	Maximum	120.0	3.800	210	2.10	7.50	6.45	1800	2700
	Mean	7.3	0.132	21	0.27	6.11	4.74	415	594
	Median	0.4	0.007	15	0.18	6.51	5.09	370	517
	Standard Deviation	22.6	0.639	35	0.37	1.04	1.09	285	415
	No. of non-detects	7	12	0	0	0	0	0	0
	% non-detect	23%	35%	0%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(4/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 22									
	4/20/1998	-	-	-	-	-	6.6	11	170
	6/19/1998	-0.2	-0.005	-0.1	-0.02	-	7.56	0.91	150
	7/31/1998	0.059	-0.1	0.16	-0.04	8.8	7.67	1.1	82
	8/27/1998	-0.025	-0.05	-0.1	-0.04	7.71	7.64	-2	124
	10/2/1998	0.025	-0.0165	-0.1	-0.04	7.99	7.67	1.2	128
	11/3/1998	-0.025	-0.0005	0.097	-0.02	7.52	7.46	1.1	123
	12/4/1998	-0.025	-0.0005	0.073	-0.02	7.81	7.46	1.2	-
	1/13/1999	-0.05	-0.005	-0.1	-0.005	8.79	7.87	1.2	123
	2/3/1999	-0.05	-0.005	-0.1	-0.04	-	7.82	1.4	131
	6/15/1999	-0.05	-0.005	-0.1	-0.005	8.07	-	-1	118
	7/28/1999	-0.05	-0.005	-0.1	-0.005	8.01	-	3.1	150
	9/9/1999	-0.05	-0.005	-0.1	-0.005	8.36	-	1.2	76
	10/21/1999	0.13	-0.005	-0.1	-0.005	8.18	-	1.4	130
	11/28/1999	0.064	-	-0.1	-	8.29	-	1.3	107
	12/21/1999	-0.05	-0.005	-0.1	-0.005	8.13	-	1.6	130
	1/28/2000	0.25	-0.005	0.4	-0.005	8.16	-	1.3	135
	2/11/2000	-0.05	-0.005	-0.1	-0.005	8.36	-	1.3	118
	4/28/2000	-0.05	0.016	-0.1	-0.005	8.29	-	1.2	120
	5/30/2000	0.077	-0.005	0.14	-0.005	8.27	-	1.1	130
	6/16/2000	-	-0.005	-0.1	-0.005	8.24	-	0.99	110
	7/31/2000	0.055	-0.005	0.11	-0.005	-	-	47	120
	8/29/2000	-0.05	-0.005	-0.1	-0.005	8.2	-	1.2	120
	9/27/2000	-0.05	-	-0.1	-0.04	8.48	-	1.3	130
	10/30/2000	-0.05	-0.005	-0.1	-0.005	8.31	-	1.2	110
	11/28/2000	-0.05	-0.005	-0.1	-0.005	8.3	-	1.3	51
	12/28/2000	0.14	-0.005	0.12	-0.005	8.44	-	1.5	120
	1/26/2001	-0.05	-0.005	-0.1	-0.005	8.06	-	1.6	120
	2/28/2001	-0.05	-0.005	-0.1	-0.005	8.28	-	1.6	140
	3/27/2001	-0.05	-0.005	0.11	-0.005	8.33	-	2.6	120
	4/25/2001	0.14	-0.005	0.4	-0.005	8.46	-	2.3	96
	5/29/2001	-0.05	-0.005	-0.1	-0.005	8.74	-	1.2	75
	6/27/2001	-0.05	-0.005	-0.1	-0.005	8.82	-	1.4	130
	7/26/2001	-0.05	-0.005	-0.1	0.014	8.32	-	1.4	110
	8/25/2001	0.07	-0.001	-0.1	-0.001	8.47	-	1.1	140
	9/28/2001	-0.05	-0.005	-0.1	-0.005	8		1.2	120
	10/29/2001	-0.05	-0.005	-0.1	-0.005	8.08		1.2	120
	No. of Samples	31	31	32	32	27	9	30	29
	Minimum	-0.20	-0.1	-0.10	-0.04	7.52	6.60	-2.0	51
	Maximum	0.25	0.016	0.40	0.014	8.82	7.87	11.0	170
	Mean	0.05	0.0052	0.08	0.006	8.27	7.53	1.7	119
	Median	-0.05	-0.0050	-0.10	-0.005	8.29	7.64	1.3	123
	Standard Deviation	0.05	0.0095	0.09	0.007	0.31	0.35	1.8	24
	No. of non-detects	22	30	24	31	0	0	2	0
	% non-detect	71%	97%	75%	97%	0%	0%	7%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 23									
	1/7/1998	0.35	-0.005	8.1	0.16	-	5.6	360	500
	2/13/1998	100	2.5	150	1.8	-	2.99	1700	2400
	3/18/1998	17	-0.005	8.4	0.32	3.42	3.57	400	570
	5/20/1998	-0.2	-0.005	1.9	0.077	6.12	6.16	180	240
	6/18/1998	-0.2	0.0095	3	0.079	6.6	-	200	320
	7/31/1998	2.8	-0.1	16	0.25	7.68	5.01	380	553
	8/27/1998	7.4	-0.05	8.5	0.33	3.36	3.43	580	717
	10/2/1998	5.3	-0.1	13	0.27	4.28	4.56	470	632
	11/3/1998	1.7	-0.0005	17	0.24	4.63	5.06	440	582
	12/4/1998	1.2	-0.0005	8	0.18	5.23	5.06	400	-
	1/13/1999	0.31	0.0069	10	0.19	6.11	6.39	360	576
	2/3/1999	43	0.14	38	0.95	-	3.24	520	1130
	5/19/1999	-0.05	-0.005	0.11	0.048	-	6.83	88	132
	6/15/1999	0.062	-0.005	3.6	0.15	6.8	-	90	152
	7/28/1999	5.2	-0.005	8.6	0.25	3.87	-	390	620
	8/12/1999	-	-	-	-	4.18	-	-	-
	8/16/1999	-	-	-	-	3.86	-	-	-
	8/19/1999	5.1	-0.005	4.7	0.26	3.41	-	430	602
	9/3/1999	8.4	-0.005	14	0.38	4.01	-	510	746
	9/8/1999	6.4	-0.005	3.5	0.27	3.91	-	760	1120
	9/15/1999	8.5	-0.005	23	0.41	4	-	610	860
	9/25/1999	5.3	-0.001	1.8	0.33	4.72	-	1300	2000
	9/28/1999	5.5	-0.005	10	0.35	4.66	-	960	1400
	10/9/1999	3.9	-0.005	7	0.24	4.61	-	760	1200
	10/15/1999	5.4	0.0051	25	0.35	4.6	-	600	880
	10/21/1999	0.92	-0.005	10	0.22	5.28	-	400	630
	11/28/1999	0.054	-0.005	6	0.15	6.91	-	370	545
	12/21/1999	0.092	-0.005	7.1	0.19	6.68	-	390	550
	1/28/2000	3.3	0.0066	6.8	0.18	6.13	-	350	547
	2/11/2000	0.14	-0.005	5.4	0.16	6.47	-	390	496
	3/2/2000	-0.05	-0.005	4.3	0.14	-	-	420	480
	4/28/2000	-0.05	0.0086	-0.1	0.08	7.05	-	200	320
	5/5/2000	-	-	-	-	6.86	-	-	-
	5/30/2000	0.62	-0.005	2.3	0.17	5.76	-	320	480
	6/15/2000	-	-0.005	6.4	0.21	5.13	-	420	520
	7/31/2000	2.3	-0.005	0.1	0.2	-	-	1100	1100
	8/29/2000	1.8	-0.005	2.1	0.19	1.7	-	910	1200
	9/7/2000	-	-	-	-	6.58	-	-	-
	9/27/2000	0.061	-0.005	1.3	0.14	6.68	-	420	520
	10/30/2000	-0.05	-0.005	1.9	0.13	7.01	-	320	420
	11/28/2000	0.12	-0.005	1.6	0.11	6.96	-	420	430
	12/28/2000	0.11	-0.005	3.9	0.15	6.82	-	330	540
	1/26/2001	0.22	-0.005	1.5	0.12	6.5	-	310	500
	3/1/2001	0.24	-0.005	-0.1	-0.04	6.54	-	330	520
	3/27/2001	0.071	-0.005	2.5	0.096	6.96	-	250	390
	4/24/2001	-0.05	-0.005	-0.1	0.048	7.89	-	150	280
	4/25/2001	-0.05	-0.005	-0.1	0.04	7.46	-	150	280
	5/29/2001	-0.05	-0.005	1.6	0.15	6.49	-	310	410
	6/27/2001	0.14	-0.005	1.8	0.18	6.19	-	390	520
	7/26/2001	0.16	0.012	-0.1	0.073	7.32	-	250	410
	8/25/2001	0.42	-0.001	0.5	0.089	7.41	-	680	900
	9/28/2001	0.13	-0.005	-0.1	0.042	7.43		340	520
	9/28/01 (dup)	0.14	-0.005	-0.1	0.043	7.43		340	520
	10/29/2001	7.9	-0.005	9.8	0.4	7.15		960	1300
	No. of Samples	43	47	43	43	41	12	43	42
	Minimum	-0.2	-0.100	-0.1	-0.04	3.36	2.99	88	132
	Maximum	100.0	2.500	150.0	1.80	7.89	6.83	1700	2400
	Mean	5.6	0.062	10.4	0.24	5.68	4.83	449	659
	Median	0.4	-0.005	5.4	0.18	6.12	5.04	390	546
	Standard Deviation	16.2	0.360	22.8	0.28	1.35	1.24	295	437
	No. of non-detects	9	39	5	1	0	0	0	0
	% non-detect	21%	83%	12%	2%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest

(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 24									
	1/7/1998	-0.2	-0.005	-0.1	-0.02	-	7.84	1.2	100
	2/13/1998	0.25	0.0096	0.42	-0.02	-	6.85	1.5	160
	3/18/1998	-0.2	0.0052	0.21	-0.02	8.39	6.97	7	140
	5/20/1998	-0.2	-0.005	-0.2	-0.02	7.44	7	1.6	110
	6/18/1998	-0.2	0.0086	0.16	-0.02	8.26	-	5.6	210
	7/31/1998	-0.05	-0.1	-0.1	-0.04	-	7.97	1	95
	8/27/1998	-0.025	-0.05	-0.1	-0.04	7.56	7.76	-2	118
	10/2/1998	-0.0165	-0.0165	-0.1	-0.04	7.85	7.86	1.4	123
	11/3/1998	-0.025	-0.0005	-0.05	-0.02	7.99	7.7	1.1	123
	12/4/1998	-0.025	-0.0005	-0.05	-0.02	7.73	7.7	1.4	-
	1/13/1999	-0.05	-0.005	-0.1	-0.005	8.08	7.93	1.3	73
	2/3/1999	0.38	0.0099	0.56	-0.04	-	7.74	1.4	105
	3/12/1999	-0.05	-0.005	-0.1	-0.005	-	7.31	1.9	123
	4/20/1999	0.65	0.012	0.41	-	-	-	2.2	124
	5/19/1999	-0.05	-0.005	-0.1	-	-	7.78	1.4	63
	6/15/1999	-0.05	-0.005	-0.1	-0.005	8.4	-	1.4	143
	7/28/1999	-0.05	-0.005	-0.1	-0.005	8.53	-	-0.1	120
	8/12/1999	-	-	-	-	8.02	-	-	-
	8/16/1999	-	-	-	-	8.25	-	-	-
	9/9/1999	-0.05	-0.005	0.22	-0.005	8.37	-	1	106
	10/21/1999	-0.05	-0.005	-0.1	-0.005	8.22	-	1.5	130
	11/28/1999	-0.05	-0.005	-0.1	-0.005	8.34	-	1.1	125
	12/21/1999	-0.05	-0.005	-0.1	-0.005	7.99	-	1.4	130
	1/28/2000	0.097	-0.005	0.13	-0.005	8.21	-	1.6	123
	2/11/2000	-0.05	-0.005	-0.1	-0.005	8.36	-	1.4	97
	3/2/2000	-0.05	-0.005	-0.1	-0.005	-	-	2	130
	4/28/2000	-0.05	0.014	-0.1	-0.005	8.32	-	1.5	100
	5/5/2000	-	-	-	-	8.3	-	-	-
	5/30/2000	-0.05	-0.005	0.14	-0.005	8.33	-	2.4	100
	6/15/2000	-	-0.005	-0.1	-0.005	8.44	-	1.1	110
	7/31/2000	-0.05	-0.005	-0.1	-0.005	-	-	2.3	120
	8/29/2000	-0.05	-0.005	-0.1	-0.005	8.2	-	1	130
	9/7/2000	-	-	-	-	8.35	-	-	-
	9/27/2000	-0.05	-0.005	-0.1	-0.001	8.42	-	0.95	98
	10/30/2000	-0.05	-0.005	-0.1	-0.005	8.43	-	1.3	32
	11/28/2000	-0.05	-0.005	-0.1	-0.005	8.24	-	1.4	53
	12/28/2000	-0.05	-0.005	-0.1	-0.005	8.08	-	1.7	120
	1/26/2001	0.052	-0.005	-0.1	-0.005	8.05	-	1.6	110
	3/1/2001	-0.05	-0.005	-0.1	-0.005	8.12	-	1.9	130
	3/27/2001	-0.05	-0.005	-0.1	-0.005	8.27	-	2.5	120
	4/24/2001	0.061	-0.005	-0.1	-0.005	7.52	-	2.5	110
	4/25/2001	-0.05	-0.005	-0.1	-0.005	8.55	-	2.5	110
	5/29/2001	-0.05	-0.005	-0.1	-0.005	8.49	-	1.4	72
	6/27/2001	-0.05	-0.005	-0.1	-0.005	8.44	-	1.1	110
	7/26/2001	0.071	-0.005	-0.1	0.011	8.49	-	0.98	110
	8/25/2001	-0.05	-0.001	0.11	0.0047	8.44	-	0.98	130
	9/28/2001	-0.05	-0.005	-0.1	-0.005	8.14		1	120
	10/29/2001	-0.05	0.0071	-0.1	-0.005	7.84		90	240
	No. of Samples	41	42	42	40	34	13	38	37
	Minimum	-0.20	-0.100	-0.2	-0.040	7.44	6.85	-2	53
	Maximum	0.65	0.014	0.6	0.011	8.55	7.97	7	210
	Mean	0.06	0.005	0.1	0.006	8.19	7.57	1.7	115
	Median	-0.05	-0.005	-0.1	-0.005	8.27	7.74	1.4	118
	Standard Deviation	0.11	0.008	0.1	0.006	0.29	0.38	1.2	27
	No. of non-detects	34	36	33	38	0	0	2	0
	% non-detect	83%	86%	79%	95%	0%	0%	5%	0%

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Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(1/1998 - 10/2001)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 25									
	1/7/1998	-0.2	-0.005	0.69	0.041	-	7.3	95	210
	2/13/1998	40	0.14	29	0.73	-	3.22	610	910
	3/18/1998	4	-0.005	2.3	0.16	4.98	4.97	180	320
	4/20/1998	-	-	-	-	-	6.07	93	200
	5/20/1998	-0.2	-0.005	-0.2	0.044	6.86	6.93	110	190
	6/18/1998	-0.2	-0.005	-0.1	0.033	7.23	-	97	230
	7/31/1998	-0.05	-0.1	0.57	0.082	6.23	6.76	130	255
	8/27/1998	0.82	-0.05	1	0.083	6.83	6.88	130	275
	10/2/1998	0.071	-0.1	0.21	0.076	7.38	7.32	110	256
	11/3/1998	0.1	-0.0005	0.5	0.059	7	7.3	110	228
	12/4/1998	0.037	-0.0005	0.8	0.063	7.2	7.3	120	-
	1/13/1999	-0.05	-0.005	0.85	0.05	7.49	7.42	96	237
	1/21/1999	66	0.18	14	1.3	-	3.3	800	1000
	2/3/1999	8.3	-0.005	5	0.33	-	4.7	240	296
	3/12/1999	0.77	-0.005	2.3	0.19	5.58	5.74	170	278
	4/20/1999	0.42	0.012	1.4	0.041	-	7.7	69	178
	5/19/1999	-0.05	-0.005	-0.1	0.032	-	6.65	59	124
	6/15/1999	-0.05	-0.005	0.82	0.064	7.34	-	200	337
	7/28/1999	-0.05	-0.005	0.8	0.064	7.44	-	110	250
	8/12/1999	-	-	-	-	7.61	-	-	-
	8/16/1999	-	-	-	-	7.53	-	-	-
	8/19/1999	0.058	-0.005	0.24	0.053	7.64	-	480	221
	9/3/1999	0.19	-0.005	2.4	0.11	7.3	-	150	275
	9/8/1999	0.063	-0.005	0.7	0.075	7.43	-	180	337
	9/15/1999	-0.05	-0.005	5.9	0.13	6.98	-	200	400
	9/25/1999	0.098	-0.005	0.25	0.1	7.39	-	390	690
	9/28/1999	0.13	-0.005	2.2	0.1	7.22	-	300	550
	10/9/1999	0.066	-0.005	1.2	0.072	7.44	-	210	380
	10/15/1999	0.083	-0.005	4	-0.04	7.28	-	160	280
	10/21/1999	0.17	-0.005	1.4	0.055	7.58	-	94	250
	11/28/1999	-0.05	-0.005	1.2	0.05	7.83	-	120	255
	12/21/1999	-0.05	-0.005	0.71	-0.04	7.84	-	63	200
	1/28/2000	0.91	-0.005	1.7	0.054	7.54	-	97	253
	2/11/2000	-0.05	-0.005	0.84	0.043	7.58	-	90	216
	3/2/2000	-0.05	-0.005	0.91	0.049	-	-	110	230
	3/16/2000	-0.05	-0.005	0.17	0.05	-	-	130	240
	3/23/2000	-0.05	-0.005	0.23	0.044	-	-	-	-
	3/31/2000	0.099	-0.005	0.53	0.04	-	-	94	180
	4/6/2000	0.092	-0.005	0.52	0.035	-	7.5	680	210
	4/14/2000	0.061	-0.005	-0.1	0.031	-	7.4	74	170
	4/17/2000	-0.05	-0.005	0.23	0.035	-	7.7	82	230
	4/28/2000	-0.05	0.01	-0.1	0.023	8.05	-	89	210
	5/5/2000	0.054	-0.005	0.42	0.047	7.88	-	84	230
	5/12/2000	0.12	-0.005	1.2	0.053	7.61	-	99	240
	5/30/2000	0.21	-0.005	0.3	0.042	7.97	-	96	240
	6/15/2000	-	-0.005	0.14	0.038	7.94	-	100	220
	7/31/2000	0.15	-0.005	-0.1	0.031	-	-	170	330
	8/29/2000	0.072	-	-0.1	0.046	7.71	-	230	430
	9/7/2000	-	-	-	-	8.11	-	-	-
	9/27/2000	-0.05	-0.005	-0.1	-0.001	8.26	-	67	180
	10/30/2000	-0.05	-0.005	0.27	0.032	8.1	-	91	210
	11/28/2000	0.075	-0.005	0.2	0.033	8.05	-	100	190
	12/28/2000	-0.05	-0.005	0.47	0.032	7.99	-	79	230
	1/26/2001	0.34	-0.005	0.59	0.033	7.81	-	82	210
	3/1/2001	0.26	-0.005	-0.1	0.03	8	-	84	230
	3/27/2001	-0.05	-0.005	0.75	0.045	7.31	-	120	240
	4/24/2001	-0.05	-0.005	-0.1	0.022	8.35	-	92	210
	4/25/2001	0.11	-0.005	-0.1	0.0024	8.16	-	94	190
	5/29/2001	-0.05	-0.005	-0.1	0.012	8.17	-	85	170
	6/27/2001	0.39	-0.005	-0.1	0.024	8.15	-	72	200
	7/26/2001	0.057	-0.005	-0.1	0.016	8.26	-	31	160
	8/8/2001	0.059	-0.005	-0.1	-0.005	-	-	21	130
	8/16/2001	-	-	-	-	-	-	19	130
	8/22/2001	-	-0.005	-	0.008	-	-	55	190
	8/25/2001	0.073	-0.001	0.11	0.013	8.21	-	98	260
	8/29/2001	-0.05	-0.005	-0.1	0.016	-	-	110	240
	9/6/2001	-0.05	-0.005	-0.1	0.0063	-	-	140	290
	9/12/2001	-0.05	-0.005	-0.1	0.026	-	-	280	480
	9/28/2001	-0.05	-0.005	-0.1	0.0058	na		59	190
	10/29/2001	-0.05	-0.005	1.4	0.1	7.64		330	470
	No. of Samples	59	62	61	60	43	19	60	59
	Minimum	-0.20	-0.100	-0.20	-0.040	4.98	3.22	19	124
	Maximum	66.00	0.180	29.00	1.300	8.35	7.70	800	1000
	Mean	2.12	0.010	1.49	0.086	7.48	6.43	154	275
	Median	0.06	-0.005	0.50	0.044	7.54	6.93	100	230
	Standard Deviation	9.90	0.029	4.09	0.187	0.66	1.37	148	158
	No. of non-detects	26	58	18	4	0	0	0	0
	% non-detect	44%	94%	30%	7%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values

LEVIATHAN MINE SITE

Concentrations of Parameters of Interest
(2/1998 - 6/2000)

Station	Date	Aluminum mg/l	Arsenic mg/l	Iron mg/l	Nickel mg/l	Field pH s.u.	Lab pH s.u.	Sulfate mg/l	TDS mg/l
Station 26									
	2/13/1998	25	-0.005	2.8	0.48	-	3.77	430	620
	3/19/1998	-0.2	-0.005	0.28	0.1	-	5.93	65	300
	2/3/1999	-0.05	-0.005	0.59	0.2	-	6.47	150	305
	6/14/1999	0.14	-0.005	-0.1	0.025	-	-	70	192
	8/17/1999	-	-	-	-	8.16	-	-	-
	9/29/1999	0.088	-0.005	0.19	0.028	8.17	-	160	360
	10/21/1999	0.051	-0.005	0.15	0.016	8.2	-	73	250
	6/15/2000	-	-0.005	-0.1	0.0067	8.21	-	56	190
	No. of Samples	6	7	7	7	4	3	7	7
	Minimum	-0.20	-0.005	-0.1	0.01	8.16	3.77	56	190
	Maximum	25.00	-0.005	2.8	0.48	8.21	6.47	430	620
	Mean	4.23	0.003	0.59	0.12	8.19	5.39	143	317
	Median	0.07	-0.005	0.19	0.03	8.19	5.93	73	300
	Standard Deviation	9.29	0	0.92	0.16	0.02	1.17	123	136
	No. of non-detects	2	7	2	0	0	0	0	0
	% non-detect	33%	100%	29%	0%	0%	0%	0%	0%

Notes: "-" denotes no data available
All values represent dissolved concentration
Negative values represent concentrations below the detection limit with the detection limit reported
Mean and Standard Deviation calculated using half of the detection limit for non-detect values
N/A = Not Applicable

APPENDIX B

SUMMARY OF 1998 GROUNDWATER CHEMICAL DATA

APPENDIX B
SUMMARY OF 1998 GROUNDWATER CHEMICAL DATA

Well Name	Sample Date	Field pH (SU)	TDS (mg/l)	Sulfate (mg/l)	Aluminum (mg/l)	Arsenic (mg/l)	Iron (mg/l)	Nickel (mg/l)
MW-1	10/13/98	7	1820	846	0.06	-0.002	0.122	-0.0151
MW-1	11/3/98	nm	1580	873	-0.0135	0.0012	0.0819	-0.0151
MW-2s	10/19/98	4	6180	8400	294	-0.001	823	5.7
MW-2s	11/5/98	3	5890	6820	319	0.017	904	6.23
MW-2d	10/19/98	4	7510	8860	283	0.0165	863	9.62
MW-2d	11/5/98	4	7560	9900	310	-0.005	889	10.5
MW-3	10/19/98	nm	6340	9370	280	6.6	788	2.5
MW-3	10/16/98 Dup.	nm	6520	7760	306	6.68	818	2.66
MW-3	11/3/98	2	6440	6260	299	6.52	936	2.55
MW-4	10/16/98	nm	3100	2560	112	0.0115	0.531	0.792
MW-4	11/3/98	4	3000	3380	99.8	0.0072	0.643	0.701
MW-5d	10/19/98	4	5770	6670	128	0.0088	297	1.41
MW-6	10/20/98	4	3470	2390	18.7	0.305	347	1.28
MW-6	11/6/98	4	3330	3230	20.6	0.306	340	1.35
MW-7	10/20/98	5	217	63.7	0.0289	0.0612	4.24	0.0199
MW-7	11/6/98	6	246	90.1	0.103	0.0264	4.12	0.0232
MW-8	10/20/98	3	1820	1120	29.6	0.375	228	0.313
MW-8	11/6/98	4	1860	1550	29.2	0.336	227	0.313
MW-10s	10/16/98	4	3830	2440	22	0.69	463	1.65
MW-10s	11/5/98	4	3930	2320	23.4	0.42	573	1.66
MW-10d	10/14/98	6	1250	617	0.0279	0.0282	7.22	-0.0151
MW-10d	11/5/98	6	1700	771	0.0172	0.123	37	-0.0151
MW-11	10/14/98	7	314	24.8	0.0182	-0.001	0.0628	-0.0151
MW-11	11/5/98	7	329	25.0	-0.0135	0.0011	0.0436	-0.0151
MW-12	10/13/98	6	2340	1140	0.174	0.044	102	0.0899
MW-12	11/3/98	6	1930	1310	0.184	0.0608	108	0.0702
MW-12	11/3/98 Dup.	6	1960	1010	0.203	0.0568	117	0.081
USGS-33	11/2/98	6	326	155	-0.0135	0.0018	0.0255	-0.0151
USGS-25	11/2/98	4	107	22.3	0.408	0.0045	0.152	-0.0151
STATISTICAL SUMMARY								
Shallow Wells								
	Min	2.2	107.0	22.3	-0.014	-0.002	0.026	-0.015
	Max	7.3	6,520.0	9,370.0	319	6.68	936	6.23
	Avg	4.9	2,786.6	2,631.7	77.27	0.94	282.67	1.16
Deep Wells								
	Min	3.1	1,250.0	617.0	0.02	-0.005	7.22	-0.015
	Max	6.9	7,560.0	9,900.0	310	0.123	889	10.5
	Avg	4.7	4,758.0	5,363.6	144.21	0.034	418.64	4.30

Notes: NS = not sampled
nm = not measured
SU= standard unit
Negative values represent concentrations below the detection limit.
Paired wells are designated with an "s" suffix for shallow well and a "d" suffix for deep well.

APPENDIX C

LIST OF DOCUMENTS TO BE REVIEWED

LEVIATHAN MINE LIST-DOCUMENTS TO BE REVIEWED

Doc Date	Docid	Title/Subject	Author	SAP Avail.	DSR Avail.
01/01/0001	43962	Carson River chronology-chron. hist. of Carson River & related water issues	NV Dept of Conserv. & Nat. Res.-Div. of Water Planning		
01/01/0001	43967	Table 1 - length of stream polluted, pounds of trout eradicated by mine pollution & future potential fishing use of downstream waters if mine pollution abated (Leviathan & Bryant Creeks)			
01/01/0001	45212	Plans & rpts produced in NRDA-performed according to 43 CFR part 2	Environmental Protection Agency- Region 9		
01/01/0001	45823	Addendum to site 5-year workplan	CA Regional Water Quality Control Board-Lahontan Reg.		
12/01/0001	77100	Memo: Transmits USGS data fr sampling of Leviathan providing an idea of water quality at points throughout site, w/ attachment	Gerard Thibeault-CA Regional Water Quality Control Board-Lahontan Region		
7/9/52	76148	Ltr: Results of tests on water samples taken from Aspen Cr. & Leviathan Cr.	W White-NV Dept. of Health		
9/24/52	75535	Memo:Decision not to stock fish in Polson Creek, w/stocking record for Mountaineer Creek, 9/24/52	George Coyan		
2/1/53	45833	Supplementary report on Leviathan Sulphur Mine	James Wilson-Anaconda Minerals Co.		
8/27/54	76149	Ltr: Complaints of dead fish in Leviathan Creek have been received	R Paul-Ca Dept. of Fish & Game		
6/30/55	76153	Ltr: Money requested in 1955-56 budget to investigate reported pollution problem occurring in Leviathan Creek	John Leggett-CA Regional Water Quality Control Board Lahontan Region		
9/19/55	76132	Nevada Division of Wildlife-Stream Survey, Bryant Creek	NV Dept of Conservation & Nat. Res.-Division of Wildlife		
6/25/57	45224	Fish population inventory-Leviathan Creek			
6/26/57	43989	Rpt on investigation of interstate pollution-Leviathan Creek & E. Carson River (CA & NV) with special reference to biological findings (6/24-6/26/57) w/TL to J Leggett fr R Poston 8/21/57	John Wilson-US Public Health Service		
2/18/58	76151	Ltr: Transmits laboratory results obtained fr Leviathan Creek samples collected 9/27/57, w/ enclosure	E Reinke-CA Dept of Public Health		
4/25/58	76152	Summary rpt on quality of interstate waters, Leviathan Creek w/ TL to M Merrill for R Fostor	US Public Health Service		
7/1/58	45223	Bioassay rpt (to determine toxicity to fish)-Leviathan Creek	S Coli		
7/1/58	76134	Stream & lake survey, biological & physical data work sheet-Bryant Creek, w/rpt, Leviathan Creek bioassay by SJ Coli	NV Dept of Conservation & Natural Resources Division of Wildlife		
1/1/59	43992	Report of Leivathan Creek Pollution-1959	Thomas Trelease-NV Fish & Game Commission		

8/13/59	76246	Report of mineral examination-Anaconda unpatented claims, w/o claim map	G Plumb
9/21/65	45834	Ltr: CRWQB actions with Anaconda Copper Co & C Mann & Assoc re Leviathan sulphur mine drainage & sources of contamination, w/o attchs	John Leggett-CA Regional Water Quality Board Lahontan Region
2/3/69	76289	Ltr: Resolution 69-9 ordering Alpine Mining enterprises to cease & desist violation of waste discharge requirements adopted by Board & transmits Resolution 69-9, w/attch	John Leggett-CA Regional Water Quality Board Lahontan Region
2/24/69	76290	Ltr: Transmits portion of Lahontan Regional Water Quality Board meeting minutes, CA Department of Fish & Game rpt & water quality data, w/attchs	John Leggett-CA Regional Water Quality Board Lahontan Region
7/24/69	45861	Geological rpt on source of mineral water for tunneling-site (draft) w/ marginalia	
4/19/80	77098	Leviathan Mine surface rights drawing, w/BLM geographic index of claims & claimants & Leviathan Mineral survey #6365 A & B parcel location maps	US Dept of the Interior-Bureau of Land Management
8/13/80	76199	Memo: Leviathan Mine assessors data, w/attch	Julie Vankleeck-CA Regional Water Quality Board-Lahontan
6/1/82	77096	USGS hydrogeotechnical program, w/lab analytical sheets, USGS 6/82 survey test drilling rpt, attchs & marginalia	US Dept of the Interior-Geological Survey
5/24/83	45808	Ltr: Comments re draft environmental impact report (EIR)-site pollution abatement project	Richard Krablin Anaconda Minerals Co.
7/27/83	45236	Memo: Transmits 7/22/83 ltr re status of water quality cleanup, w/attchs	Kathleen Gnekow, CA Dept of Justice-Office of Atty. Gen.
8/23/83	76236	Aerial Photo: Site before Regional Water Quality Control Board Project, b&w 1:12000	Cartwright Aerial Surveys, Inc.
10/25/84	76237	Aerial Photo: Site during Regional Water Quality Control Board project, b&w 1:12000	Cartwright Aerial Surveys, Inc.
7/1/86	76242	Excerpt fr Fishery management plan for Lahontan cutthroat trout (salmo clarki henshaw) in California & western Nevada waters (p 41-Carson River sub-basin)	Eric Gerstung-CA Dept of Fish & Game
5/1/87	44391	Chapter: Mining (100 years of history, recreation lore in Alpine County, CA 1864-1964, p43, Centenniel Book Committee)	
7/1/88	75472	Mining waste study, final rpt (section 5.6-Leviathan Mine p 221-228)	Univ of California-Berkeley
1/1/89	45942	Final revised analyses of major & trace elements fr acid mine waters in Leviathan	James Ball/D Nordstrom-US Dept of Interior Geological Survey

10/1/90	75526	Ltr: Decision re listing of impaired water & point sources for California-Leviathan Mine listed as point source, w/o encls	Doug Eberhardt-Environmental Protection Agency-Region 8
1/1/91	75475	Preliminary assessment, final report	Greystone Development Consultants, Inc.
1/4/91	45241	ROC: Site activity information sought for purpose of site screening	Angela Harris-CA Dept of Health Services-Hazardous Waste Management Services
5/1/91	45232	Preliminary assessment (PA) site-final rpt, w/ appendices A-D, w/o oversize map	Greystone Development Consultants, Inc.
1/1/92	45941	Thesis - ground conductivity study of Leviathan sulphur mine (draft) w/marginalia	Kevin Graves-California State Univ-Sacramento
6/4/93	45939	Article: Transport & natural attenuation of Cu, Zn, As & Fe in acid mine drainage of Leviathan & Bryant Creeks w/ marginalia	D Nordstrom/Kathleen Smith-US Geological Survey Jenny Webster-Institute of Environmental Health & Forensic Science
4/5/95	45234	Maps: Assessors - Alpine Co (1951-1995)	Alpine County - Assessors Office
8/25/95	45231	Aquatic invertebrate bioassessment monitoring of acid mine drainage impacts in Leviathan Creek watershed-technical rpt	David Herbst-Univ of California-Sierra Nevada Aquatic Research Laboratory
5/20/97	76240	Ltr: Pond 4 discharge identified as hazardous waste under RCRA & transmits scientific & regulatory analysis of Pond 4 discharge, w/ enclosures	J Akenhead-Akenhead Compliance & Environmental Services
5/27/97	45233	Ltr: petition & supporting data for issuanceof administrative order re site pollution abatement project, w/encls	John Martin Beavers & Young
8/15/97	73836	Lahontan CRWQCB water sample sites & list of sampling sites & list for data summary sheets, w/maps, chain of custody forms & analytical rpts, (12-95-8/97)	California Laboratory Services
10/11/97	47737	Pollution report (POLREP) 2	Dan Suter-EPA Region 9
10/25/97	47739	Pollution report (POLREP) #4	Dan Suter-EPA Region 9
10/25/97	47740	Pollution report (POLREP) #5	Dan Suter-EPA - Region #5
1/1/98	44348	Trace-element enrichment in streambed sediment & crayfish, Carson & Truckee Rivers, NV & CA (9/92), w/ draft-occurrence of trace elements in Bryant Creek drainage basin	Stephen Lawrence-US Dept of the Interior-Geological Survey
1/1/98	45282	Water quality in Las Vegas valley area & Carson & Truckee River basins, NV	Hugh Bevens/Stephen Lawrence/Michael Lico

4/5/98	45164	Map: Proposed data sites-1998 (Doud Creek, Bryant Creek, Barney Riley Creek, Mountaineer Creek, Leviathan Creek)	
5/4/98	44409	Memo: Site water sampling program w/ encls	Mary Marks-US Forest Service
5/6/98	75529	Contact rpt re Lahontan cutthroat trout in Carson River basin	Karen Johnson-Ecology & Environment, Inc.
6/2/98	76260	Ltr: Water filled pit discovered in upper reaches of Aspen Creek during site visit & transmits map showing CA Water Quality Control Board water sampling locations, w/ encls	Mary Marks-US Forest Service-Humboldt-Toiyabe National Forest
7/6/98	45955	Ltr: Transmits 2 Excel 5.0 files-flowsheet.els & ndep.xls & 3.5 in computer disc w/attch	Carol Yeatman-Washoe Tribe of Nevada & California
8/25/98	45167	Memo: Transmits sediment pore water sampling-rationale & technique, w/ acute toxicity of site water to rainbow trout under static-renewal test conditions & pollution incident daily resource rpt (govt personnel travel expenses) & TLs	Gene Mancini-Atlantic Richfield Co
9/11/98	45149	Ltr: Transmits & discusses initial study & notice of preparation of draft environmental document for proposed amendments to water quality control plan for Lahontan Basin w/encls	Robert Dodds-CA Regional Water Quality Control Board-Lahontan Region
9/29/98	47741	Pollution report (POLREP) #6 (FINAL)	Dan Suter-EPA - Region 9
10/1/98	45616	Site stream monitoring program-spring 1998	S R K Consulting
10/28/98	44542	Ltr: Suggests sharing Bryant Creek total maximum daily loads (TMDLs) with Leviathan Mine Council re proposed basin plan amendments, w/ marginalia	Jacques Landy-EPA - Region 9
11/12/98	45946	Computer Disc: Site Water quality data (5/29/98-11/12/98), 3.5 inces	Kevin Mayer-EPA - Region 9
11/19/98	45144	Ltr: Transmits site water quality tables & surface water sampling plan for Leviathan Mine, water year 1998, w/ attchs	Chris Stetler-CA Regional Water Quality Control Board-Lahontan Region
3/8/99	75516	Ltr: Fish captured in upper Leviathan Creek Derived fr cutthroat trout & transmits results of genetic analysis, w/ encl	Jonathan Clark-CA Dept of Fish & Game-Office of Spill Prevention & Response
3/17/99	76263	Ltr: DNA results from fish captured in upper Leviathan Creek confirmed that it was derived from Lahontan cutthroat trout evolutionary lineage	Stafford Lehr-CA Dept of Fish & Game
2/18/00	90771	Monthly work assignment rpts, 11/30/99-2/18/2000	Science Applications International Corp.

APPENDIX D

EPA SITE FILE INDEX

Site File Index In Chronological Order

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
01/01/0001	44578	List of Leviathan mill site & lodes	US Dept of the Interior - Bureau of Land Management		UNC				SER/014A	
01/01/0001	45540	Newsclipping: Wallace wins his 3rd term	Geoff Dornan Record-Courier, The		REL	006			SER/014A	
01/01/0001	44539	Mtg overheads - RI/FS	Kevin Mayer Environmental Protection Agency - Region 9		REL	067		000022	SER/014A	
01/01/0001	10110	Ltr: Transmits modification to administrative abatement action of 7/19/2000, docket #00-16(a), w/o encls	Keith Takata Environmental Protection Agency - Region 9	Harold Singer CA Regional Water Quality Control Board - Lahontan Region	REL	001		000028	SER/014A	
01/01/0001	76227	Newsclip: Carson Valley agricultural news - Bryant Creek is polluted	Leonard Anker US Dept of Agriculture - Soil Conservation Service		UNC	006		000021	SER/014A	
01/01/0001	76147	Map: Approximate location of private property at Leviathan Mine site - showing parcels owned by Alpine Mining Enterprises & other parties			UNC	004		000021	SER/014A	
01/01/0001	45212	Plans & rpts produced in NRDA - performed according to 43 CFR part 2	Environmental Protection Agency - Region 9		DAC DAW DDP			000022 000031	SER/014A	
01/01/0001	44541	Statement of work (SOW) for RI/FS	Kevin Mayer Environmental Protection Agency - Region 9		REL	094		000022 000029	SER/014A	
01/01/0001	44366	Pamphlet: Mining claims & sites on federal lands	US Dept of the Interior - Bureau of Land Management		UNC	081		000021	SER/014A	
01/01/0001	43938	Site response enforcement strategy for removal action	Environmental Protection Agency - Region 9		DAC DAW DDP	064		000021 000028	SER/014A	
01/01/0001	44382	Pamphlet: Alpine County historical complex - museum, old Webster School, old log jail - state point of historic interest	Historical Society of Alpine County		UNC	081		000021	SER/014A	
01/01/0001	44359	Mogul mining index - books c & d (1875 - 1891) re Leviathan #2 & Leviathan Copper Mine			UNC			000021	SER/014A	
01/01/0001	45222	Map: Pine nut allottments			UNC	004		000020 000021	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
01/01/0001	43962	Carson River chronology - chronological history of Carson River & related water issues	NV Dept of Conservation & Natural Resources - Div of Water Planning		REL			000021 000022	SER/014A	
01/01/0001	76031	Ltr: Notice of intent to perform natural resource damage assessment (draft)	Robert Hunter US Dept of the Interior - Bureau of Indian Affairs	Atlantic Richfield Co State of California	UNC	001		000021	SER/014A	
01/01/0001	44396	Monitor mining index - books b & c (1863-1879)			UNC			000021	SER/014A	
01/01/0001	75545	Leviathan mill site survey information			UNC			000021	SER/014A	
01/01/0001	43967	Table 1 - length of stream polluted, pounds of trout eradicated by mine pollution & future potential fishing use of downstream waters if mine pollution abated (Leviathan & Bryant Creeks)			REL			000021 000022	SER/014A	
01/01/0001	45211	Areas of high, medium & low overlap between EPA site remediation process & trustee NRDA process	Environmental Protection Agency - Region 9		UNC			000021 000022	SER/014A	
01/01/0001	44106	Grant deed (partial) - Siskon Mining Corp grants Leviathan Mine property to Calsul Mining Corp	Siskon Mining Corp		UNC	083		000021	SER/014A	
01/01/0001	45823	Addendum to site 5-year workplan	CA Regional Water Quality Control Board - Lahontan Region		REL	010		000022 000031	SER/014A	
12/10/0001	77100	Memo: Transmits USGS data fr sampling of Leviathan providing an idea of water quality at points throughout site, w/attch	Gerard Thibeault CA Regional Water Quality Control Board - Lahontan Region	Carol Aiello	REL	001 003 .013		000021	SER/014A	
04/15/1870	44096	Deed - Leviathan Mine property transfer fr A Jones to E Dorsett	Aseneth Jones T Jones		UNC	083		000021	SER/014A	
06/13/1870	44097	Deed - Leviathan Mine property transfer fr A Jones to F Morse	Aseneth Jones T Jones		UNC	083		000021	SER/014A	
07/02/1870	44400	Newsclip: Success - Leviathan	Alpine Chronicle		REL	006		000021	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
08/13/1870	44402	Newsclip: Leviathan	Alpine Chronicle		REL	006		000021	SER/014A	
06/15/1871	44098	Deed - Leviathan Mine property transfer fr F Morse to G Sharpe	Freeman Morse		UNC	083		000021	SER/014A	
06/15/1871	44099	Deed - Leviathan Mine property transfer fr G Sharpe to E Dorset	George Sharpe		UNC	083		000021	SER/014A	
11/17/1871	44100	Deed - Leviathan Mine property transfer fr E Dorset to G Sharpe	Edward Dorset		UNC	083		000021	SER/014A	
12/21/1871	44102	Deed (partial) - Leviathan Mine property transfer fr A & T Jones to G Sharpe			UNC	083		000021	SER/014A	
01/01/1872	44355	Excerpts fr Statistics of mines & mining in states & territories west of Rocky Mountains - 4th annual rpt (1871), w/marginalia	Rossiter Raymond US Commission of Mining Statistics		UNC	008		000021	SER/014A	
03/09/1872	44403	Newsclip: Local intelligence - Leviathan	Alpine Chronicle		REL	006		000021	SER/014A	
06/29/1872	44405	Newsclip: Local mining - Leviathan Mine	Alpine Chronicle		REL	006		000021	SER/014A	
07/20/1872	44407	Newsclip: Local mining - Leviathan	Alpine Chronicle		REL	006		000021	SER/014A	
05/02/1876	44103	Notice - Leviathan #2 mining claim	B Kincaid		UNC	083		000021	SER/014A	
01/22/1880	44104	Notice - Leviathan Copper Mine #29 claim	J Mayo		UNC	083		000021	SER/014A	
01/01/1888	44356	Excerpts fr 8th annual rpt of state mineralogist for year ending 10/1/88	William Irelan CA State Mining Bureau		UNC	008		000021	SER/014A	
01/03/1888	44105	Notice of location - Leviathan Copper Mine claim	P Curtz		UNC	083		000021	SER/014A	
12/01/1898	90718	Article: One page only re formation of Leviathan Mining Co (Engineering & Mining Journal, v66, July-Dec 1898, p405)	Engineering & Mining Journal		REL	073			SER/014A	
07/06/1907	90719	Article: Alternating current in coal-mining operations (Engineering & Mining Journal, v84, #1, 1907)	George Wood Engineering & Mining Journal		REL	005 073			SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
12/24/1919	76037	Notice of desire to hold mining claim by Leviathan Copper System Trustees & Jack Tehen	Jack Tehen		UNC			000021	SER/014A	
10/01/1931	44357	Excerpts fr chapter of Rpt 27 of state mineralogist covering activities of division of mines including geologic branch (California Journal of Mines & Geology, v27, #4, 490-491)	Walter Bradley CA Dept of Natural Resources - Div of Mines		UNC	008		000021	SER/014A	
06/17/1932	76058	Notice of location of quartz or other rock in place claim, Leviathan #19-22, by Western Clay & Metals Company	Western Clay & Metals Co		UNC			000021	SER/014A	
05/18/1933	76062	Notices of location & notices of location of quartz or other rock in place claim, Leviathan #68-86, by Leviathan Sulphur Co	Leviathan Sulphur Co		UNC			000021	SER/014A	
06/26/1933	76064	Proof of labor upon mining claim by Leviathan Sulphur Company & Western Clay & Metals Company	Leviathan Sulphur Co Western Clay & Metals Co		UNC			000021	SER/014A	
10/19/1933	76066	Notice of location of quartz or other rock in place claim, Leviathan #88, by Leviathan Sulphur Company	Howard Pyle Leviathan Sulphur Co		UNC			000021	SER/014A	
05/14/1935	76069	Proof of labor on mining claim by Leviathan Sulphur Company	E Bierce Leviathan Sulphur Co		UNC			000021	SER/014A	
05/16/1935	44107	Agreement - Leviathan Sulphur Co leases lode mining claims to Calpine Corp for 27 years			UNC	083		000021	SER/014A	
05/20/1935	76071	Notices of location, Leviathan #19-22, 36, 55, 65 & 75, by Leviathan Sulphur Company	E Bierce Leviathan Sulphur Co		UNC			000021	SER/014A	
06/30/1936	76072	Notice of work & labor completed in Leviathan Mining District fr (7/1/35 to 6/30/36) by Calpine Corp under lease fr Leviathan Sulphur Company	Calpine Corp, The		UNC			000021	SER/014A	
10/01/1939	44358	Article: Sulphate minerals at Leviathan Sulpur Mine, Alpine Co, CA (California Journal of Mines & Geology, v35, #4, 488-489)	George Gary CA Dept of Natural Resources - Div of Mines		UNC	073		000021	SER/014A	

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07/08/1941	76073	Notice of work & labor completed in Leviathan Mining District fr (7/1/40 to 6/30/41) by Calpine Corp under lease fr Leviathan Sulphur Company	Calpine Corp, The		UNC			000021	SER/014A	
12/10/1941	76074	Affidavit re assessment work performed, (7/1/41 to 12/2/41), by Calpine Corporation under lease fr Leviathan Sulphur Company	Hugh Wright Calpine Corp, The		UNC			000021	SER/014A	
12/10/1941	44108	Quit claim deed - Calpine Corp surrenders to Leviathan Sulphur Co lode mining leases & rights of way	L Wickes Calpine Corp, The		UNC	083		000021	SER/014A	
06/21/1943	76075	Notice of desire to hold lode/placer mining claims by Leviathan Sulphur Company	E Bierce Leviathan Sulphur Co Melvin McKinnon Leviathan Sulphur Co		UNC			000021	SER/014A	
06/19/1945	76076	Notice of desire to hold lode mining claims by Siskon Mining Corporation	Alleene Schwartz Siskon Mining Corp L Wickes Siskon Mining Corp		UNC			000021	SER/014A	
08/30/1945	76077	Notice of location of lode mining claim by Siskon Mining Corporation for Leviathan #23	Hugh Wright Siskon Mining Corp		UNC			000021	SER/014A	
08/31/1945	44575	Certificate of location - Siskon Mining Corp re Leviathan mill site	Hugh Wright Siskon Mining Corp		UNC			000021	SER/014A	
09/01/1945	44576	Amended certificate of location - Siskon Mining Corp re Leviathan mill site	Hugh Wright Siskon Mining Corp		UNC			000021	SER/014A	
06/21/1946	76078	Notice of desire to hold lode mining claims by Siskon Mining Corporation	L Wickes Siskon Mining Corp		UNC			000021	SER/014A	
06/25/1946	76079	Notice of desire to hold lode mining claim by Siskon Mining Corporation for Leviathan #33	L Wickes Siskon Mining Corp Alleene Schwartz Siskon Mining Corp		UNC			000021	SER/014A	
09/30/1946	76080	Notice of location of quartz or other rock in place claim & statement of markings of boundaries & performance of required discovery work by Siskon Mining Corporation	Hugh Wright Siskon Mining Corp		UNC			000021	SER/014A	

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04/18/1947	44579	Certificate of approval of field notes & survey of mining claim - Siskon Mining Corp re Leviathan mill site & lodes	US Dept of the Interior - Bureau of Land Management		UNC			000021	SER/014A	
04/18/1947	69708	Oversize Drawings (5): Mineral survey #6365 A & B, 12" x 17"	US Dept of Interior - Bureau of Land Management		CBR	003		000022	SER/014A	
05/13/1947	44577	Survey (partial) - Siskon Mining Corp re Leviathan mill site & lodes			UNC				SER/014A	
06/20/1949	76081	Proof of labor for mining year ending 7/1/49 by Siskon Mining Corporation	L Wickes Siskon Mining Corp		UNC			000021	SER/014A	
01/13/1950	44109	Land patent - Leviathan lode mining & mill site claims by Siskon Mining Corp	James Homer US Dept of the Interior - Bureau of Land Management		UNC	083		000021	SER/014A	
01/30/1950	44369	Grants Leviathan lode mining & mill site claims to Siskon Mining Corp	US Dept of the Interior - Bureau of Land Management		UNC	083		000021	SER/014A	
02/21/1950	44571	Mineral application for sulphur, gold & copper by Siskon Mining Corp re Leviathan mill site & lodes			UNC			000021	SER/014A	
07/01/1950	76082	Notice of desire to hold mining claim for year ending 7/1/50 by Siskon Mining Corporation	Siskon Mining Corp		UNC			000021	SER/014A	
11/30/1951	44110	Grant deed - Calsul Mining Corp grants Anaconda Copper Mining Co patented lode mining claims, patented mill site claim & property	McIntyre Farles Calsul Mining Corp		UNC	083		000021	SER/014A	
07/09/1952	76148	Ltr: Results of tests on water samples taken fr Aspen Creek & Leviathan Creek	W White NV Dept of Health	A Millar Anaconda Copper Mining Co	REL	001		000021	SER/014A	
09/24/1952	75535	Memo: Decision not to stock fish in Poison Creek, w/stocking record for Mountaineer Creek, 9/24/52	George Coyan William White		REL	001		000020 000021	SER/014A	
02/01/1953	45833	Supplementary rpt on Leviathan Sulphur Mine	James Wilson Anaconda Minerals Co		REL	013		000020 000021	SER/014A	

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08/27/1954	76149	Ltr: Complaints of dead fish in Leviathan Creek have been received	R Paul CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	REL	001		000021	SER/014A	
06/30/1955	76153	Ltr: Money requested in 1955-56 budget to investigate reported pollution problem occurring in Leviathan Creek	John Leggett CA Regional Water Quality Control Board - Lahontan Region	Thomas Trelease NV Fish & Game Commission	REL	001		000021	SER/014A	
09/19/1955	76132	Nevada Division of Wildlife stream survey - Bryant Creek	NV Dept of Conservation & Natural Resources - Div of Wildlife		REL	003		000021	SER/014A	
12/01/1955	45851	Article: Mining with Anaconda in NV (Explosives Engineer, 167-182)	Lewis Nordyke Explosives Engineer, The		REL	005 073		000021	SER/014A	
06/25/1957	45224	Fish population inventory - Leviathan Creek			REL			000021 000022	SER/014A	
06/26/1957	43989	Rpt on investigation of interstate pollution - Leviathan Creek & E Carson River (CA & NV) with special reference to biological findings (6/24-6/26/57), w/TL to J Leggett fr R Poston 8/21/57	John Wilson US Public Health Service		REL	001		000021	SER/014A	
07/10/1957	76455	Ltr: Complaints received at annual fish planting allotment meeting re Leviathan Creek pollution, w/testimonials fr fisherman 12/68	Robert Montgomery	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
07/10/1957	43991	Ltr: Annual fish planting allottment meeting complaints re Leviathan Creek pollution	Robert Montgomery	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
02/18/1958	76151	Ltr: Transmits laboratory results obtained fr Leviathan Creek samples collected 9/27/57, w/encl	E Reinke CA Dept of Public Health	John Leggett CA Regional Water Quality Control Board - Lahontan Region	REL	001		000021	SER/014A	
04/25/1958	76152	Summary rpt on quality of interstate waters, Leviathan Creek, w/TL to M Merrill fr R Fostor	US Public Health Service		REL	001 003		000021	SER/014A	
07/01/1958	76134	Stream & lake survey, biological & physical data work sheet - Bryant Creek, w/rpt, Leviathan Creek bioassay by S J Coli	NV Dept of Conservation & Natural Resources - Div of Wildlife		REL	003		000021	SER/014A	

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07/01/1958	45223	Bioassay rpt (to determine toxicity to fish) - Leviathan Creek	S Coli		REL	004		000021 000022	SER/014A	
01/01/1959	43992	Rpt of Leviathan Creek pollution - 1959	Thomas Trelease NV Fish & Game Commission		REL			000021	SER/014A	
08/13/1959	76246	Rpt of mineral examination - Anaconda unpatented claims, w/o claim map	G Plumb		REL			000021	SER/014A	
10/07/1959	76248	Ltr: Transmits signed stipulation form indicating that Forest Service recognizes Anaconda's surface rights on claims, w/attchs	Floyd Iverson US Forest Service - Intermountain Region	J Forman Anaconda Co	UNC	001		000021	SER/014A	
03/07/1962	45940	Shallow groundwater flow in vicinity of open pit at site (draft) w/marginalia	Dale Hammermeister US Geological Survey David Prudic US Geological Survey	CA Regional Water Quality Control Board - Lahontan Region	REL			000022	SER/014A	
11/19/1962	76154	Sale of Leviathan mining claims - Indenture between Anaconda Company & William Chris Mann & Zella N Mann	Anaconda Co		UNC			000021	SER/014A	
05/15/1963	44112	Deed - Property exchange between Grant & Angie Merrill & Alpine Mining Enterprises	Grant Merrill Angie Merrill		UNC	083		000021	SER/014A	
07/09/1963	76159	Ltr: Compliant fr Brooks Park re drainage fr Leviathan Mine tailings seeping to Bonnie O'Riley Creek & into his irrigation system	W White NV Dept of Health	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
01/01/1964	44397	Excerpt fr Rpt on history of Grover Hot Springs State Park area & surrounding region of Alpine County	Turrentine Jackson CA Dept of Parks & Recreation - Div of Beaches & Parks		UNC	008		000021 000022	SER/014A	
02/04/1964	44118	Deed - patented & unpatented Leviathan mining claims & mill site granted fr Alpine Mining Enterprises to Lloyd E Neel	Chris Mann Alpine Mining Enterprises, Inc Zella Mann Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	

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02/13/1964	44115	Certificate - Alpine Mining Enterprises authorizes transfer of corporate assets (patented & unpatented Leviathan mining claims & mill site) to L Neel	Margaret Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
02/18/1964	43986	Ltr: Requests status of Anaconda Mining properties compliance with 12/20/62 Water Pollution Control Board standards	Thomas Trelease NV Fish & Game Dept	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
09/30/1964	44119	Quitclaim deed - patented Leviathan lode mining claims #16 & #30 transferred fr Lloyd Neel to Robert Parker, w/exhibits A & B	Lloyd Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
10/30/1964	44120	Quitclaim deed - Leviathan lode mining claims #14 & #15 transferred fr Lloyd Neel to Eva Wasson, w/exhibits A & B	Lloyd Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
10/30/1964	44122	Quitclaim deed - Leviathan lode mining claims #19 & #20 transferred fr Lloyd Neel to Geodesic Structures, w/exhibits A & B	Lloyd Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
04/10/1965	44123	Quitclaim deed - unpatented Leviathan lode mining claims transferred fr Alpine Mining Enterprises to Robert Parker	Lloyd Neel Alpine Mining Enterprises, Inc Margaret Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
09/21/1965	45834	Ltr: CRWQB actions with Anaconda Copper Co & C Mann & Assoc re Leviathan sulphur mine drainage & sources of contamination, w/o attch	John Leggett CA Regional Water Quality Control Board - Lahontan Region	CA Regional Water Quality Control Board - Lahontan Region	REL	001		000021 000022	SER/014A	
03/25/1966	44125	Indenture - portion of Leviathan #16 lode mining claim sold to Eva Wasson by Robert & Catherine Parker	Robert Parker Catherine Parker		UNC	083		000021	SER/014A	
12/07/1966	44126	Grant deed - Leviathan #21 & #22 patented mine lode claims sold to Anne Palmer by Grant & Angie Merrill	Grant Merrill Angie Merrill		UNC	083		000021	SER/014A	

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08/18/1967	44135	Purchase agreement - Alpine Mining Enterprises grants right to US Borax & Chemical Co to prospect & evaluate mineral deposits, w/patented & unpatented Leviathan claim maps	Lloyd Neel Alpine Mining Enterprises, Inc		UNC	004 083		000021	SER/014A	
03/06/1968	44136	Amendment of purchase agreement (8/18/67) - Alpine Mining Enterprises extends date for US Borax & Chemical Co to prospect & evaluate mineral deposits, w/patented & unpatented Leviathan claim maps	Lloyd Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
11/12/1968	43964	Ltr: Requests history of Leviathan Creek fish & wildlife habitat	Fred McLaren CA Regional Water Quality Control Board - Lahontan Region	Arthur Brown CA Dept of Fish & Gam	UNC	001		000021 000022	SER/014A	
11/24/1968	44340	Ltr: Responds to request for information re Leviathan Creek prior to mine pollution w/TL to D Walsh fr P Tuttle 1/30/98	Arthur Brown CA Dept of Fish & Game	Fred McLaren CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000022	SER/014A	
11/24/1968	75530	Ltr: Response to request for information re Leviathan Creek prior to pollution by mine - historic facts of Leviathan Creek	Arthur Brown CA Dept of Fish & Game	Fred McLaren CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000020 000021	SER/014A	
11/25/1968	76163	Rpt on pollution of Leviathan Creek caused by Leviathan Mine	CA Regional Water Quality Control Board - Lahontan Region		UNC	008		000021	SER/014A	
12/06/1968	76164	Ltr: Relationship between US Borax & Chemical Corp & Alpine Mining Enterprises, Inc re ownership of Leviathan Mine	John Leggett CA Regional Water Quality Control Board - Lahontan Region	J Cook Alpine County - Office of District Attorney	UNC	001		000021	SER/014A	
12/20/1968	43968	Ltr: Arrangements for acid mine specialist to provide technical assistance	Richard O'Connell US Dept of the Interior - Federal Water Pollution Control Administration	Kerry Mulligan CA Water Resources Control Board	UNC	001		000022	SER/014A	
12/21/1968	44558	Testimonials of fishermen re Leviathan Creek pollution (12/6/68 - 12/21/68)			UNC	001 051		000021 000031	SER/014A	
02/03/1969	76289	Ltr: Resolution 69-9 ordering Alpine Mining enterprises to cease & desist violation of waste discharge requirements adopted by Board & transmits Resolution 69-9, w/attch	John Leggett CA Regional Water Quality Control Board - Lahontan Region	J Cook Alpine County - Office of District Attorney	REL	001		000021	SER/014A	

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02/24/1969	76290	Ltr: Transmits portion of Lahontan Regional Water Quality Control Board meeting minutes, CA Department of Fish & Game rpt & water quality data, w/attchs	John Leggett CA Regional Water Quality Control Board - Lahontan Region	J Cook Alpine County - Office of District Attorney	REL	001 003 067		000021	SER/014A	
04/18/1969	76166	Ltr: Transmits 11/13/68 ltr to Brooks Park re forage production on his ranch, w/encl	Gail Munk Douglas County, NV - Extension Service	Fred McLaren CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
06/12/1969	43980	Ltr: Requests information for use in legal action against Alpine Mining Enterprises re fishery resource of Leviathan & Bryant Creeks & E Fork Carson River	John Leggett CA Regional Water Quality Control Board - Lahontan Region	Raymond Arnett CA Dept of Fish & Gam	UNC	001		000021	SER/014A	
06/27/1969	75778	Memo: Leviathan Mine pollution - response to request for information re fishery resource of Leviathan Creek, Bryant Creek & East Fork Carson River, w/ltr to R Arnett fr J Leggett 6/12/69 & ltr to K Mulligan fr R O'Connell 12/20/68	James Leiby CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
06/27/1969	76173	Ltr: Responds to request for information re effect of Leviathan Mine wastes on fish, aquatic life & wildlife (Leviathan & Bryant Creeks & E Fork Carson River), w/ltr to R Arnett fr J Leggett 6/12/69 & ltr S Davis fr T Trelease 6/18/69	James Leiby CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	
06/27/1969	43973	Ltr: Responds to request for information re effect of Leviathan Mine wastes on fish, aquatic life, & wildlife (Leviathan & Bryant Creeks & E Fork Carson River)	James Leiby CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021 000022	SER/014A	
06/27/1969	43970	Ltr: Confirms Nevada Fish & Game cooperation re Leviathan Mine pollution abatement proceedings, w/o encl	James Leiby CA Dept of Fish & Game	Frank Groves NV Fish & Game Commission	UNC	001		000021	SER/014A	
07/24/1969	45861	Geological rpt on source of mineral water fr tunneling - site (draft) w/marginalia			REL			000021 000022	SER/014A	
07/30/1969	43982	Ltr: Responds to request for information re fishery resource of Leviathan & Bryant Creeks & E Fork Carson River	Raymond Arnett CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021	SER/014A	

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07/30/1969	76176	Ltr: Responds to request for information re fishery resource of Leviathan & Bryant Creeks & E Fork Carson River, w/attchs	Raymond Arnett CA Dept of Fish & Game	John Leggett CA Regional Water Quality Control Board - Lahontan Region	UNC	001 003		000021	SER/014A	
09/19/1969	76136	Memo: Pollution in Leviathan Creek & conversation with Emmet Matthews, w/statements of 2 fishermen	Thomas Trelease NV Fish & Game Dept	NV Fish & Game Dept	UNC	001 013 051		000021	SER/014A	
09/26/1969	45856	Rpt on site hydrologic study (5/14/69-9/26/69)	R Art CA Water Resources Control Board - Div of Water Rights		REL	003 004		000022	SER/014A	
10/17/1969	45886	Geological rpt on source of mineral water fr Leviathan Mine	A Franks		REL	008		000021 000022	SER/014A	
09/01/1970	76097	Statement of proof of labor for assessment year beginning 9/1/70 & ending 9/1/71 for Alpine Mining Enterprises, Inc	Alpine Mining Enterprises, Inc		UNC			000021	SER/014A	
10/07/1971	76179	Ltr: Request for clarification re EPA demonstration grant & mining operations for period of correction activities	James Neel Alpine Mining Enterprises, Inc	Bertram Buzzini CA Dept of Justice	UNC	001		000021	SER/014A	
01/01/1973	90723	Personal property ownership records, w/marginalia	US Forest Service		REL				SER/014A	
09/11/1973	44137	Corporation grant deed - Alpine Mining Enterprises grants Copper Bar Quartz Mine to Ernest & Eva Wasson	Margaret Neel Alpine Mining Enterprises, Inc James Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
10/05/1973	76226	List of Leviathan Mine parcel numbers & owners, (12/19/60 - 10/5/73), w/handwritten notes re owners & parcel numbers			UNC	013		000021	SER/014A	
03/18/1974	76286	History of mining operations, w/TL to P Jones fr R Hampson 3/18/74, encls & marginalia			UNC	001 003 004 008		000021	SER/014A	
01/01/1975	76674	Rpt on pollution of Leviathan & Bryant Creeks & East Fork Carson River caused by Leviathan Sulphur Mine (oversize drawings only)	CA Regional Water Quality Control Board - Lahontan Region		UNC	003 004		000021	SER/014A	

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01/01/1975	76278	Rpt on pollution of Leviathan & Bryant Creeks & East Fork Carson River caused by Leviathan Sulphur Mine, w/o oversize drawings	CA Regional Water Quality Control Board - Lahontan Region		UNC	003 004 008		000021	SER/014A	
01/01/1975	45829	Rpt on pollution - Leviathan & Bryant Creeks & East Fork Carson River caused by Leviathan sulphur mine, w/marginalia	CA Regional Water Quality Control Board - Lahontan Region		REL	003 004 008		000021	SER/014A	
01/20/1975	76146	Statement by Nevada Department of Fish & Game relative to Leviathan Mine pollution problem	NV Fish & Game Dept		UNC			000021	SER/014A	
01/23/1975	76186	Public hearing re condition of pollution or nuisance in matter of Anaconda Leviathan Sulphur Mine, 1/23/75	CA Regional Water Quality Control Board - Lahontan Region		UNC	067		000021	SER/014A	
03/03/1975	76190	Ltr: Anaconda's mining operation at Leviathan	Hubert Bruns Alpine County - Board of Supervisors	Michael O'Callaghan NV Office of the Governor	UNC	001		000021	SER/014A	
03/27/1975	76195	CRWQCB Lahontan Region resolution #75-3 - referring matter of Anaconda Leviathan Sulfur Mine to State Water Resources Control Board, w/note re persons to contact & directions 8/12/75	CA Regional Water Quality Control Board - Lahontan Region		UNC	001		000021	SER/014A	
06/01/1977	44352	Excerpts fr County rpt 8 - mines & mineral resources of Alpine Co, CA	CA Dept of Conservation - Div of Mines & Geology		UNC	003 073		000021	SER/014A	
06/01/1979	45221	Excerpts fr Feasibility study for abatement of pollution fr site - final rpt	Skelly & Loy	CA Regional Water Quality Control Board - Lahontan Region	REL	099		000021 000022	SER/014A	
04/19/1980	77098	Leviathan Mine surface rights drawing, w/BLM geographic index of claims & claimants & Leviathan mineral survey #6365 A & B parcel location maps	US Dept of the Interior - Bureau of Land Management		REL	003 004		000021	SER/014A	
08/13/1980	76199	Memo: Leviathan Mine assessors data, w/attch	Julie Vankleeck CA Regional Water Quality Control Board - Lahontan Region	Chuck White CA Regional Water Quality Control Board - Lahontan Region	REL	001 013		000021	SER/014A	
08/26/1980	76245	Ltr: Transmits orthoquad with flight lines & model control target locations & California grid coordinates for targets, w/encls & marginalia	Max Montgomery US Forest Service - Humboldt-Toiyabe National Forest	Charles White CA Regional Water Quality Control Board - Lahontan Region	UNC	001 004		000021	SER/014A	

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09/11/1980	76205	CRWQCB Lahontan Region resolution 80-6, authorizing executive officer to negotiate & execute contracts for site closure, cleanup & abatement & maintenance of Leviathan Mine	CA Regional Water Quality Control Board - Lahontan Region		UNC			000021	SER/014A	
10/01/1980	45943	Ltr: Preliminary results of geophysical surveys at site w/attchs	Kit Custis CA Dept of Conservation - Office of Mine Reclamation	Catherine Schoen CA Regional Water Quality Control Board - Lahontan Region	REL	001 003		000022	SER/014A	
10/21/1980	76255	Leviathan Mine, rpt of survey, w/Department of Water Resources survey note forms (9/15/80 - 10/21/80) & marginalia	US Forest Service		UNC	003 004 008		000021	SER/014A	
11/18/1980	44138	Individual quitclaim deed - Angie Merrill releases to Angie T Merrill Revocable Intervivos Trust claim to property (south of west fork of Carson River), w/exhibit A	Angie Merrill		UNC	083		000021	SER/014A	
11/18/1980	44139	Individual quitclaim deed - Angie Merrill releases to Angie T Merrill Revocable Intervivos Trust claim to Leviathan #22 Quartz Mine situate, w/exhibit A	Angie Merrill		UNC	083		000021	SER/014A	
03/12/1981	76208	CRWQCB Lahontan Region meeting of 3/12/81, Tahoe-Truckee Sanitation Agency - status rpt on Leviathan Mine pollution abatement project, w/attch	CA Regional Water Quality Control Board - Lahontan Region		UNC	067		000021	SER/014A	
04/29/1981	77097	Leviathan Mine rpt of survey made during 9/80, w/Proposal for collection of basic records & geochemical aspects, Leviathan Mine, 4/29/81	US Dept of the Interior - Geological Survey		UNC	003 008		000021	SER/014A	
09/17/1981	76213	CRWQCB Lahontan Region meeting of 9/17/81, Bishop - Leviathan Mine pollution abatement project - notes of discussion	CA Regional Water Quality Control Board - Lahontan Region		UNC	067		000021	SER/014A	
01/01/1982	46121	Description of construction work alternatives - pit, waste dump & spoil area			REL	003 004		000022	SER/014A	
03/15/1982	45893	USGS hydrogeotechnical program w/marginalia	US Dept of the Interior - Geological Survey		REL			000022	SER/014A	

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06/01/1982	77096	USGS hydrogeotechnical program, w/lab analytical sheets, USGS 6/82 survey test drilling rpt, attchs & marginalia	US Geological Survey		REL	001 003 004 013		000021	SER/014A	
08/17/1982	44385	Memo: Site visit with F Keith, Leviathan Mine manager fr 1953-1957 re site conditions prior to pit opening	Gerard Thibeault CA Regional Water Quality Control Board - Lahontan Region	Roy Hampson CA Regional Water Quality Control Board	UNC	001		000021	SER/014A	
12/23/1982	44140	Individual quitclaim deed - Angie T Merrill Revocable Intervivos Trust releases to Austin, Robert & Stuart Merrill claim to Leviathan #22 Quartz Mine, w/exhibit A	Angie Merrill		UNC	083		000021	SER/014A	
01/01/1983	45944	Thesis - historical & environmental geologic study of Leviathan Creek basin landslide	John Sciacca Univ of California, Davis		REL	003		000022	SER/014A	
04/01/1983	44389	Site pollution abatement project - design rpt & draft environmental impact rpt (EIR)	Brown & Caldwell Consultants	CA Regional Water Quality Control Board - Lahontan Region	REL	057		000022	SER/014A	
04/01/1983	75543	Excerpt fr Leviathan Mine pollution abatement project, design rpt & draft environmental impact rpt (chapter 2, p 2-1 - 2-6)	Brown & Caldwell	CA Regional Water Quality Control Board - Lahontan Region	UNC	057		000021	SER/014A	
04/01/1983	76235	Excerpts fr Leviathan Mine pollution abatement project, design rpt & draft environmental impact rpt (p 2-5 - 2-7, 2-15 - 2-20 & maps/drawings)	Brown & Caldwell	CA Regional Water Quality Control Board - Lahontan Region	UNC	003 004 008		000021	SER/014A	
04/14/1983	76221	CRWQCB Lahontan Region meeting of 4/14/83, Bishop - Leviathan Mine pollution abatement project - notes of discussion, w/resolution #83-3 requesting CA Attorney General to initiate appropriate legal proceedings against Anaconda Minerals	CA Regional Water Quality Control Board - Lahontan Region		UNC	067		000021	SER/014A	
05/01/1983	45807	Site pollution abatement project - final environmental impact rpt (EIR) (supplement) w/appendices A-C	Brown & Caldwell Consultants	CA Regional Water Quality Control Board - Lahontan Region	REL	001 045 057		000022 000031	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
05/24/1983	45808	Ltr: Comments re draft environmental impact rpt (EIR) - site pollution abatement project	Richard Krablin Anaconda Minerals Co	Gerard Thibeault CA Regional Water Quality Control Board - Lahontan Region	REL	001 045		000021 000022	SER/014A	
07/26/1983	44639	Settlement & release of liability agreement, w/copy of check & TL fr J Landy to J Martin 7/11/97	Kathleen Gnekow CA Dept of Justice - Office of the Attorney General Paul Christensen CA Regional Water Quality Control Board - Lahontan Region	James Marvin Atlantic Richfield Co	UNC	001		000021	SER/014A	
07/27/1983	45236	Memo: Transmits 7/22/83 ltr re status of water quality cleanup, w/attchs	Kathleen Gnekow CA Dept of Justice - Office of the Attorney General	Gerard Thibeault CA Regional Water Quality Control Board - Lahontan Region	REL	001		000021 000022	SER/014A	
08/23/1983	76236	Aerial Photo: Site before Regional Water Quality Control Board project, b&w, 1:12000	Cartwright Aerial Surveys, Inc		REL	007		000021	SER/014A	
12/19/1983	76223	Corporation grant deed - Alpine Mining Enterprises transfers ownership of Leviathan Mine to State of California, w/exhibit A & attchs re conveyance of property to CWQCB	James Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
12/19/1983	44141	Corporation grant deed - Alpine Mining Enterprises grants Leviathan patented lode claims & Leviathan Mill site claims to State of CA, w/exhibit A	James Neel Alpine Mining Enterprises, Inc Marshall Neel Alpine Mining Enterprises, Inc		UNC	083		000021	SER/014A	
06/29/1984	45802	Ltr: Transmits draft rpt - hydrologic & water-quality data fr Leviathan Mine & vicinity (1981-1983) w/encl	Terry Katzer US Geological Survey	Gerard Thibeault CA Regional Water Quality Control Board - Lahontan Region	REL	001 003		000022	SER/014A	
10/25/1984	76237	Aerial Photo: Site during Regional Water Quality Control Board project, b&w, 1:12000	Cartwright Aerial Surveys, Inc		REL	007		000021	SER/014A	
01/01/1985	45889	Hydrologic data for Leviathan Mine & vicinity (1981-1983)	Dale Hammermeister US Dept of the Interior - Geological Survey Stephen Walmsley US Dept of the Interior - Geological Survey		REL	004		000022	SER/014A	

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01/01/1985	43993	Data fr solute transport experiment in site drainage, 10/82 (partial rpt), w/marginalia	US Dept of the Interior - Geological Survey		UNC				SER/014A	
01/01/1986	45242	Article: Sierra watch - Leviathan means huge	Leo Poppoff, resident City of Carnelian Bay		REL	073		000021 000022	SER/014A	
06/26/1986	45237	Memo: Identifies repair work conducted on site concrete structures fr 6/11/85 - 8/30/85 (concurrence copy), w/o attchs	Craig Morgan CA Regional Water Quality Control Board	James Kuykendall CA Regional Water Quality Control Board	REL	001		000021 000022	SER/014A	
07/01/1986	76242	Excerpt fr Fishery management plan for Lahontan cutthroat trout (salmo clarki henshawi) in California & western Nevada waters (p 41 - Carson River sub-basin)	Eric Gerstung CA Dept of Fish & Game		REL			000021	SER/014A	
08/22/1986	45238	Memo: Discusses Mittry v CA Regional Water Quality Control Board & recommends completion of concrete repair work (concurrence copy)	Carol Hunter CA Dept of Justice - Office of the Attorney General	William Attwater CA Water Resources Control Board - Office of Chief Counsel	UNC	001		000021 000022	SER/014A	
10/17/1986	45239	Memo: Discusses concrete structure repairs (concurrence copy) w/marginalia	Ossian Butterfield CA Regional Water Quality Control Board - Lahontan Region	William Attwater CA Water Resources Control Board - Office of Chief Counsel	UNC	001		000021 000022	SER/014A	
11/21/1986	45827	Draft operation & maintenance plan - site pollution abatement project	CA Regional Water Quality Control Board - Lahontan Region		REL			000021 000022	SER/014A	
01/01/1987	90720	Location, recordation & assessment work for mining claims & sites in California, w/addressee lists	US Dept of the Interior - Bureau of Land Management		REL				SER/014A	
02/19/1987	45240	Resolution #87-5 requesting assistance for damaged concrete repair re site pollution abatement project, w/TL fr O Butterfield to W Ryan, Jr 3/3/87	Ossian Butterfield CA Regional Water Quality Control Board - Lahontan Region	CA Dept of Health Services	REL	001		000021 000022	SER/014A	
05/01/1987	44391	Chapter: Mining (100 years of history, recreation, lore in Alpine County, CA, 1864-1964, p43, Centenniel Book Committee)			REL	073		000021	SER/014A	
05/01/1987	45831	Leviathan - state of mine, spring of 1987	Tom Kukol CA Regional Water Quality Control Board - Lahontan Region		REL	003 004 008		000021 000022	SER/014A	

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01/01/1988	76239	Article: Status, life history & management of Lahontan cutthroat trout (American Fisheries Society Symposium, v4, p93-106)	Eric Gerstung CA Dept of Fish & Game		UNC	004 073		000021	SER/014A	
04/01/1988	43946	Silver Bow - Butte mining claim - title search supplement - summary of ARCO - Anaconda merger, w/exhibits A-P & TL fr C Elsen 10/1/97	Jacobs Engineering Group, Inc	Environmental Protection Agency - Region 8	DAC DAW DDP	091 097		000021	SER/014A	
07/01/1988	75472	Mining waste study, final rpt (section 5.6 - Leviathan Mine, p 221-228)	Univ of California, Berkeley		REL	003		000021	SER/014A	
01/01/1989	45942	Final revised analyses of major & trace elements fr acid mine waters in Leviathan Mine drainage basin, CA & NV (10/81-10/82)	James Ball US Dept of the Interior - Geological Survey D Nordstrom US Dept of the Interior - Geological Survey		REL			000022	SER/014A	
01/11/1990	76228	CA Water Quality Control Board Lahontan Region, board order #6-90-12, rescinding resolutions #64-3 & 69-9 for Leviathan Sulphur Mine, w/resolution #64-3 & 69-9	CA Regional Water Quality Control Board - Lahontan Region		UNC			000021	SER/014A	
03/03/1990	45243	Screening site inspection (SSI) reassessment, w/marginalia	Su-san Wen Ecology & Environment, In	Ginny Cummings Environmental Protection Agency - Region 9	REL	004 034		000020 000021	SER/014A	
10/01/1990	75526	Ltr: Decision re listing of impaired water & point sources for California - Leviathan Mine listed as point source, w/o encls	Doug Eberhardt Environmental Protection Agency - Region 9	Jane Schmidt US Forest Service	REL	001		000020 000021	SER/014A	
10/01/1990	77061	Ltr: Decision re listing of impaired water & point sources for California - Leviathan Mine listed as point source, w/final decision & response to comments	Doug Eberhardt Environmental Protection Agency - Region 9	Jane Schmidt US Forest Service	UNC	001 045		000021	SER/014A	
01/01/1991	75475	Preliminary assessment, final rpt	Greystone Development Consultants, Inc	US Forest Service - Carson Ranger District	REL	003 033		000020 000021	AR#/RV1-00-0001 SER/014A	
01/04/1991	45241	ROC: Site activity information sought for purpose of site screening	Angela Harris CA Dept of Health Services - Hazardous Waste Management Sectio	Jason Churchill CA Regional Water Quality Control Board - Lahontan Region	REL	002 013		000021 000022	SER/014A	

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01/15/1991	77094	Memo: Lahontan Regional water Quality Board meeting - notes re how to proceed now that Leviathan has been added to EPA's short list under Clean Water Act section 304 1 legislation, w/attchs	Guy Pence US Forest Service - Carson Ranger District	Forest Supervisor US Forest Service - Toiyabe National Forest	UNC	001 003 067		000021 000022	SER/014A	
04/01/1991	45229	History of Leviathan Mine pollution abatement project	Jason Churchill CA Regional Water Quality Control Board - Lahontan Region Ranjit Gill CA Regional Water Quality Control Board - Lahontan Region Eric Taxer CA Regional Water Quality Control Board - Lahontan Region		REL	004 008		000021 000022	SER/014A	
05/01/1991	45232	Preliminary assessment (PA) - site - final rpt, w/appendices A-D, w/o oversize map	Greystone Development Consultants, Inc	US Forest Service	REL	004 005 033		000020	SER/014A	
05/01/1991	74087	Preliminary assessment (PA) - site - final rpt, w/appendices A-D (oversize map only)	Greystone Development Consultants, Inc	US Forest Service	REL	004 005 033		000020	SER/014A	
06/26/1991	45230	Ltr: Accepts recommendation of no further action & transmits preliminary assessment (PA) - mining waste study final rpt	John Lupis US Forest Service - Intermountain Region	Carolyn Douglas Environmental Protection Agency - Region 9	REL	001 004 033		000020 000021	SER/014A	
01/01/1992	45157	Map: Washoe lands - present & pre-European contact lands of Washoe Indian Tribe of NV & CA, w/marginalia by K Mayer	Kenneth Miller		REL	004			SER/014A	
01/01/1992	45941	Thesis - ground conductivity study of Leviathan sulphur mine (draft) w/marginalia	Kevin Graves California State Univ, Sacramento		REL			000021 000022	SER/014A	
04/10/1992	45235	Ltr: Notifies & requests US Forest Service participation re proposed site remediation strategies & time schedules	Eric Taxer CA Regional Water Quality Control Board - Lahontan Region	Guy Pence US Forest Service	REL	001		000021 000022	SER/014A	

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06/04/1993	45939	Article: Transport & natural attenuation of Cu, Zn, As & Fe in acid mine drainage of Leviathan & Bryant creeks w/marginalia	D Nordstrom US Geological Survey Kathleen Smith US Geological Survey Jenny Webster Institute of Environmental Health & Forensic Science		REL			000022	SER/014A	
10/01/1993	45169	Pamphlet: Lahontan national fish hatchery (Gardnerville, NV)	US Dept of the Interior - Fish & Wildlife Service		REL	081			SER/014A	
01/01/1994	75492	Excerpts fr Financial Stock Guide Service, Directory of obsolete securities, 1994 edition	Financial Information, Inc		UNC	008		000021	SER/014A	
09/16/1994	76288	Newsclip: Water cleaning project full of manure, straw	Mike Sion Reno Gazette-Journal		UNC	006		000021	SER/014A	
01/30/1995	76238	Lahontan cutthroat trout (oncorhynchus clarki henshawi) recovery plan	US Dept of the Interior - Fish & Wildlife Service, Region 1 Patrick Coffin William Cowan		UNC	004 005 008		000021 000022	SER/014A	
04/05/1995	45234	Maps: Assessors - Alpine Co (1951-1995)	Alpine County - Assessors Office		REL	004		000020 000021	SER/014A	
07/01/1995	44002	Leviathan Mine workplan (draft) w/attchs A-D	Diana Henrioulle-Henry CA Regional Water Quality Control Board - Lahontan Region Catherine Schoen CA Regional Water Quality Control Board - Lahontan Region Bruce Warden CA Regional Water Quality Control Board - Lahontan Region		UNC	004 010		000023	SER/014A	
07/01/1995	75537	Leviathan Mine 5-year workplan	Catherine Schoen CA Regional Water Quality Control Board - Lahontan Region		REL	003 004 010		000021 000028	AR#/RV1-00-0002 SER/014A	

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08/25/1995	45231	Aquatic invertebrate bioassessment monitoring of acid mine drainage impacts in Leviathan Creek watershed - technical rpt	David Herbst Univ of California - Sierra Nevada Aquatic Research Laboratory		REL	004 005 008		000021 000022	SER/014A	
12/07/1995	45213	Memo: Investigation based on review of Washoe Tribe documents & site visit, w/marginalia	Carol Yeatman Nevada Indian Rural Legal Services, Inc	Thomas Burton National Indian Environmental Council	UNC	001		000021 000022	SER/014A	
01/01/1996	45228	Feasibility of lime treatment at site using in-line system w/appendices A-H	Terry Ackman US Dept of Energy - Pittsburgh Research Cente Ann Kim US Dept of Energy - Pittsburgh Research Cente	CA Regional Water Quality Control Board - Lahontan Region	REL	099		000022	SER/014A	
01/01/1996	45158	Map: Earthquake activity 1960-1996 (by site latitude & longitude) w/marginalia by K Mayer			REL	004			SER/014A	
01/01/1996	77058	Ta Gum Osh (Pine Nut Mountains) - Investigation of conditions impacting Washoe allotted lands, pine nut allotments	Washoe Tribe of Nevada & California - Washoe Tribal Council		UNC	008		000021	SER/014A	
01/01/1996	75473	Excerpts fr Feasibility of lime treatment at Leviathan Mine using in-line system, (p 5-10, background & environmental remediation)	Terry Ackman US Dept of Energy - Pittsburgh Research Cente Ann Kim US Dept of Energy - Pittsburgh Research Cente	CA Regional Water Quality Control Board - Lahontan Region	UNC	003 008		000021	SER/014A	
04/01/1997	45812	Carson River chronology - chronological history of Carson River & related water issues (Ist update)	Gary Horton NV Div of Water Planning		REL	004		000021 000022	SER/014A	
04/01/1997	75490	Page I-14 fr Carson River Chronology	Gary Horton NV Dept of Conservation & Natural Resources - Div of Water Planning		UNC	008		000021	SER/014A	
05/01/1997	44006	Leviathan Mine Council communication lists - trustee, EPA, technical staff & PRP, w/marginalia	Environmental Protection Agency - Region 9		UNC			000021	SER/014A	
05/01/1997	45887	History & current status of site oversight & activities by CRWQB-Lahontan Region			REL			000021 000022	SER/014A	

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05/20/1997	76240	Ltr: Pond 4 discharge identified as hazardous waste under RCRA & transmits scientific & regulatory analysis of Pond 4 discharge, w/encls	J Akenhead Akenhead Compliance & Environmental Services	Brian Wallace Washoe Tribe of Nevada & California	REL	001		000021	SER/014A	
05/27/1997	45233	Ltr: Petition & supporting data for issuance of administrative order re site pollution abatement project, w/encls	John Martin Beavers & Young	Ron Brown Environmental Protection Agency - Region 9	REL	001		000021 000022	SER/014A	
06/08/1997	75476	Ltr: EPA will reevaluate Leviathan no further action status based on new information & transmits 3/3/90 screening site inspection reassessment, w/encl	Matthew Mitguard Environmental Protection Agency - Region 9	John Martin Beavers & Young	UNC	001 003		000020 000021	SER/014A	
06/13/1997	75477	Ltr: Response to concerns raised in Washoe Tribe's 5/2/97 ltr & at 4/29 meeting re Leviathan Mine & its impact on Tribe	Alexis Strauss Environmental Protection Agency - Region 9	Brian Wallace Washoe Tribe of Nevada & California	UNC	001		000020 000021 000031	SER/014A	
06/26/1997	45153	Aquatic invertebrate bioassessment monitoring of acid mine drainage impacts in Leviathan Creek watershed (revised)	David Herbst Univ of California - Sierra Nevada Aquatic Research Laboratory	CA Regional Water Quality Control Board - Lahontan Region	REL	008		000022	SER/014A	
08/15/1997	73836	Lahontan CRWQCB water sample sites & list of sampling sites for data summary sheets, w/maps, chain of custody forms & analytical result rpts (12/95 - 8/97)	California Laboratory Services		REL	001 004		000022	SER/014A	
09/01/1997	45254	Site treatibility summary			REL	068		000022	SER/014A	
09/16/1997	76287	Leviathan Mine field review notes fr 9/12/97 site visit, w/TL to M Marks fr K Pitt 9/25/97	Ken Pitt US Forest Service		UNC	001		000021	SER/014A	
09/17/1997	45257	Memo: Site visit (9/12/97) observations	Rick Sugarek Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	REL	001		000020	SER/014A	
09/19/1997	44041	Corp & limited partnership search - Atlantic Richfield			UNC	097		000021	SER/014A	
09/19/1997	44036	Co history & mergers re Anaconda Copper Mining Co, Anaconda Co, ARCO & Atlantic Richfield Co (Appendix C), w/marginalia	Science Applications International Corp		UNC	097		000021	SER/014A	

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09/19/1997	75538	Anaconda & Atlantic Richfield corporate documents - Anaconda relationship to ARCO & Atlantic Richfield partnership search results			UNC	097		000021	SER/014A	
09/24/1997	75508	Action Memo: Request for approval of removal action, w/enforcement strategy & attchs	Dan Suter Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	UNC	001 003 093		000021 000028	SER/014A	
09/25/1997	45270	Ltr: Supports EPA's proposed emergency response activities re acid mine drainage (AMD)	Ranjit Gill CA Regional Water Quality Control Board - Lahontan Region	Dan Suter Environmental Protection Agency - Region 9	UNC	001		000021 000028	SER/014A	
09/25/1997	45269	Ltr: General notice of federal interest re Atlantic Richfield Co (ARCO), w/o certified mail receipt #274-217-263 & #274-218-030	Keith Takata Environmental Protection Agency - Region 9	C Knowles ARCO Environmental Remediation L L C	REL	001 059		000021	SER/014A	
09/29/1997	47736	Pollution report (POLREP) #1	Daniel Suter Environmental Protection Agency - Region 9		REL	001 084 094				
09/30/1997	75466	Ltr: Notification of natural resource trustees re time critical removal action at site, w/o addressee list	Dan Suter Environmental Protection Agency - Region 9	Addressees	UNC	001		000021 000028	SER/014A	
10/01/1997	45542	Ltr: Answers invitation to participate in response actions	C Knowles Atlantic Richfield Co Environmental Remediation, L L C	Keith Takata Environmental Protection Agency - Region 9	REL	001		000021	SER/014A	
10/08/1997	45271	Ltr: Notifies CA of removal action commencement & encourages CA to join Atlantic Richfield Co to implement permanent site measures	Keith Takata Environmental Protection Agency - Region 9	Harold Singer CA Regional Water Quality Control Board	UNC	001		000021 000028	SER/014A	
10/10/1997	45272	Ltr: Responds to Washoe Tribe of NV & CA's offer to enter into agreement re implementation of site projects	Harold Singer CA Regional Water Quality Control Board	John Martin Beavers & Young	UNC	001		000021 000022	SER/014A	
10/11/1997	47737	Pollution report (POLREP) 2	Dan Suter Environmental Protection Agency - Region 9		REL	001 008 084 094				
10/25/1997	47739	Pollution report (POLREP) #4	Dan Suter Environmental Protection Agency - Region 9		REL	001 008 084 094				

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10/25/1997	47740	Pollution report (POLREP) #5	Dan Suter Environmental Protection Agency - Region 9		REL	001 008 084 094				
12/31/1997	77067	Ltr: Forest Service would like to become member of Leviathan Mine Natural Resource Damages Trustee Discussion Group & lists key project contacts, w/FS meeting minutes	Jack Blackwell US Forest Service	Dan Suter Environmental Protection Agency - Region 9	UNC	001 067		000021	SER/014A	
01/01/1998	44348	Trace-element enrichment in streambed sediment & crayfish, Carson & Truckee Rivers, NV & CA (9/92), w/draft - occurrence of trace elements in Bryant Creek drainage basin	Stephen Lawrence US Geological Survey		REL			000021 000031	SER/014A	
01/01/1998	44641	Sport fish restoration - east & main Carson River region - federal aid job progress rpt (1/1/97-12/31/97)	NV Dept of Conservation & Natural Resources - Div of Wildlife		UNC	008		000021	SER/014A	
01/01/1998	45282	Water quality in Las Vegas valley area & Carson & Truckee River basins, NV & CA, 1992-1996	Hugh Bevans US Geological Survey Stephen Lawrence US Geological Survey Michael Lico US Geological Survey		REL	004 005		000022	SER/014A	
01/05/1998	43937	Site history, hazardous substance releases, liability, potentially affected natural resources	Brian Wallace Washoe Tribe of Nevada & California Wayne Nordwall US Dept of the Interior - Bureau of Indian Affairs US Forest Service	US Dept of the Interior	DAC DAW DDP	064		000021	SER/014A	
01/09/1998	45227	Ltr: Information fr computer files & transmits list of references fr historical newspaper sources re Carson River fisheries, w/attch & TL to D Kaffer, fr M Sevon	NV Dept of Conservation & Natural Resources	NV Dept of Conservation & Natural Resources - Div of Wildlife	UNC	001		000021 000022	SER/014A	
01/20/1998	45260	Memo: Recommends treatment options w/o attch	Will Duncan Superfund Technical Assistance Response Tea Vicki Frankel Superfund Technical Assistance Response Tea	Dan Suter Environmental Protection Agency - Region 9	REL	001		000022	SER/014A	

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01/23/1998	45159	Ltr: Confirms Washoe Tribes request for site health consultation, w/o attchs, w/marginalia by G Eng	John Martin Beavers & Young	Gwendolyn Eng US Dept of Health & Human Services - Agency for Toxic Substances & Disease Registry	REL	001		000021	SER/014A	
01/30/1998	75546	TL: 11/24/68 ltr establishing occurrence of cutthroat trout in creek	Peter Tuttle US Dept of the Interior - Fish & Wildlife Service	Larry Thompson US Dept of the Interior - Fish & Wildlife Service Dan Welsh US Dept of the Interior - Fish & Wildlife Service	UNC	001		000021	SER/014A	
02/01/1998	45160	Map: Site (East Fork Carson River & Bryant Creek) w/marginalia by K Mayer			REL	004		000020	SER/014A	
02/01/1998	45161	Map: Bryant Creek & East Fork Carson River fr site to Dresslerville marking Washoe Tribe, US Forest Service & private lands			REL	004		000020	SER/014A	
02/01/1998	75479	Fact Sheet: EPA to continue work at site	Environmental Protection Agency - Region 9		REL	011		000021 000022	SER/014A	
02/02/1998	45217	Ltr: Washoe Tribe requests US Depts of Interior & Justice legal representation re claims arising fr site activities	Beavers & Young	Shelley Hall US Dept of the Interior - Div of Conservation & Wildlife Suzanne Schaeffer US Dept of the Interior - Office of the Solicitor Janet Wong US Dept of the Interior - Office of the Solicitor	UNC	001		000021 000028	SER/014A	
02/03/1998	44025	Memo: Transmits documentation of relationship between Texas Gulf Sulphur & PCS Phosphate Co, Inc, Dunn & Bradstreet rpt & co summaries for PCS Phosphate Co & Potash Corp of Saskatchewan, w/encls	Christine Chong Atlantic Richfield Co	Charles McKinley US Dept of the Interior - Office of the Solicitor	UNC	001 097		000021	SER/014A	
02/04/1998	45244	Joint prosectution confidentiality agreement pertaining to documents re site response & restoration			UNC			000021	SER/014A	

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02/10/1998	76019	Ltr: Meeting notes of Leviathan Mine Council (11/13/97) & meeting agenda (2/19/98) re Leviathan Mine natural resource damage assessment, w/o encl	Michael Smith US Dept of the Interior - Bureau of Indian Affairs	Interested Party	UNC	001 067		000021	SER/014A	
02/10/1998	43995	Ltr: Meeting notes of Leviathan Mine Council (11/13/97) & meeting agenda (2/19/98) re Leviathan Mine natural resource damage assessment, w/encl	Michael Smith US Dept of the Interior - Bureau of Indian Affairs		UNC	001 067		000020 000031	SER/014A	
02/17/1998	76032	Memorandum of agreement (MOA) among Washoe Tribe of Nevada & California, EPA, US Department of Interior, State of Nevada & US Department of Agriculture - revised draft			UNC			000021	SER/014A	
02/18/1998	76243	Email: Bryant Creek could support trout if cleaned up - Bryant Creek not addressed as part of LCT recovery for Carson River Basin, w/history	Pat Coffin US Dept of the Interior - Fish & Wildlife Service	Stanley Wiemeyer US Dept of the Interior - Fish & Wildlife Service	UNC	001		000021	SER/014A	
02/21/1998	45276	Newsclip: Chemist warns of mercury in crawdads here, w/rtg slip to S Wilson fr J Smitherman (2/27/98)	Sharon Carter Record-Courier, The		REL	006		000022	SER/014A	
02/23/1998	45215	Ltr: Invites ARCO & Lahontan regional water quality control board to meet natural resource trustees re site removal action to control contaminated liquids releases (partial final draft)		Mark Flickinger ARCO Environmental Remediation L L C	UNC	001		000021 000022 000028	SER/014A	
02/24/1998	45266	Ltr: Confirms ARCO's attendance at 3/4/98 natural resource trustee meeting re ARCOs role in future site actions, w/o encls	Dennis Gebhardt Washoe Tribe of Nevada & California Kevin Mayer Environmental Protection Agency - Region 9	Mark Flickinger ARCO Environmental Remediation L L C	REL	001		000021 000022 000028	SER/014A	
02/24/1998	45216	Memo: Forwards email information re Carson River Fishery Conference, w/marginalia	John Krause US Dept of the Interior	Jeff Loman US Dept of the Interior	UNC	001		000021 000024	SER/014A	
02/26/1998	44344	Press Release: Urban activity & past mining practices may add chemicals to Carson & Truckee Rivers	US Dept of the Interior - Geological Survey		UNC	080		000021 000031	SER/014A	

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02/27/1998	76021	Ltr: Request for Department of Justice to represent Department of Interior in investigating & pursuing natural resources damage assessment claim re Leviathan Mine, w/o attch	Katherine Verburg US Dept of the Interior - Office of the Solicitor	Joel Gross US Dept of Justice - Environmental Enforcement Section	UNC	001		000021	SER/014A	
02/27/1998	43996	Ltr: Requests US Dept of Justice representation re Washoe Tribe natural resources damage assessment claim, w/encl	Katherine Verburg US Dept of the Interior - Office of the Solicitor	Joel Gross US Dept of Justice - Environmental Enforcement Section	UNC	001		000021	SER/014A	
02/27/1998	45162	Ltr: Comments re US Geologic Survey #97-4258 (Trace-element enrichment in streambed & crayfish, Carson & Truckee Rivers, NV & CA)w/attchs	Dennis Gebhardt Washoe Tribe of Nevada & California	Kevin Mayer Environmental Protection Agency - Region 9	REL	001 045		000022	SER/014A	
03/04/1998	44534	Mtg Agenda: Leviathan Mine (Reno, NV)	Kevin Mayer Environmental Protection Agency - Region 9		REL	067			SER/014A	
03/04/1998	90721	Trustee communication list & PRP communication list			REL			000021	SER/014A	Atlantic Richfield Co CA Regional Water Quality Control Board - Lahontan Regio
03/05/1998	45280	Graph re flow & stage for East Fork Carson River - Markleeville (monitor precipitation & runoff site activity) w/marginalia by D Gebhardt			REL			000022	SER/014A	
03/06/1998	45279	Graph re Spratt Creek - Snotel site, w/marginalia by D Gebhardt			REL			000022	SER/014A	
03/14/1998	45533	Newsclipping: Officials negotiate cleanup, w/marginalia	Sheila Gardner Record-Courier, The		REL	006		000021	SER/014A	
03/16/1998	45146	Memo: Transmits State of CA budget change proposal for fiscal year 1998-1999 & 5-year workplan, w/budget change proposal & addendum to 5-year work plan, w/o 5-year workplan	CA Regional Water Quality Control Board - Lahontan Region		REL	001 010		000021 000029	SER/014A	
03/16/1998	45163	Request for qualifications (to prepare natural resource damage assessment plan) w/TL fr D Gebhardt to K Mayer 3/24/98	Washoe Tribe of Nevada & California		REL	001 004			SER/014A	
04/05/1998	45164	Map: Proposed data sites - 1998 (Doud Creek, Bryant Creek, Barney Riley Creek, Mountaineer Creek, Leviathan Creek)			REL	004		000022	SER/014A	

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05/04/1998	44409	Memo: Site water sampling program w/encls	Mary Marks US Forest Service	Dennis Gebhardt Washoe Tribe of Nevada & California	REL	001 004			SER/014A	
05/06/1998	75529	Contact rpt re Lahontan cutthroat trout in Carson River basin	Karen Johnson Ecology & Environment, In	Colleen Holley NV Dept of Conservation & Natural Resources - Div of Wildlife Leroy McLelland NV Dept of Conservation & Natural Resources - Div of Wildlife	REL	002		000021	SER/014A	
05/11/1998	45172	Ltr: Mtg notes (2/19/98) re natural resource damage assessment, w/encls	Barry Welch Leviathan Mine Council		REL	001 067		000021 000022	SER/014A	
05/11/1998	45557	Administrative order on consent for removal action, docket #98-07, w/attchs	Keith Takata Environmental Protection Agency - Region 9		REL	041		000021 000028	DKT/98-07 SER/014A	
05/13/1998	45171	Memorandum of agreement (MOA) re site natural resource damages	Brian Wallace Washoe Tribe of Nevada & California Keith Takata Environmental Protection Agency - Region 9 Wayne Nordwall US Dept of the Interior - Bureau of Indian Affairs Jack Blackwell US Forest Service		REL			000021 000022	SER/014A	
05/19/1998	10143	Ltr: Leviathan acid mine drainage treatment technology, w/attchs	Will Duncan Ecology & Environment, In	Karen Nelson Environmental Protection Agency - Region 9	UNC	001		000023	SER/014A	
05/26/1998	44432	Ltr: Designates M Marks, M Manderbach, K Pitt as representative, alternate representative, & legal counsel respectively re memorandum of agreement (MOA)	Jack Blackwell US Forest Service	Carol Yeatman Washoe Tribe of Nevada & California	REL	001			SER/014A	

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06/01/1998	45147	Ltr: Transmits workshop agenda (6/3/98) & CA water resources control board resolution authorizing agreement with Atlantic Richfield Co re site removal &/or treatment of acid mine drainage to increase storage pond capacity	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region		REL	001 067		000021 000028	SER/014A	
06/01/1998	44543	Workplan for response action at site w/o appendices & w/comments & TL fr K Mayer to C Yeatman 6/2/98	Atlantic Richfield Co Environmental Remediation, L L C	Environmental Protection Agency - Region 9	REL	001 010 045		000028	SER/014A	
06/01/1998	75481	Workplan for response action at site, w/o appendices	ARCO Environmental Remediation L L C	Environmental Protection Agency - Region 9	UNC	003 010		000021 000022	SER/014A	
06/02/1998	76260	Ltr: Water filled pit discovered in upper reaches of Aspen Creek during site visit & transmits map showing CA Water Quality Control Board water sampling locations, w/encl	Mary Marks US Forest Service - Humboldt-Toiyabe National Forest	Larry Thompson US Dept of the Interior - Fish & Wildlife Service	REL	001 003 004		000021	SER/014A	
06/03/1998	45572	Ltr: AERL discontinues seeking site access permission fr RWQCB for EPA re administrative order on consent (AOC) #98-07, w/TL	Christine Chong Atlantic Richfield Co	Charles McKinley US Dept of the Interior - Office of the Solicitor	REL	001		000021 000028	SER/014A	
06/04/1998	45283	Memo: Notification of planned field activities (6/8/98) w/marginalia	Terry Braun Steffen, Robertson & Kirste	Kevin Mayer Environmental Protection Agency - Region 9 Tony Smokey Washoe Tribe of Nevada & California Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	REL	001		000022	SER/014A	
06/08/1998	75522	Memo: 2nd status rpt on Leviathan project	Tony Schwarz ARCO Environmental Remediation L L C	Leviathan Team	DSN	001		000021 000022	SER/014A	
06/11/1998	45620	Ltr: Transmits site health & safety plan w/attchs	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001 010 061		000021 000022 000028 000031	SER/014A	

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06/19/1998	45165	Ltr: Transmits & discusses proposed assessments of injuries to aquatic natural resources - phase 1 (6/18/98)	Carol Yeatman Washoe Tribe of Nevada & California	Neal Brody Atlantic Richfield Co	REL	001		000022	SER/014A	
06/22/1998	45595	Site removal action - workplan addendum #001 - perimeter monitoring plan for pond 1 enhanced evaporation system operations w/TL to K Mayer fr J Beck (6/23/98)	J M Beck & Assoc		REL	001 010		000021 000028	SER/014A	
06/22/1998	45281	Ltr: Comments on draft monitoring plan, w/attchs & TL fr J Nowlin to N Black	John Nowlin US Dept of the Interior - Geological Survey	Leviathan Mine Technical Group	REL	001 004 045		000022	SER/014A	
06/25/1998	45561	Tolling agreement	Neal Brody Atlantic Richfield Co Walt Pettit CA Water Resources Control Board Harold Singer CA Regional Water Quality Control Board Brian Wallace Washoe Tribe of Nevada & California Lois Schiffer US Dept of Justice - Office of Attorney General Jon Mueller US Dept of Justice - Environment & Natural Resources Div		REL			000021	SER/014A	
07/01/1998	45571	Ltr: Requests written concurrence re proposal to expand evaporative system w/TL to C McKinley fr D Suter & marginalia	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001		000021 000028	SER/014A	
07/01/1998	45166	Ltr: Requests written concurrence for expansion of enhanced evaporative system at site	Anthony Schwarz ARCO Environmental Remediation L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001		000021 000024	SER/014A	
07/01/1998	10110	Ltr: Transmits site characterization workplan, w/o encl	Anthony Schwarz ARCO Environmental Remediation L L C	Daniel Suter Environmental Protection Agency - Region 9	REL	001		000028	SER/014A	

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07/01/1998	45809	Site 1998 workplan (draft) w/appendices A-B	ARCO Environmental Remediation L L C	Environmental Protection Agency - Region 9	REL	010 046 060 065 066		000021 000022	SER/014A	
07/06/1998	45955	Ltr: Transmits 2 Excel 5.0 files - flowshet.xls & ndep.xls & 3.5 in computer disc w/attch	Carol Yeatman Washoe Tribe of Nevada & California	Leviathan Mine Council	REL	001		000022	SER/014A	
07/15/1998	45566	Ltr: Process to allow ARCO to fund USGS for surface water quality & flow monitoring w/site aquatic resource assessment program	Gene Mancini Atlantic Richfield Co	Carol Yeatman Washoe Tribe of Nevada & California	REL	001		000021 000022	SER/014A	
07/15/1998	45145	Ltr: Comments re proposed expansion of enhanced evaporation system	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	Anthony Schwarz ARCO Environmental Remediation L L C	REL	001 045		000028	SER/014A	
07/15/1998	45570	Memo: Site status rpt #3 w/TL fr C Kezos (7/21/98)	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Leviathan Team	REL	001 036 046		000021 000028	SER/014A	
07/17/1998	45274	Certificate of treatment & waste management re waste water	U S Filter Recovery Services	Environmental Protection Agency - Region 9	REL				SER/014A	
07/22/1998	45142	Consent & agreement for entry & access (draft) w/TL to C McKinley fr S Russell (7/31/98)	CA Dept of Justice - Office of Attorney General	Environmental Protection Agency - Region 9	REL	001		000021 000028	SER/014A	
07/23/1998	75507	Time critical removal action memorandum, w/TL to Forest Supervisor, Humboldt-Toiyabe NF fr J Blackwell	Jack Blackwell US Forest Service		UNC	001 093		000021 000028	SER/014A	
07/28/1998	45143	Sampling of overspray (buckets of sand) - metals & STLC metals (draft) w/TL to K Mayer fr R Tucker & marginalia by K Mayer	CA Regional Water Quality Control Board - Lahontan Region		REL	001			SER/014A	
07/28/1998	45618	Site emergency removal action - workplan addendum #002 - perimeter monitoring plan for expanded (ponds 1, 2S, 2N & 3) enhanced evaporation system operations w/TL to D Suter fr A Schwarz (7/29/98)	Atlantic Richfield Co Environmental Remediation, L L C	Environmental Protection Agency - Region 9	REL	001 003 010		000021 000028	SER/014A	

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07/30/1998	75528	Preassessment screen determination, Leviathan Mine, for natural resource damage assessment, w/signature page, 8/11/98, w/o exhibits	Washoe Tribe of Nevada & California US Dept of the Interior - Bureau of Indian Affairs US Forest Service		UNC	008		000021	SER/014A	
08/01/1998	45594	Phase 1 NRDA proposed workplan w/attchs & TL to C Yeatman fr N Brody (8/14/98)	Atlantic Richfield Co Environmental Remediation, L L C	Leviathan Mine Council	REL	001 010		000021 000022	SER/014A	
08/06/1998	45585	Memo: Site status rpt #4 (7/98)	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Leviathan Team	REL	001 036 046		000021 000028	SER/014A	
08/14/1998	45148	Ltr: Comments re proposed site expansion of enhanced evaporation system at site	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	Anthony Schwarz ARCO Environmental Remediation L L C	REL	001 045		000021 000028	SER/014A	
08/17/1998	45591	Agreement re communications to & fr CA Dept of Fish & Game	Leviathan Mine Council Neal Brody Atlantic Richfield Co		REL			000021 000022	SER/014A	
08/25/1998	45167	Memo: Transmits sediment pore water sampling - rationale & technique, w/acute toxicity of site water to rainbow trout under static-renewal test conditions, & pollution incident daily resource rpt (govt personnel travel expenses) & TLs	Gene Mancini Atlantic Richfield Co	Leviathan Mine Council	REL	001		000022	SER/014A	
09/03/1998	45170	Funding & participation agreement for assessment of natural resource damages between ARCO, Washoe Tribe of NV & CA, US Dept of Interior, US Dept of Agriculture - Forest Service, & CA Dept of Fish & Game, w/marginalia & exhibits A-1, A-2, B-C	Atlantic Richfield Co		REL	010		000021 000029 000031	SER/014A	
09/11/1998	45149	Ltr: Transmits & discusses initial study & notice of preparation of draft environmental document for proposed amendments to water quality control plan for Lahontan Basin w/encl	Robert Dodds CA Regional Water Quality Control Board - Lahontan Region		REL	001 004		000028	SER/014A	

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09/17/1998	76229	Draft Collection agreement between USDA Forest Service, Humboldt-Toiyabe National Forest & CA Regional Water Quality Control Board-Lahontan Region, w/TL to C Stetler fr M Marks	US Forest Service - Humboldt-Toiyabe National Forest CA Regional Water Quality Control Board - Lahontan Region		UNC	001		000021	SER/014A	
09/18/1998	45535	Ltr: Site air monitoring	Jim Kubalik Atlantic Richfield Co Environmental Remediation, L L C	Ranjit Gill CA Regional Water Quality Control Board - Lahontan Region	REL	001		000022	SER/014A	
09/24/1998	45569	Ltr: Requests draft workplan delivery date extension re administrative order on consent (AOC) #98-07 w/attch	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001		000021	SER/014A	
09/24/1998	44023	Memo: Transmits PCS Phosphate Co, Inc corporate history, Western Clay & Metals Co & Calpine Co articles of incorporation & dissolution, w/encls	Neal Brody Atlantic Richfield Co	Charles McKinley Environmental Protection Agency - Region 9	UNC	001 097		000021	SER/014A	
09/29/1998	47741	Pollution report (POLREP) #6 (FINAL)	Dan Suter Environmental Protection Agency - Region 9		REL	001 008 084 094				
10/01/1998	45616	Site stream monitoring program - spring 1998	S R K Consulting	Environmental Protection Agency - Region 9	REL	004		000021	SER/014A	
10/05/1998	45598	Memo: Site status rpt #6 (9/98)	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Leviathan Team	REL	001 036 046		000021 000028	SER/014A	
10/08/1998	45568	Ltr: Requests EPA's concurrence to modified removal action activities, w/technical memorandum - active treatment with sludge stabilization	Anthony Schwarz ARCO Environmental Remediation L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001		000021 000028	SER/014A	
10/13/1998	76230	Ltr: Request for US Army Corp of Engineers to identify ARARs re response action for Leviathan Mine road, w/encl	Gloria Flora US Forest Service - Humboldt-Toiyabe National Forest	Nancy Kang US Army Corps of Engineers	UNC	001 004		000021	SER/014A	

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10/13/1998	45536	Memo: Drill cuttings proposal	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Kevin Mayer Environmental Protection Agency - Region 9 Dan Suter Environmental Protection Agency - Region 9	REL	001		000022	SER/014A	
10/20/1998	45567	Ltr: Requests EPA extend compliance deadline of 11/1/98 fr administrative order on consent (AOC) #98-07	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	Dan Suter Environmental Protection Agency - Region 9	REL	001		000021 000028	SER/014A	
10/28/1998	76234	Draft participating agreement between CA Regional Water Quality Control Board-Lahontan Region & US Department of Agriculture - Forest Service, Intermountain Region for Leviathan Mine removal action, w/TL to S Russell & B Dodds fr K Pitt	CA Regional Water Quality Control Board - Lahontan Region US Forest Service - Intermountain Region		UNC	001		000021 000028	SER/014A	
10/28/1998	44542	Ltr: Suggests sharing Bryant Creek total maximum daily loads (TMDLs) with Leviathan Mine Council re proposed basin plan amendments, w/marginalia	Jacques Landy Environmental Protection Agency - Region 9	Judith Unsicker CA Regional Water Quality Control Board - Lahontan Region	REL	001			SER/014A	
10/29/1998	75478	Memo: Leviathan trip rpt for 9/28 - 9/30/98 & for 10/27/98	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAC DAW DDP	001		000021	SER/014A	
10/30/1998	45574	Ltr: Response to ARCO's schedule extension requests re administrative order on consent (AOC) #98-07	Joshua Wirtschafter Environmental Protection Agency - Region 9	Neal Brody Atlantic Richfield Co	REL	001		000021 000028	SER/014A	
11/02/1998	44020	Ltr: Notification of & invitation to participate in site natural resource damage assessment	Brian Wallace Washoe Tribe of Nevada & California	Thomas Wright P C S Phosphate Co, In	UNC	001 059		000021	SER/014A	
11/02/1998	45150	Ltr: Response to ARCO's 9/3/98 ltr re use of enhanced evaporation & pond overspray at site, w/o encl	Harold Singer CA Regional Water Quality Control Board	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	REL	001		000028	SER/014A	

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11/02/1998	45151	Ltr: Concerns re proposed alterations to site overflow structure	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	Anthony Schwarz Atlantic Richfield Co Environmental Remediation, L L C	REL	001		000028	SER/014A	
11/12/1998	45946	Computer Disc: Site water quality data (5/29/98-11/12/98), 3.5 inches	Kevin Mayer Environmental Protection Agency - Region 9		REL			000022	SER/014A	
11/19/1998	45144	Ltr: Transmits site water quality data tables & surface water sampling plan for Leviathan Mine, water year 1998, w/attchs	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	Leviathan Mine Council	REL	001			SER/014A	
11/25/1998	43958	Ltr: Requests time extension for PCS Phosphate Co response re site involvement	Robert King Brooks, Pierce, McLendon, Humphrey & Leonard (Attorneys)	Brian Wallace Washoe Tribe of Nevada & California	UNC	001		000021	SER/014A	
12/09/1998	45543	Ltr: Responds to request for site documents	Charles McKinley US Dept of the Interior - Office of the Solicitor	Robert King Brooks, Pierce, McLendon, Humphrey & Leonard, LLP	REL	001			SER/014A	
12/10/1998	44433	Tribal risk assessment conference (12/8/98 - 12/10/98) - Las Vegas, NV	Environmental Protection Agency - Region 9		REL	005 007 067 073			SER/014A	
12/18/1998	10110	Ltr: Responds to J Wirtschafter's 10/30/98 ltr & reports on ARCO's status of compliance w/AOC 98-07, w/encls	Michael Hagood ARCO Environmental Remediation L L C	Daniel Suter Environmental Protection Agency - Region 9	REL	001 003		000028	SER/014A	
12/23/1998	45219	Ltr: Requests information re Artie Brown, former Alpine Co fish & game warden	Kim Muratore Environmental Protection Agency - Region 9	Arthur Brown, resident City of Oakdale	FX6	001		000020	SER/014A	
12/23/1998	90722	Computer search results on corporation & limited partnership - all available states	Kim Muratore Environmental Protection Agency - Region 9		REL				SER/014A	
12/23/1998	45220	Ltr: Requests information re Artie Brown, former Alpine Co fish & game warden	Kim Muratore Environmental Protection Agency - Region 9	Arthur Brown, resident City of Eureka	FX6	001		000020	SER/014A	
01/06/1999	10111	Fax TL: Transmits survey requested, w/o encl	Michael Hagood ARCO Environmental Remediation L L C	Kevin Mayer Environmental Protection Agency - Region 9	REL	001		000028	SER/014A	

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02/04/1999	45140	Memo: Leviathan trip rpt (12/28 - 12/31/98) & follow-up activities	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DAW DDP	001		000021	SER/014A	
02/16/1999	10111	Ltr: Evaporation pond data & related discussion, w/encls	James Beck J M Beck & Assoc	Kevin Mayer Environmental Protection Agency - Region 9	REL	001 003		000022 000028	SER/014A	
02/19/1999	10111	Memo: Redelegation of authorized official for Leviathan Mine, CA, natural resource damage assessment & restoration activities, w/attchs	Hilda Manuel US Dept of the Interior - Bureau of Indian Affairs	John Krause US Dept of the Interior	REL	001		000028	SER/014A	
03/08/1999	75516	Ltr: Fish captured in upper Leviathan Creek derived fr cutthroat trout & transmits results of genetic analysis, w/encl	Jonathan Clark CA Dept of Fish & Game - Office of Spill Prevention & Response	Mary Marks US Forest Service - Humboldt-Toiyabe National Forest	REL	001		000021	SER/014A	
03/08/1999	10112	Ltr: Comments on proposed additional natural resource damages assessment	Sandra Stash ARCO Environmental Remediation L L C	Brian Wallace Washoe Tribe of Nevada & California	REL	001 045		000028	SER/014A	
03/17/1999	76263	Ltr: DNA results fr fish captured in upper Leviathan Creek confirmed that it was derived fr Lahontan cutthroat trout evolutionary lineage	Stafford Lehr CA Dept of Fish & Game	Mary Marks US Forest Service - Humboldt-Toiyabe National Forest	REL	001		000021	SER/014A	
03/17/1999	76241	Ltr: DNA results fr fish captured in upper Leviathan Creek confirmed that it was derived fr Lahontan cutthroat trout evolutionary lineage, w/ltr to S Weimeyer fr J Clark 3/8/99 & attch	Stafford Lehr CA Dept of Fish & Game	Stan Weimeyer US Dept of the Interior - Fish & Wildlife Service	UNC	001		000021	SER/014A	
03/18/1999	77099	Ltr: Natural resource damages assessment - ARCO declines to participate in funding or performance of further NRDA activities at site, w/TL to M Manderbach & M Marks fr J Alexander 3/29/99, w/o attch	Neal Brody Atlantic Richfield Co	Charles McKinley US Dept of the Interior - Office of the Solicitor	UNC	001		000021	SER/014A	

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04/21/1999	75480	Memo: Leviathan trip rpt for 4/8 & 4/9/99 & related activities	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAC DAW DDP	001		000021	SER/014A	
04/27/1999	10112	Email: Transmits & comments on Leviathan data, w/attchs	Amy Wheaton KEECO	Kevin Mayer Environmental Protection Agency - Region 9	REL	001 045		000028	SER/014A	
05/07/1999	10113	Ltr: Response to copy of ltr to F Marcus re impacts of mine on surface & ground waters	Kenny Guinn NV Office of the Governor	Brian Wallace Washoe Tribe of Nevada & California	REL	047		000028	SER/014A	
05/24/1999	90724	Results of computer search under CA corporation & limited partnership records for CALPINE, 00/00/0000 - 5/14/99	Environmental Protection Agency - Region 9		REL				SER/014A	
05/25/1999	75495	CDB Infotek on-line corporate/financial search results for selected mining & mineral companies, (5/24 & 5/25/99)			UNC	008		000021	SER/014A	
06/01/1999	10113	Mtg Agenda: Leviathan Mine mtg at Cal/EPA offices			REL	067		000028	SER/014A	
06/01/1999	10113	Attach 1 - Potential ARARs for Leviathan Mine removal action memo of 6/99	Environmental Protection Agency - Region 9		REL	042		000028	SER/014A	
06/28/1999	10113	Ltr: Transmits 7 documents requested, w/list only, w/o docs	Kevin Mayer Environmental Protection Agency - Region 9	Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	REL	001		000028	SER/014A	
06/30/1999	75536	1999 Treatability study/removal action project workplan	CA Regional Water Quality Control Board - Lahontan Region	Environmental Protection Agency - Region 9	UNC	003 010		000021 000028	SER/014A	
07/02/1999	10113	Biweekly progress rpt, 6/15/99 - 6/29/99	U R S Corp - U R S Greiner Woodward Clyde		REL	077		000028	SER/014A	
07/08/1999	75532	HRS documentation record for Leviathan Mine, w/review cover sheet	Karen Johnson Ecology & Environment, In		UNC	004 062		000020 000021	SER/014A	
07/08/1999	75531	Hazard ranking system summary scoresheet for Leviathan Mine	Karen Johnson Ecology & Environment, In		UNC	062		000020 000021	SER/014A	

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07/15/1999	90725	Technical Memo: Activates 2 work assignment tasks - title search & expert opinion	Kim Muratore Environmental Protection Agency - Region 9	Susan Corbaley Science Applications International Corp	UNC	094			SER/014A	
07/22/1999	76244	Memo: Transmits survey map & map - on ground GPS of disturbances, w/marginalia by Kim Muratore on GPS map	Mary Marks US Forest Service - Humboldt-Toiyabe National Forest	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 004 013		000021	SER/014A	
07/29/1999	90850	Ltr: Request for survey data fr ARCO, w/CA statute on real property access	William Donovan Piedmont Surveying Co	Kim Muratore Environmental Protection Agency - Region 9	UNC	001		000022	SER/014A	
07/29/1999	75527	Parcel map & CA real property searches by parcel number, data available through 2/4/99 for current parcel ownership (6/24/99 & 7/29/99)			FX6	004		000021	SER/014A	
07/29/1999	90786	Email: Access for Leviathan	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DDP FX5	001		000021 000022	SER/014A	
08/17/1999	90741	Ltr: Request for access to private property for survey work, w/signed access agreement	John Kemmerer Environmental Protection Agency - Region 9	Patrick Parker, resident City of Orofino, ID Virginia Parker, resident City of Orofino, ID	FX6	001		000022	SER/014A	
08/17/1999	90734	Ltr: Request to access private property for site survey work, w/signed access agreement & note	John Kemmerer Environmental Protection Agency - Region 9	Ernest Wasson, resident City of Cupertino Eva Wasson, resident City of Cupertino	FX6	001 013		000022	SER/014A	
08/17/1999	90732	Ltr: Request to access private property for site survey work, w/signed access agreement	John Kemmerer Environmental Protection Agency - Region 9	Betty Curtis, resident City of Santa Rosa Maurice Curtis, resident City of Santa Rosa	FX6	001		000022	SER/014A	
08/17/1999	75509	Ltr: 104(e) request for information, w/encls, w/o mail receipt Z039-960-667	John Kemmerer Environmental Protection Agency - Region 9	Mike Bowlin Atlantic Richfield Co	UNC	001 040		000021	SER/014A	

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08/17/1999	90740	Ltr: Request for access to private property for survey work, w/signed access agreement	John Kemmerer Environmental Protection Agency - Region 9	Robert Merrill, resident City of Woodside	FX6	001		000022	SER/014A	
08/17/1999	90731	Ltr: 104(e) request for information w/o mail receipt Z 039 960 667 (concurrence copy)	Environmental Protection Agency - Region 9	Michael Bowlin Atlantic Richfield Co	UNC	040		000021	SER/014A	Atlantic Richfield Co
08/17/1999	90739	Ltr: Request for access to private property for survey work, w/signed access agreement	John Kemmerer Environmental Protection Agency - Region 9	Geodesic Structures	UNC	001		000022	SER/014A	
08/29/1999	90787	Email: Update on Leviathan title search	Sandy Richardson Science Applications International Corp	Kim Muratore Environmental Protection Agency - Region 9	DAC DDP FX5	001		000021	SER/014A	
08/31/1999	90788	Email: Update on Leviathan Mine activities	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9 Kim Muratore Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	
09/03/1999	90793	Email: Update on Leviathan Mine activities, w/history	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9 Kim Muratore Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	
09/15/1999	69699	Response to 8/17/99 EPA 104(e) request for information	ARCO Environmental Remediation, L L C	Environmental Protection Agency - Region 9	CBR	039		000021	SER/014A	
09/15/1999	70431	Response to 8/17/99 EPA 104(e) request for information	ARCO Environmental Remediation L L C	Environmental Protection Agency - Region 9	CBR	039		000021	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
09/16/1999	75511	Ltr: Response to 104(e) request for information, w/o encls	Neal Brody Atlantic Richfield Co	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 039		000021	SER/014A	
10/22/1999	73826	Remedial site assessment decision - further assessemnt needed under CERCLA, site proposed for NPL on 10/22/99, w/NPL fact sheet 10/99	Environmental Protection Agency - Region 9		UNC	011		000020 000022	SER/014A	
12/06/1999	75506	On-line corporate data search of Centex Corp			UNC	008		000021	SER/014A	
12/09/1999	76498	Memo: Leviathan trip rpt for 12/1 - 12/3/99 & related follow up, w/hand written changes & attchs (oversize map only)	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAC DAW DDP	004		000021	SER/014A	
12/09/1999	76297	Memo: Leviathan trip rpt for 12/1 - 12/3/99 & related follow up, w/hand written changes & attchs, w/o oversize map	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAC DAW DDP	001 003 004 005		000021	SER/014A	
12/09/1999	66635	Memo: Leviathan trip rpt for 12/1 - 12/3/99 & related follow up (oversize map only)			DAC DAW DDP FX5 FX6	004		000020 000021	SER/014A	
12/09/1999	66634	Memo: Leviathan trip rpt for 12/1 - 12/3/99 & related follow up, w/attchs (w/o oversize map)	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DAW DDP FX5 FX6	001 004 005 067		000020 000021 000031	SER/014A	
12/14/1999	75519	Ltr: Transmits affidavit of Allan Van DeVelde re sighting of black bear cub drinking water fr Leviathan Creek, w/encl	Sandy Richardson Science Applications International Corp	Kim Muratore Environmental Protection Agency - Region 9	UNC	001		000021	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
12/15/1999	69700	Draft title search rpt, w/attchs & TL to K Muratore fr S Richardson	Science Applications International Corp	Environmental Protection Agency - Region 9	CBR	091 094		000021	SER/014A	
12/15/1999	75534	Email: Contractors as PRPs - Isabell Construction's work at Leviathan Mine	Joshua Wirtschafter Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9	DAC DAW DDP	001		000021	SER/014A	
12/15/1999	70430	Draft title search rpt, w/attchs & TL to K Muratore fr S Richardson	Science Applications International Corp	Environmental Protection Agency - Region 9	CBR	091 094		000021	SER/014A	
12/22/1999	75514	Ltr: Request for EPA's help re potential environmental problems with Leviathan Mine Road & property of Terry & Susan Hunt	Kirk Johnson Robertson & Benevento	Kevin Mayer Environmental Protection Agency - Region 9	UNC	001		000021 000031	SER/014A	
12/22/1999	90798	Email: Leviathan in Nevada - what the Hunts wanted to talk about, w/history	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	
01/04/2000	90802	Email: Leviathan in Nevada - what the Hunts wanted to talk about, w/history	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	
01/04/2000	90745	Ltr: Transmits comments on draft Leviathan title search & on ground survey, w/comments	Kim Muratore Environmental Protection Agency - Region 9	Sandy Richardson Science Applications International Corp	UNC	001 045		000022	SER/014A	
01/19/2000	10110	Data on stream-water & bed-sediment quality in vicinity of Leviathan Mine, Alpine County, CA & Douglas County, NV, revised, w/TL & request for comments to S Wiemeyer fr K Thomas 1/20/00	Michael Lico US Geological Survey Karen Thomas US Geological Survey		REL	001		000028	SER/014A	
01/24/2000	90804	Email: Schedule for Leviathan well sampling & possible drinking water contamination on Hunt property	Kevin Mayer Environmental Protection Agency - Region 9	Peter Husby Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
01/31/2000	10346	Final title search & survey for Leviathan Mine Site (redacted, FOIA ex 6)	Science Applications International Corp	Environmental Protection Agency - Region 9	REL	003 091 094		000020 000021	SER/014A	
01/31/2000	75533	Final title search & survey for site, w/attchs 1-4	Science Applications International Corp	Environmental Protection Agency - Region 9	FX6	003 004 091 094		000021	SER/014A	
01/31/2000	94017	Final title search & survey for site, w/attchs 1-4	Science Applications International Corp	Environmental Protection Agency - Region 9	FX6	003 004 091 094		000021	SER/014A	
01/31/2000	76457	Final title search & survey for site (oversize drawing only)	Science Applications International Corp	Environmental Protection Agency - Region 9	FX6	003		000021	SER/014A	
02/01/2000	90823	Ltr: Transmits 3 copies of final title search & survey rpt, w/o encls	Sandy Richardson Science Applications International Corp	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 094		000021	SER/014A	
02/07/2000	90824	Ltr: Transmits 3 corrected pages 9 & 10 & 3 copies of revised Figure 2 for title search & survey rpt, w/o encls	Sandy Richardson Science Applications International Corp	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 094		000021	SER/014A	
02/14/2000	73812	Memorandum of understanding between EPA-9 & USDA-Forest Service Region 4	Environmental Protection Agency - Region 9	US Forest Service - Region 4	REL	001		000022	SER/014A	
02/15/2000	73824	Ltr: Transmits modification of 1998 administrative order on consent re removal actions & documentation of account will be provided, w/o encl	Neal Brody ARCO Environmental Remediation L L C	Joshua Wirtschafter Environmental Protection Agency - Region 9	REL	001		000021 000028	SER/014A	
02/16/2000	69702	Memo: Leviathan trip rpt for 2/13 & 2/14/2000, w/2 interviews	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAC DAW DDP	001		000021	SER/014A	
02/17/2000	73832	Memo: Agreement to modify 1998 consent order for removal action, w/o consent order & attch #1 (concurrence copy) - version approved before changes	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	John Kemmerer Environmental Protection Agency - Region 9	DAC DAW DDP FX5 FX7	001		000021 000028	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
02/17/2000	73829	Memo: Agreement to modify 1998 consent order for removal action, w/o consent order, w/attch #1 (concurrence copy)	Kevin Mayer Environmental Protection Agency - Region 9 Joshua Wirtschafter Environmental Protection Agency - Region 9	John Kemmerer Environmental Protection Agency - Region 9	DAC DAW DDP FX5 FX7	001		000021 000028	SER/014A	
02/18/2000	90771	Monthly work assignment rpts, 11/30/99-2/18/2000	Science Applications International Corp	Environmental Protection Agency - Region 9	CBI	077 094		000002 000022	SER/014A	
02/18/2000	68168	Modification of administrative order on consent for removal action, docket #98-07A	Keith Takata Environmental Protection Agency - Region 9	ARCO Environmental Remediation L L C	REL	041		000021 000028 000029	DKT/98-07A SER/014A	ARCO Environmental Remediation L L C
02/22/2000	73823	Ltr: Transmits modification of 1998 administrative order on consent re removal actions & confirmation that ARCO will provide documentation of accoumt, w/o encl	Joshua Wirtschafter Environmental Protection Agency - Region 9	Neal Brody ARCO Environmental Remediation L L C	REL	001		000021 000028	SER/014A	
02/23/2000	73822	TL: Modification of 1998 administrative order on consent re removal actions	Kevin Mayer Environmental Protection Agency - Region 9	Timothy Seward Washoe Tribe of Nevada & California	REL	001		000021 000028	SER/014A	
03/06/2000	75501	Ltr: Supplemental 104(e) request for information, w/encls, w/o mail receipt Z 039 960 786	Kathi Moore Environmental Protection Agency - Region 9	Mike Bowlin Atlantic Richfield Co	UNC	001 040		000021	SER/014A	
03/06/2000	75498	Ltr: 104(e) request for information, w/encls, w/o mail receipt Z039-960-787	Kathi Moore Environmental Protection Agency - Region 9	Laurence Hirsch Centex Corp	UNC	001 040		000021	SER/014A	
03/06/2000	90746	Ltr: 104(e) supplemental request for information, w/mail receipt Z 039 960 786 (concurrence copy)	Kathi Moore Environmental Protection Agency - Region 9	Michael Bowlin Atlantic Richfield Co	UNC	040		000021	SER/014A	Atlantic Richfield Co
03/06/2000	90750	Ltr: 104(e) request for information, w/mail receipt Z 039 960 787 (concurrence copy)	Kathi Moore Environmental Protection Agency - Region 9	Laurence Hirsch Centex Corp	UNC	040		000021	SER/014A	
03/20/2000	90806	Email: Leviathan Mine site visit rpt	Kevin Mayer Environmental Protection Agency - Region 9	Chip Demarest US Dept of the Interior John Krause US Dept of the Interior Daniel Welsh US Dept of the Interior - Fish & Wildlife Service	DAC DDP FX5	001		000022	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
03/29/2000	73821	Ltr: Request for copy of return receipt showing date & person who signed for ltr, w/copy of certified mail receipt Z039-960-786	Kim Muratore Environmental Protection Agency - Region 9	Postmaster US Postal Service - Los Angeles, CA	UNC	001		000021	MAI/Z039-960-786 SER/014A	
03/29/2000	73820	Ltr: Request for copy of return receipt showing date & person who signed for ltr, w/copy of certified mail receipt Z039-960-786	Kim Muratore Environmental Protection Agency - Region 9	Postmaster US Postal Service - Dallas, TX	UNC	001		000021	MAI/Z039-960-787 SER/014A	
03/31/2000	73819	Ltr: Response to 104(e) request for information, w/encl	Raymond Smerge Centex Corp	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 039		000021	SER/014A	
04/06/2000	90755	Ltr: Confirms voicemail message granting 2-wk extension through 4/25/2000 to submit response to 104(e) supplemental request for information	Neal Brody Atlantic Richfield Co	Joshua Wirtschafter Environmental Protection Agency - Region 9	UNC	001 053		000021	SER/014A	Atlantic Richfield Co
04/06/2000	90752	Email: Rpt on Leviathan pond storage, w/newsclip	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9 John Kemmerer Environmental Protection Agency - Region 9 Kathi Moore Environmental Protection Agency - Region 9	UNC	001 006		000024 000028	SER/014A	
04/07/2000	90784	Email: Weekly activities for weeks ending 4/7/2000 & 6/23/2000, w/history	John Kemmerer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	DAC DDP FX5	084		000022	SER/014A	
04/24/2000	75502	Ltr: Response to supplemental 104(e) request for information, w/encls	Neal Brody Atlantic Richfield Co	Kim Muratore Environmental Protection Agency - Region 9	DSN	001 039		000021	SER/014A	
05/11/2000	90756	Newsclip: Superfunding granted for Leviathan Mine cleanup, w/2nd newsclip & TL to K Muratore fr K Mayer	Mary Thompson Tahoe Daily Tribune		UNC	001 006		000021 000024	SER/014A	Atlantic Richfield Co
05/15/2000	75424	Ltr: Response to supplemental 104(e) request for information, w/encls	Neal Brody Atlantic Richfield Co	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 005 007 039		000021	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
05/16/2000	90808	Email: Leviathan Mine PRP search, w/handwritten notes & history	Kevin Mayer Environmental Protection Agency - Region 9	Kim Muratore Environmental Protection Agency - Region 9	DAC DDP FX5	001 013		000021	SER/014A	
05/31/2000	75426	Memo: Leviathan Mine PRP search rpt, w/appendix - list of PRP search related documents	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	DAW DDP FX5	001 003 004		000021	SER/014A	
05/31/2000	75422	Memo: Leviathan Mine ownership & operational history, w/attchs	Kim Muratore Environmental Protection Agency - Region 9	Kevin Mayer Environmental Protection Agency - Region 9 Josh Wirtschafer Environmental Protection Agency - Region 9	UNC	001 003 004		000021	SER/014A	
06/26/2000	75425	TL: Copy of EPA rpt Leviathan Mine ownership & operational history	Kim Muratore Environmental Protection Agency - Region 9	Harold Singer CA Regional Water Quality Control Board - Lahontan Region	UNC	001		000021 000022	SER/014A	
06/30/2000	77056	Ltr: Transmits copies of documents flagged during review of Leviathan Mine file & Steven Brooks is now on-scene coordinator, w/o encl	Mary Marks US Forest Service	Kim Muratore Environmental Protection Agency - Region 9	UNC	001		000021	SER/014A	
07/19/2000	99109	Administrative abatement action #2000-16, w/attch & w/TL fr K Takata to H Singer 7/19/00	Environmental Protection Agency - Region 9		REL	001 041 093		000021 000028	DKT/2000-16 SER/014A	CA Regional Water Quality Control Board - Lahontan Regio Leviathan Mine
08/04/2000	90810	Email: Leviathan ponds have over 6.7 million gallons storage capacity on 8/4/2000	Kevin Mayer Environmental Protection Agency - Region 9	Kim Muratore Environmental Protection Agency - Region 9	DAC DDP FX5	001		000022	SER/014A	
08/14/2000	90758	Draft statement of work for Leviathan Mine			UNC			000022	SER/014A	
10/01/2000	10495	Leviathan Mine natural resources damage assessment, phase 1 - fisheries assessment	CA Dept of Fish & Game		UNC	001 003 004 056		000022	SER/014A	

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
11/14/2000	87432	Ltr: Response to supplemental 104(e) request for information, additional documents discovered in Univ of Wyoming collection of Anaconda materials, w/encls	Jean Martin Atlantic Richfield Co	Kim Muratore Environmental Protection Agency - Region 9	UNC	001 005 039		000021	SER/014A	
11/21/2000	10113	Memo: Comments on UAO for early response actions, RI/FS under sec 106(a) of CERCLA & requests signed approval of UAO, w/attch 1 (concurrence copy)	Joshua Wirtschafter Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	DAW DDP	001 045		000028	SER/014A	
11/21/2000	10115	Memo: Comments on UAO for early response actions, RI/FS under sec 106(a) of CERCLA & requests signed approval of UAO, w/o attch 1 (concurrence copy)	Joshua Wirtschafter Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	REL	001 045		000028	SER/014A	
11/22/2000	85869	Administrative order for early response actions & RI/FS, docket #2001-05, w/attchs & TL fr K Takata to S Stash 11/22/00	Environmental Protection Agency - Region 9		REL	001 041		000021 000022	DKT/2001-05 SER/014A	Atlantic Richfield Co Leviathan Mine
12/01/2000	10115	2000 year-end rpt for Leviathan Mine, w/TL to K Mayer fr C Stetler, 12/20/2000	CA Regional Water Quality Control Board - Lahontan Region	Environmental Protection Agency - Region 9	REL	001 003 005		000022 000028	SER/014A	
06/29/2001	10008	Action Memo: Request for approval of removal action at Leviathan Mine, w/attchs (redacted, FOIA Exs 5 & 7)	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	REL	001 004 010 093		000021 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio Leviathan Mine
06/29/2001	10008	Action Memo: Request for approval of removal action at Leviathan Mine, w/attchs	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	DAC DAW DDP FX5 FX7	001 004 010 093		000021 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio Leviathan Mine
07/05/2001	10115	Memo: Administrative abatement action under sec 106(a) of CERCLA, docket #00-16(a), w/o attch (concurrence copy)	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	DAC DDP FX5 FX7	001		000028	SER/014A	
07/05/2001	10007	Modification to administrative abatement action of 7/19/00, #2000-16(a), w/attchs (redacted, FOIA Exs 5 & 7)	Environmental Protection Agency - Region 9		REL	001 004 010 041 093		000021 000028	DKT/2000-16(a) SER/014A	CA Regional Water Quality Control Board - Lahontan Regio Leviathan Mine
07/05/2001	10006	Modification to administrative abatement action of 7/19/00, #2000-16(a), w/attchs	Environmental Protection Agency - Region 9		DAC DAW DDP FX5 FX7	001 004 010 041 093		000021 000028	DKT/2000-16(a) SER/014A	CA Regional Water Quality Control Board - Lahontan Regio Leviathan Mine

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
07/27/2001	10116	Memo: Request for approval of removal action at Leviathan Mine (redacted) (concurrence copy)	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	REL	001 003 004		000028	SER/014A	
07/27/2001	10116	Memo: Request for approval of removal action at Leviathan Mine (concurrence copy)	Kevin Mayer Environmental Protection Agency - Region 9	Keith Takata Environmental Protection Agency - Region 9	DAC DDP FX5 FX7	001 003 004		000028	SER/014A	
10/11/2001	99059	Polrep #RWQCB 2001-Start (01 PRP Removal Action Start 004, 7/5/01)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio
10/11/2001	99058	Polrep #ARCO 2001-Complete (00 PRP Removal Action Complete 002, 9/30/01)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	Atlantic Richfield Co
10/11/2001	99057	Polrep #ARCO 2001-Start (00 PRP Removal Action Start 002, 7/27/01)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	Atlantic Richfield Co
10/11/2001	99056	Polrep #RWQCB 2000-Completion (01 PRP Removal Action Complete 003, 11/1/00)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio
10/11/2001	99054	Polrep #RWQCB 2000-Start (01 PRP Removal Action Start 003, 7/19/00)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio
11/01/2001	10117	Fact Sheet: Update on cleanup activities	Environmental Protection Agency - Region 9		REL	004 011		000028	SER/014A	
11/07/2001	10117	Public Notice: Community meeting for Washoe Tribe on 11/07/01	Environmental Protection Agency - Region 9		REL	004 080		000028	SER/014A	
11/13/2001	10145	Memo: Dresslerville community mtg comments & request to be added to mailing list (01 PRP Removal Action Complete 004, 11/27/01)	Michael Matuska Federation of Fly Fishers - CA & NV Council	Kevin Mayer Environmental Protection Agency - Region 9	UNC	001 051		000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio

Doc Date	Docid	Title/Subject	Author	Addressee	Acc	Doc Type	OU	Phase	Tracknbr	PRP
11/28/2001	10145	Tetra Tech EMI oversight rpt of Leviathan Mine on 11/28/01, 10:00 AM - 1:30 PM (01 PRP Removal Action Complete 004, 11/27/01)	Doug Carey CA Regional Water Quality Control Board - Lahontan Region Joel Bauman Tetra Tech E M Inc Chris Stetler CA Regional Water Quality Control Board - Lahontan Region	Environmental Protection Agency - Region 9	UNC			000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio
12/04/2001	10146	Polrep #RWQCB 2001-Complete (01 PRP Removal Action Complete 004, 11/27/01)	Kevin Mayer Environmental Protection Agency - Region 9	Kathi Moore Environmental Protection Agency - Region 9	UNC	084		000001 000028	SER/014A	CA Regional Water Quality Control Board - Lahontan Regio

APPENDIX E

DATABASE MEETING MINUTES

LEVIATHAN MINE SITE
DATABASE MEETING
February 27, 2002

Meeting Notes

GENERAL

A meeting was held in Reno, Nevada on February 27, 2002 to discuss the Leviathan Mine Site database. The following were in attendance:

• Tim Tsukamoto	University of Nevada – Reno (UNR)
• Stan Wiemeyer	United States Fish and Wildlife Service (USFWS)
• Melanie Markin	USFWS
• Rob Greenbaum	Washoe Tribe
• Jean Ray	Montgomery Watson Harza (MWH)
• Steve Ferry	Atlantic Richfield Company
• Nicki Miller	Atlantic Richfield Company
• Don Booth	EMC²
• Dan McMindes	United States Army Corps of Engineers (USACE)
• Laurie Scribe	Lahontan Regional Water Quality Control Board (RWQCB)
• Chris Stetler	RWQCB
• Douglas Carey	RWQCB
• Jennifer Carr	Nevada Department of Environmental Protection (NDEP)
• Randy Pahl	NDEP
• Steve Brooks	United States Forest Service (USFS)
• David Reisman	United States Environmental Protection Agency (EPA)
• Greg Reller	TetraTech EMI
• Joel Bauman	TetraTech EMI
• Toby Leeson	MWH
• Ned Black	EPA
• Kevin Mayer	EPA
• Peter Husby	EPA
• Dr. Miller	UNR

MEETING INTRODUCTION

Kevin Mayer (EPA) indicated that the purpose of the meeting was threefold:

- Outline the mechanics of the database
- Discuss information missing from the database
- Discuss how data quality will be assessed and how data will be used to make decisions

Steve Ferry (Atlantic Richfield Company) further noted that the focus of the data quality discussion would be on how to evaluate historic data. He stressed the importance of reaching agreement on the existing database before embarking upon detailed data evaluation and discussing future data inputs. He indicated that the Phase 1 Work Plan would present a Statement of Work for moving forward with the database, as well as a global SAP and QAPP for managing future site data.

DATABASE PRESENTATION

Atlantic Richfield Company contractors presented a review of the historical environmental database for the site. The presentation included discussions of the following:

- Purpose of the database
- Database structure
- Historic data inventory
- Historic usability evaluation
- Using existing database

A handout outlining these discussion items was distributed to meeting participants. Open discussion was held throughout the presentation, as outlined below.

GENERAL COMMENTS, QUESTIONS, DISCUSSION ITEMS

Data Management/Updating the Database

- The database is currently being updated monthly (with USGS data and as data is provided by RWQCB).

- The database will be placed on the FTP site quarterly or bi-annually, upon completion.

- Given the size of the database, downloading from FTP has been an issue. As an interim measure, EPA requested a CD version of the database for use and distribution.

- EPA noted that data management is critical – from collection of the sample in the field to data quality evaluation to data entry; this is a central coordination task.

Database/GIS Interface

- The database is structured to be dynamically linked with the GIS.

- Per EPA, it is difficult to move forward without accurate spatial and temporal information.

- According to EPA and the USACE, the database must form the template for querying and GIS layers should be user friendly to allow immediate access of data on a media, as well as a spatial or system level (e.g. – accessing information pertaining to the Aspen "system' or Leviathan "system"). In addition, the ability to access "reach-based" information (e.g. – a certain reach of Aspen Creek) and watershed-based data is also important

- Per USACE, GIS provides for the ability to access information spatially; this is where we should be headed with the data

Historic Data Inventory

- Atlantic Richfield Company outlined data currently included in the database (Database Index), as well as documents to be reviewed for inclusion of additional historic data (List of Documents to be Reviewed). Both of these lists were included in the meeting handout. Atlantic Richfield Company noted that the List of Documents to be Reviewed was based on

a preliminary review of EPA's Site File Index to identify, based on document titles, the documents likely to contain data. Atlantic Richfield Company's review of the Site File Index documents is ongoing and Atlantic Richfield Company anticipates distributing an updated List of Documents to be Reviewed to meeting participants in early March.

- EPA requested that the date and revision number of these tables be added, so that subsequent revisions can be tracked

- EPA also requested that a list of "Rejected" documents be kept to assist with site document tracking

- Atlantic Richfield Company noted that the list of Documents to be Reviewed is a subset of EPA's Site File Index (EPA distributed a copy of the Site File Index to meeting participants).

- Meeting participants agreed to review EPA's Site File Index and provide EPA with lists of information/data/reports missing from the index by March 21, as well as copies of the information

- Atlantic Richfield Company also requested meeting participants to indicate whether any of this additional information and/or any of the other documents listed on EPA's Site File Index (and not yet included on the List of Documents to be Reviewed), should be added to the List of Documents to be Reviewed

- Atlantic Richfield Company further requested that documentation such as SAPs, QAPPs, FSPs, etc. be forwarded to EPA to assist with the data usability evaluation

- EPA noted that they would update the Site File Index and that Atlantic Richfield Company would update the database after input from meeting participants was received

Missing Data

- EPA and the USFS noted that biological (macroinvertebrate) data must also be included in the database (Herbst collected data from 1995 – 2000)

- NDEP noted that they had collected data on Bryant Creek and the Carson River – and did not see it in the database

- USFS indicated that they had geotechnical data from the 1970s

- RWQCB noted that SRK did a file review in 1998, and they were not certain that the file review information was in the Site File Index or database

- RWQCB further noted that sediment data were collected in conjunction with the Herbst study

- EPA stated that they would double check ORD and Las Vegas for data that might be missing from the Site File Index

- RWQCB indicated that they did an exhaustive research review when they took over the site in 1983, and they do not recall data from the early 1960s and 1970s

- UNR stated that Aspen Seep data are not currently included in the database. For Aspen Seep and other treatment data it was agreed that only influent and effluent data would be included within the site-wide database; process data will be kept separate from the site-wide database, since DQOs on process management are much different than DQOs on stream data

General Data Adequacy

- Per RWQCB, weather data are currently being obtained from the Monitor Pass Weather Station, but the site weather station should be operational in the very near future

- EPA expressed concern that the current stage measurement data from the ponds may not be of sufficient quality for anticipated modeling efforts

Historic Data Usability

- Historic data indicated in the Database Index are currently contained in the database

- The database is a "work-in-progress" and is currently structured as indicated in the handout (categorized by media into three primary data tables, with supporting "administrative" tables)

- Metals data are entered as either total or dissolved, if information is available; it was recommended by UNR that it should also be noted in the database if not specified

- After much discussion on usability of historic data, meeting participants agreed with the following categories:

  - High documentation, as defined in the handout (with the modifications that: 1) data from some draft data summary reports may still be considered having complete documentation provided it is know that the data has been through QA and is not provisional; and 2) data sampling and laboratory analysis methods are known and documented somewhere [i.e., in the DSR or in the laboratory reports] even if some of the SAPs and laboratory methods may have yet to be compiled). (this data was formerly termed "data usable – high")

  - Low documentation (this data was formerly termed "data usable – low")

  - Rejected (rejected data will placed in a separate "graveyard" database)

- It was agreed that neither a minimum data quality objective nor a specified detection limit would be required of historical data (although detection limits would be specified in the database)

- It was further agreed, however, that some historical data might fill a data gap, and therefore might require further scrutiny

- Future data will not be classified as complete (high) or incomplete (low), since data collected will be in accordance with approved SAPs and QAPPs and DQOs will outline how we proceed in the future

- The meeting was summarized by EPA as a "plea" to get the database complete with historical data, with as much substantiating documentation as possible; after the historical database is complete, future data collection will be in accordance with approved SAPs and QAPPs with defined DQOs. As such, the emphasis is to move forward with high quality data. The global SAP and QAPP will outline conformance criteria for the site-specific SAPs and QAPPs (e.g. – the global documents will outline that the site-specific SAPs and QAPPs must conform to the specified seven-step DQO process and the site-specific documents will outline the process for the activities being performed)

ACTION ITEMS

- Atlantic Richfield Company will add dates and revision numbers to the Database Index table and the List of Documents to be Reviewed

- Meeting participants will review the Site File Index and List of Documents to be Reviewed and provide EPA with additional information/documents to be added to these lists by March 21, 2002; in addition, they will provide copies of the missing information/documents

- EPA will update the Site File Index and Atlantic Richfield Company will update the List of Documents to be Reviewed and database accordingly

- Atlantic Richfield Company will prepare a global SAP and QAPP, to be included in the Phase 1 RI Work Plan (scheduled to be submitted to EPA in April 2002); data management and data transfer will be outlined

- EPA and the RWQCB will provide links to USGS, meteorological, and other relevant site data

SCHEDULE

- March 7, 2002: Updated List of Documents to be Reviewed distributed by Atlantic Richfield Company

- March 8, 2002: Teleconference to discuss SMP comments

- March 21, 2002: Review of Site File Index and List of Documents to be Reviewed completed by meeting participants and missing information forwarded to EPA

- March 29, 2002: 2002 ERA Work Plan forwarded to EPA by Atlantic Richfield Company

- April 2002: Phase 1 RI Work Plan, with global SAP and QAPP, forwarded to EPA by Atlantic Richfield Company

- April 2002: Biphasic Treatment Work Plan distributed by RWQCB

PRESENTATION OF HISTORICAL ENVIRONMENTAL DATABASE

LEVIATHAN MINE
ALPINE COUNTY, CALIFORNIA

FEBRUARY 27, 2002

PRESENTATION OUTLINE

- Purpose of database
- Database structure
- Historic data inventory
- Historic usability evaluation
- Using existing database
- Open discussion

DATABASE STRUCTURE

The database consists of a relational database management system (RDMS) using Microsoft Access. The historical data has initially been organized by primary data source (e.g., RWQCB, USGS, SRK) and by media to facilitate management of historical data entry. Future versions of the RDBMS will be organized solely by media and will consist of the following three primary data tables:

1. - Surface water
    - Water quality
   - Groundwater
    - Depths to water
    - Groundwater quality
   - Soils and sediments geochemistry
2. Climate
3. Surface water flows

In addition to these data types, the database also includes the following "administrative" tables:

- Database index
- Parameter & quality control code definitions
- Historical data usability code descriptions
- Data source references
- Sampling station descriptions & location ID aliases
- Well construction details

The tables are linked based on common fields (e.g., location IDs, sample IDs, date and source code). These relationships allow custom data queries.

HISTORICAL DATA USABILITY CATEGORIES

In order for a data set to be categorized, it must be considered pertinent and meet the objectives of the database. If a data set is considered pertinent it is then assigned one of three categories of usability:

- Data Usable, High
- Data Usable, Low
- Data Rejected

For a data set to be considered "Usable", it must be described with at least the following data fields:

- Media sampled
- Analytes
- Sample location
- Date collected
- Results
- Units

If the data set includes this basic information it is considered "Usable", if not, the data is "Rejected". Data that is rejected will not be loaded into the RDBMS or listed on the Database Index Table, but will be documented in the Data Inventory table, which will be kept separate from the RDBMS. The "Usable" data set is then assigned a "High" or "Low" designation. In order for the data set to be assigned a "High" designation, the following supporting documentation must be included in the project files:

- Source of data must be documented (i.e., a final data summary report (DSR))
- The data must have been collected in accordance with a published Sampling & Analysis Plan (SAP) or Standard Operating Procedures (SOPs) that is on-file
- Accurate X and Y coordinates must be documented, as well as elevation & time/date, where applicable
- Lab analytical method must be documented