2011 Oversight Summary Report
Leviathan Mine Superfund Site
Alpine County, California

Prepared for

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AND

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ACRONYMS AND ABBREVIATIONS

Atlantic Richfield	Atlantic Richfield Company
ARWS	Atlantic Richfield Work Season
AS	Aspen Seep
ASBR	Aspen Seep Bioreactor
Burleson	Burleson Consulting, Inc.
CUD	Channel Underdrain
CWSD	Carson Valley Water Subconservancy District
Decon	Decon Environmental Inc.
DS	Delta Seep
Eh	Oxidation reduction potential
EDCDA	El Dorado County Department of Agriculture
EPA	U.S. Environmental Protection Agency
ERA	Early response action
Forest Service	U.S. Department of Agriculture, Forest Service
gpm	Gallons per minute
HDPE	High Density Polyethylene
H_2S	Hydrogen Sulfide
HDS	High Density Sludge
HMI	Human Machine Interface
HSSE	Health Safety Security and Environment
LAS	Limited Access Season
Leviathan Mine	Leviathan Mine Superfund Site
LIDAR	Light Detection and Ranging
mV	millivolt
mg/L	Milligram per liter
MRAM	Modified Removal Action Memorandum
NREL	National Renewable Energy Laboratory
ORP	Oxidation-reduction potential
O&M	Operations and Maintenance
PLC	Programmable Logic Interface

ACRONYMS AND ABBREVIATIONS (continued)

PUD	Pit Underdrain
PWTS	Pond Water Treatment System
PPM	Parts per million
RAM	Removal action memorandum
RAWP	Removal action work plan
RCTS	Rotating cylinder treatment system
Regional Board	California Regional Water Quality Control Board—Lahontan Region
RI	Remedial Investigation
SC	Specific conductance
SCADA	Supervisor Control and Data Acquisition
SDB	Sludge Drying Bed
SPLP	Synthetic Precipitation Leaching Procedure
STLC	Soluble Threshold Limit Concentrations
TCLP	Toxicity Characteristic Leaching Procedure
Tetra Tech	Tetra Tech EM Inc.
TSIT	Treatability Studies and Interim Treatment Work Plan
UPS	Uninterruptible Power Supply
USACE	U.S. Army Corps of Engineers, Sacramento District
µS/cm	MicroSiemen per centimeter
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This oversight summary report describes the activities completed and the information collected during Burleson Consulting, Inc. (Burleson) field oversight at the Leviathan Mine Superfund Site (Leviathan Mine) in Alpine County, California. Field oversight was provided from April 13, 2011, through November 9, 2011. Burleson performed oversight for the U.S. Environmental Protection Agency (EPA), Region IX, under contract with the U.S. Army Corps of Engineers (USACE), Sacramento District (Contract No. W91238-08-D-0012). Burleson personnel were on site about once every three weeks during the 2011 Leviathan Mine construction and water treatment season (April to November). The primary focus of field oversight was to: (1) monitor the effects of mine drainage capture and treatment on the quality of Leviathan Creek and associated creeks downstream from the mine, and (2) confirm that work conducted by the California Regional Water Quality Control Board—Lahontan Region (Regional Board) and Atlantic Richfield Company (Atlantic Richfield) followed the approved work plans.

1.1 LOCATION AND BACKGROUND

The Leviathan Mine is located in Alpine County, California, 5 miles east of Markleeville (see Figure 1), and encompasses 32 patented mineral claims and a patented mill site (Regional Board 2010). Native sulfur was extracted from the Leviathan Mine by underground and open-pit mining methods, which ceased in 1962 (Regional Board 1975). Leviathan Creek flows through the mine site, where the water quality becomes impaired when water contacts sulfur- and metals-bearing rock. Acidic, metals-bearing seepage discharges to the creek from known sources including a collapsed adit, the Pit Underdrain (PUD), the Channel Underdrain (CUD), Delta Seep (DS), and Aspen Seep (AS). Additional unidentified sources of contaminants may further impair surface water quality. Acid-generating mine waste in the creek bed appears to affect Leviathan Creek, although the mine waste and water contact was reduced through remediation activities conducted by the Regional Board in 1984. Leviathan Creek flows into Bryant Creek about two miles north of the mine, and Bryant Creek flows across the Nevada state line and into the East Fork of the Carson River about 9 miles north of the mine. The Leviathan Mine was listed as an EPA Superfund site on May 11, 2000. A site map of the Leviathan Mine is presented as Figure 2. A light detection and ranging (LIDAR) map of pond area features is presented as Figure 3.

Early response actions (ERA) implemented during previous years resulted in an improved appearance in Leviathan Creek during treatment. CUD discharge has been captured and treated for various durations during each treatment season since 2001. DS discharge was captured and treated during a 4-day trial in November 2002, for the duration of the 2003 treatment season, for more than half of the 2004 treatment season, and for the entire 2007, 2008, 2009, 2010, and 2011 treatment seasons. Previous ERAs resulted in reduced cloudiness and chemical staining in Leviathan and Bryant Creeks downstream from the mine (Tetra Tech 2002; 2003; 2004; 2005; 2006b; 2007; USACE 2008; Burleson 2009, 2010, and 2011). However, CUD and DS discharges were returned to Leviathan Creek at the end of each treatment season and discharged continuously until treatment resumed during the following spring.

1.2 PURPOSE AND OBJECTIVES

This report summarizes Burleson's 2011 field oversight activity and presents photographic documentation of site activities. Field measurements were collected during oversight at the on-site water treatment systems (located at Pond 1, Pond 4, and AS) and to provide insight into the effectiveness of the systems in treating acidic, metals-bearing water generated on site. Field measurements were also collected at monitoring points on Leviathan, Aspen, Mountaineer, and Bryant Creeks (see Figure 2) before, during, and after the treatment season. These field measurements are useful for evaluation of the effectiveness of the early response actions and also provide insight into the watershed's response to capture and treatment of acidic, metals-bearing water and release of effluent from the treatment systems. This insight will be used to evaluate long-term options for acid drainage treatment at the Leviathan Mine and the resulting improvement in downstream water quality in Leviathan and associated creeks.

Burleson's field oversight included maintaining communication with EPA, Regional Board, and Atlantic Richfield personnel, visiting and inspecting the treatment systems and site infrastructure, and monitoring surface water quality during the treatment season. Field observations were documented in dedicated field notebooks, on field data sheets, and in photographs. A brief oversight summary was prepared after each oversight period and was delivered to EPA and USACE. Oversight summaries and photographs are presented in Appendices A and B. Information presented in this report was acquired during field oversight and telephone calls with the Regional Board, Atlantic Richfield, and both parties' contracted personnel. Though information is accurate to the best of Burleson's knowledge, year-end reports prepared by the Regional Board and Atlantic Richfield contain information that was unavailable to Burleson during oversight.

1.3 REPORT ORGANIZATION

This report presents a summary of activities observed during field oversight at the Leviathan Mine throughout the operating season in 2011. This report is organized into the following sections:

- Section 1.0 provides an overview of the Leviathan Mine and describes objectives of oversight.
- Section 2.0 describes site activities conducted by Atlantic Richfield in 2011.
- Section 3.0 describes site activities conducted by the Regional Board in 2011.
- Section 4.0 describes site activities conducted by EPA in 2011.
- Section 5.0 describes Burleson's oversight activities and findings in 2011.

- Section 6.0 summarizes activities at Leviathan Mine in 2011 and presents conclusions and recommendations for future investigations and activities.
- Section 7.0 presents references cited in this report.

Figures and tables are presented after the report text. This report also includes the following appendices:

- Appendix A, Oversight Summaries
- Appendix B, Oversight Photographs
- Appendix C, Field Instrument Calibration Records

2.0 ATLANTIC RICHFIELD COMPANY SITE ACTIVITIES

This section describes early response actions (ERA) conducted at the Leviathan Mine by Atlantic Richfield during the 2011 operating season. The scope, objectives, and procedures for 2011 ERA activities are presented in Atlantic Richfield's 2011 Removal Action Work Plan (AMEC 2011). The scope of Atlantic Richfield's 2011 ERAs included:

- Collection of information to evaluate reliable and suitable treatment methodologies that may be incorporated into the long-term remedy for the site.
- Treat the previously identified CUD, DS, and AS flows to discharge criteria previously established for the site to the extent practicable for a treatability study.
- Optimize treatment systems.
- Implement safety-related improvements at all treatment areas.
- Reduce potential for environmental contamination due to spills or treatment disruptions.

The basic objectives of Atlantic Richfield's ERAs in 2011 included the following for the DS and CUD (AMEC 2011):

- Maintain the DS collection area to optimize flow capture;
- Maintain the CUD collection area to optimize flow capture;
- Spring commissioning, startup, and operations and maintenance of the high density sludge (HDS) treatment system for treatment of collected CUD and DS flows;
- Manage waste streams from the HDS treatment system;
- Try to extend the length of the water treatment season for the CUD and DS flows to the extent practicable while gathering information on the operational and performance reliability of the HDS Treatment System, including the CUD and DS capture and conveyance equipment, during potential limited access season (LAS) cold weather conditions;
- Continued optimization and evaluation of the HDS treatment system including clarifier inlet modifications, Lime/Sludge Mix Tank modifications, flocculant auto batch modifications, and turbidity meter replacement;
- Maintain and evaluate modifications to the DS and CUD conveyance systems to improve the operational efficiency and redundant capability of the insulated and un-insulated lines;
- Evaluate possible optimization of HDS treatment system operations to produce sludge that meets numeric limits for a non-hazardous waste;
- Evaluate Pond 4 sludge removal and processing technologies and initiate Pond 4 sludge removal;
- Shutdown and winterization of the HDS treatment system.

The basic objectives of Atlantic Richfield's ERAs in 2011 included the following for the Aspen Seep (AMEC 2011):

- Management of sludge as necessary including sludge transfer, and biocell and pipe flushing;
- Continue to optimize Aspen Seep Bioreactor (ASBR) system performance including nutrient addition chemical dosing rates, and biocell flow reversal;
- Implementing health, safety, security, and environment (HSSE) improvements including engineering controls to minimize personnel's potential exposure to hydrogen sulfide (H_2S) gas in the manholes during operations and maintenance (O&M) and upgrades to battery bank storage;
- Evaluation of the Infiltration/Overflow Pond;
- Evaluation of satellite upgrades to improve remote monitoring capabilities and communication reliability.

Burleson observed field activities associated with Atlantic Richfield's objectives identified above, but did not review data obtained by Atlantic Richfield during treatment (such as laboratory analytical data, technical operational data, or cost information). Information gained through Burleson's oversight of Atlantic Richfield's site activities at Leviathan Mine in 2011 is presented in the following sections. Analytical and technical data are presented in Atlantic Richfield's year-end report (AMEC 2012).

2.1 Channel Underdrain and Delta Seep Treatment

The HDS commenced operations during the LAS after Atlantic Richfield completed mobilization during April. LAS operations began on April 14, 2011 with snow removal and road clearing (AMEC 2012). The HDS plant was commissioned on May 4 and operated from May 5 through November 4, 2011. The HDS plant began discharging treated Pond 4 water on May 5, 2011. Atlantic Richfield captured CUD and DS discharges and treated the combined flows in the HDS plant from May 13 to November 2, 2011. The HDS plant continued to operate until November 4 to lower the water level in Pond 4 to the lowest extent possible (AMEC 2012). Intercepted flows of the CUD and DS were about 44 gallons per minute (gpm) and 21 gpm respectively in late-May; and 30 gpm and 9 gpm respectively by early-November. HDS plant discharge varied from about 70 gpm in late-May to about 58 gpm in early November. Atlantic Richfield treated about 12.4 million gallons of water from the CUD and DS along with 636,000 gallons of water collected over the previous winter in Pond 4 between May 3 and November 11, 2010. The durations of CUD and DS treatment seasons since 2001 are summarized in Table 1.

Atlantic Richfield contracted AMEC to manage and conduct CUD and DS treatment. AMEC personnel operated the HDS treatment system. CUD and DS treatment — including road maintenance, site preparation, commissioning and operation of the HDS system, effluent discharges to Leviathan Creek, sludge removal from Pond 4, sampling, disruptions during treatment, winterization, and Pond 4 runoff controls — are discussed in the sections below.

2.1.1 Road Maintenance

In accordance with their US Forest Service (USFS) permit, Atlantic Richfield maintained the access roads to Leviathan Mine during the 2011 field season. AMEC cleared snow from Leviathan Mine Road to start treatment during the LAS. The surface of the Leviathan Mine Road from Nevada and California was bladed, as necessary, to maintain a smooth surface. Base rock was added to the road surface where necessary, and graded and compacted to provide a cushion over exposed bedrock. Rolling dips along the Nevada access road near Highway 395 were regraded to improve traffic safety, and the road surface was sealed in this area to minimize dust. AMEC surveyed trees along roads near the site with US Forest Service personnel and based on this survey 24 trees that posed potential hazards were removed.

2.1.2 Pond 4 Site Preparation

Preparation of the Pond 4 area and CUD treatment system began in April 2011. Remaining snow was removed from the Pond 4 area, base rock was placed and compacted to provide a safe working surface, and office trailers were installed.

The water in Pond 4 before treatment in 2011 was a combination of (1) treated water left at the end of the treatment season in 2010; (2) direct precipitation that fell on the pond through the winter; and (3) acid drainage that may have discharged into Pond 4 from the influent standpipe, which was found to be a minor source of contamination in previous years (Brown and Caldwell 2002). Photographs B-1 and B-2 in Appendix B show Pond 4 before treatment began in 2011.

CUD and DS treatment began on May 13, 2011 about 4 weeks after AMEC reported beginning mobilization efforts. About 636,000 gallons of accumulated water from Pond 4 was treated and discharged in early May prior to capture and treatment of CUD and DS flows.

2.1.3 HDS Treatment System Operations

The HDS plant was re-commissioned and operated in the spring of 2011. A process flow diagram for the HDS plant at Pond 4 is provided in Figure 4. Photographs B-1 through B-9 in Appendix B show the HDS plant and Pond 4 area during the treatment season.

Pre-commissioning activity included de-winterization of the HDS plant, replacement of pipes and fittings broken over the winter, installation of site communications equipment, servicing of plant motors and gearboxes, set up and testing of the lime delivery system, maintenance and startup of site generators, programming of control systems, inspection of conveyance pumps, installation of capture pumps, delivery of site trailers, and system tests. System tests included static and dynamic hydraulic tests, hydraulic pump and valve tests, pH probe testing, and verifying that interceptor controls and communication systems functioned.

During 2011 the HDS plant received influent in two ways: from Pond 4, and from temporary mixing tanks during removal of sludge from Pond 4. The HDS plant was designed to receive influent water from Pond 4. To minimize chemical fluctuations and equalize flows to the HDS plant, Pond 4 acts as a storage pond used to store a mixture of raw CUD and DS water prior to treatment during HDS operations. The HDS plant was designed to operate optimally within a flow range of 25 to 100 gallons per minute. During prior years, when the combined influent flow rate fell below 25 gpm, the plant was operated intermittently to remain within optimal operating conditions. Intermittent operation due to influent flow conditions was not necessary during 2011. HDS discharge is described in section 2.1.4 below.

Influent is pumped from Pond 4 to the lime sludge mix tank where it mixes with lime and sludge from the clarifier (initial operations do not include sludge). The mixture then flows to the reactor tank where solids form as the lime and oxygen continue to mix with the solution. Reactor tank effluent enters the clarifier where flocculent is added, and solids agglomerate and settle. Water from the clarifier then flows to the effluent tank. Effluent can be used to mix flocculent, can be discharged to Pond 4, or can be discharged to Leviathan Creek. Part of the sludge is diverted to the sludge bins, and part of the sludge is recirculated to the lime/sludge mix tank. Decant water from the sludge bins is pumped back to the reactor tank, and dried sludge is profiled and disposed off site. The HDS plant was designed to drain to Pond 4 in the event of unexpected shutdown.

During removal of sludge from Pond 4, captured flow from the CUD and DS was diverted to temporary mixing tanks (two 20,000 gallon portable iron tanks) that were used to minimize chemical fluctuations and equalize influent flow to the HDS plant. The tanks were plumbed to overflow to Pond 4, and the HDS plant was configured to receive water from the tanks or Pond 4. Use of the temporary tanks allowed treatment of captured CUD and DS flows through the HDS plant to continue while control of the pond level and chemistry were maintained so that sludge removal could be completed as described below.

Operation of the HDS plant began on May 4, 2011 by treating water from Pond 4 that had collected over the previous winter. The HDS system operated to treat and discharge about 13.8 million gallons of CUD and DS flows and generated approximately 138 tons of sludge (AMEC 2012). Dewatered HDS treatment system solids had a 54% moisture content by weight which equated to approximately 64 tons of dry solids (AMEC 2012).

2.1.4 Discharges of Treated Water to Leviathan Creek

The HDS plant discharges directly to Leviathan Creek. Prior to 2010, discharges from treatment systems at Pond 4 varied with plant operations and the range of discharge volume varied significantly throughout the treatment season. This resulted in distinct peaks in discharge and stage at downstream locations in Leviathan Creek. To provide for less drastic fluctuation in downstream flow conditions, the HDS plant assumed a more consistent discharge mode during the 2010 treatment season. Discharge of treated water during 2011 HDS operations occurred continuously during plant operating periods. During the 2011 treatment season HDS discharge declined gradually from about 80 gpm to about 40 gpm (Figure 5). This decline reflects the gradual decrease in discharge from the CUD and DS throughout the treatment season. Interruptions to HDS plant operations (and HDS discharge) are summarized in Section 2.1.7. Figure 5 shows periods of discharge from Pond 4 and other sources (including untreated waters and treatment system effluents) to Leviathan Creek. Figure 5 shows the relationship between discharges from on-site sources and flow at Station 15 in Leviathan Creek (USGS 2010).

Atlantic Richfield reported HDS discharges on the following dates:

- May 5 to July 15
- July 19 to August 15
- August 17 to October 20
- October 26 to November 4

2.1.5 Pond 4 Sludge Removal

Solids from various treatment systems operated at Pond 4 prior to commencement of HDS treatment activities in 2009 accumulated, thus reducing the Pond 4 water storage capacity. During the 2011 field season, AMEC mobilized a floating dredge and sludge dewatering bins to facilitate removal of these accumulated solids. Sludge was dredged from the pond and pumped to dewatering bins. The separated water was decanted and pumped back to Pond 4, and the solids were characterized and disposed of at an off-site facility. About 134 tons of dewatered solids (707 tons of wet sludge) were removed from Pond 4. A three to four inch lift of sludge was left in Pond 4 to protect the pond liner. The sludge was characterized as non-hazardous and transported to a permitted off-site disposal facility.

Temporary storage tanks were used to convey captured CUD and DS flows to the HDS plant during sludge removal. The temporary tanks were used to allow maintenance of circum-neutral pH and a constant pond water depth in Pond 4 to facilitate use of the dredge. After completing sludge removal, the dredge was removed from Pond 4 and decontaminated prior to demobilization from the site, and the use of Pond 4 to mix and temporarily store captured water prior to treatment in the HDS plant resumed. Photographs B-5 to B-7 in Appendix B show the dredge at Pond 4.

2.1.6 Atlantic Richfield Sampling Activities

Atlantic Richfield mobilized to begin LAS operations during mid-April 2011 and HDS operations were performed under the *2011 Removal Action Work Plan Leviathan Mine Site Alpine County, California* (RAWP) (AMEC 2011). Table 6 of the RAWP specified the water quality parameters and analytes monitoring and sampling requirements during the HDS operations, and Table 7 of the RAWP specified the location and frequency of sampling during the HDS operations. Sampling was performed in accordance with the RAWP during the 2011 treatment activities at Pond 4. Water samples from the HDS were analyzed for field parameters (pH, temperature, dissolved oxygen, specific conductance [SC], oxidation-reduction potential [ORP], and ferrous iron to ferric iron ratio); laboratory analysis included acidity, alkalinity, aluminum, arsenic, cadmium, calcium, chloride, chromium, copper, hardness, iron, lead, magnesium, nickel, selenium, sulfate, total dissolved solids, total suspended solids, and zinc. Samples were analyzed in the field and laboratory to ensure compliance with the objectives in the removal action memorandum (RAM) (EPA 2001) and Modified Removal Action

Memorandum (MRAM) (EPA 2008) and to obtain process information useful for evaluating long-term treatment options. Sludge in the filtration and disposal bins was sampled for laboratory analysis (total metals, leachable metals, and physical properties).

The RAWP listed the following sampling locations and frequencies:

- CUD and DS Flows: field parameters measured monthly and samples submitted for laboratory analysis monthly.
- Pond 4: Field parameters measured once per month with pH measured on a weekly basis and samples submitted for laboratory analysis monthly.
- HDS Plant discharge to Leviathan Creek: Field parameters measured once per week for the first four weeks of operation and then measured once per month thereafter with pH and iron measured twice weekly during discharge. Samples submitted for laboratory analysis; once per week during the first four weeks of operation and then once per month thereafter.
- Treatment solids (solids in filtration and disposal bins): total and leachable (toxicity characteristic leaching procedure [TCLP], Soluble Threshold Limit Concentration [STLC], Synthetic Precipitation Leaching Procedure [SPLP]) metals, moisture content, and density prior to disposal.

Burleson observed HDS treatment system operators collecting field parameter measurements during several site visits, and conversations with operators during oversight visits indicated that samples were being collected in accordance with the RAWP.

2.1.7 Interruptions during 2011 Treatment

The following interruptions to water treatment at Pond 4 that occurred during the 2011 treatment season were reported:

May 9: Short term HDS plant interruption caused by lime feed system malfunction. No loss of capture.

May 10: Short term HDS plant interruption caused by influent pump malfunction. No loss of capture.

May 13: Short term HDS plant interruption caused by lime feed system malfunction. No loss of capture.

May 15: Eight hour loss of capture of CUD flow (about 1,800 gallons) due to pump system malfunction.

May 27: Short-term loss of DS capture for about 18 minutes (about 380 gallons discharged to creek) caused by pump failure.

May 30: HDS plant interruption caused by faulty pH sensor. No loss of capture.

May 31: HDS Treatment Plant and associated power systems including power to the CUD and DS collection pumps were shut-down for approximately 30 minutes to perform necessary servicing of the electrical equipment.

July 30: The HDS Treatment Plant automatically shut down and entered standby mode due to a high level alarm in the sludge bin sump which was caused by an extreme rain event. Discharge from the HDS plant was interrupted, and capture of CUD and DS flows was maintained during this event.

August 3: The HDS Treatment Plant automatically shut down and entered standby mode due to a reactor tank low pH alarm which was caused by lime bridging above the lime feeder hopper. A temporary interruption of treated water discharge to Leviathan Creek was experienced, and capture of CUD and DS flows was maintained during this event.

2.1.8 Winterization

CUD and DS capture were suspended on November 2, 2011. The final day of HDS Treatment Plant operation was November 4, 2011. CUD and DS discharges were returned to Leviathan Creek, and the HDS system was prepared for winter. Conveyance pipes and tanks from DS and CUD to Pond 4 were drained, polymer and lime systems were cleaned and emptied, selected valves were removed for storage, electrical conveyance components (pumps and controls) were removed, packaged and stored for the winter, and field trailers were removed from the site.

Pond 4 was pumped down to the minimum feasible depth to provide for maximum storage capacity to retain direct precipitation during the winter/spring seasons. Winterization of all components of the HDS plant was completed on November 17, 2011.

HDS winterization activities included:

- Draining and cleaning system tanks.
- Draining and cleaning system pipes.
- Removal and storage of system pumps.
- Removal and storage of freeze-damageable equipment.
- Protective wrapping of all electrical components including control panels, motors, and valves.
- Checking and refilling the antifreeze, motor oil, and diesel fuel day tank in the generators, removal of the generator batteries, and spraying rust protection on all exposed generator surfaces.
- Filling the diesel storage tank to reduce corrosion.
- Unused bagged dry lime was wrapped and stored inside the HDS building.
- Removing HDS sludge and sludge bins.

Photograph B-9 in Appendix B shows Pond 4 and the winterized HDS plant late in the treatment season.

2.1.9 Pond 4 Runoff Controls

On October 27, Regional Board, Atlantic Richfield representatives and EPA representatives inspected drainage features at the site and discussed drainage system modifications. Site drainage has been modified over the last several years by various construction activities at Pond 1, Pond 3, Pond 4, and during road maintenance. Areas inspected were the upper road from Pond 3 to Pond 4, and the Crusher Road (from Pond 3 to the Leviathan Mine Road above Delta Seep). During the inspections, short and long term approaches to controlling runoff were discussed. Short term measures included: removing part of a berm and redirecting flow from a rill to reduce sheet flow along the Upper Road; and installing two water bars and one water dip to reduce sheet flow from the Crusher Road to the Pond 4 area. Long term measures discussed included significant grading to alter the pitch of roads in both locations.

Short term surface water controls were implemented by AMEC in early November. Burleson identified removal of part of the berm along the southwest side of the Upper road (from Pond 3 to Pond 4), and two water bars installed on the Upper Road that were designed to direct runoff from the road surface and to the southwest into a drainage ditch that conveys the flow to Leviathan Creek upstream from the CUD. Burleson also identified two water dips on the Crusher Road which were designed to direct surface water flows to the northeast, into a drainage ditch which conveys the flows through a culvert and into Leviathan Creek downstream from the Delta Seep. Burleson also observed a cable gate at the entrance of Pond 3 from the Upper Road that was installed to minimize traffic on the berms around Pond 3. Photos B-10 and B-11 in Appendix B show the surface water controls.

2.2 ASPEN SEEP TREATMENT

Atlantic Richfield continued to treat water at the AS using the ASBR in recirculation mode. A diagram of the ASBR operated in recirculation mode is presented in Figure 6.

Atlantic Richfield identified the following objectives for Aspen Seep treatment during 2011 operations (AMEC 2011):

- Management of sludge as necessary including transfer, and biocell and pipe flushing;
- Continued optimization of system performance including evaluating nutrient addition chemical dosing rates, and biocell flow reversal;
- Implementing HSSE improvements including engineering controls to minimize personnel's potential exposure to hydrogen sulfide (H_2S) gas in the manholes during O&M and upgrades to battery bank storage;
- Evaluation of the Infiltration/Overflow Pond;
- Evaluation of satellite upgrades to improve remote monitoring capabilities and communication reliability.

Of the tasks listed above, Burleson observed sludge removal and dewatering. Aspen Seep bioreactor operations, sludge removal, infiltration pond investigation, and occurrence of H_2S at ASBR are described below.

2.2.1 Aspen Seep Bioreactor Operation

Atlantic Richfield's contractor AMEC continued to operate the ASBR in recirculation mode to treat AS discharge without significant modifications from 2010 operations. A belt filter press was utilized to dewater the ASB sludge after AMEC determined a centrifuge mobilized to the site earlier in the year was not appropriate for dewatering ASB sludge. The dewatering system consisted of a belt filter press, associated tanks for containment of raw sludge and dewatering effluent, and sludge and effluent pipelines.

When the ASBR operates in recirculation mode, sodium hydroxide is added to the AS influent which is then mixed with sulfide-rich water and sodium hydroxide from bioreactor cell 2 in the Settling Pond (Pond 3) for precipitation of metal sulfides (Figure 6). Water is pumped from the opposite end of the Settling Pond back to the pretreatment pond at approximately three times the system influent rate. The ASBR is operated in this mode because recirculated water has lower metals content and higher pH than raw AS water. These parameters are ideal for biological treatment in the bioreactor cells. Ethanol is added to the recirculated water to provide a carbon source for the sulfate-reducing bacteria. The Settling Pond (Pond 3) discharges to the next Settling Pond (Pond 4) from which bioreactor effluent is discharged along a rock-lined aeration channel to an infiltration pond adjacent to and above Aspen Creek. The recirculation pumps are powered by propane generators. Photographs B-12 through B-16 in Appendix B show the ASBR during 2011.

Approximately 7.2 million gallons of water from the AS bioreactor were treated and discharged to Aspen Creek during 2011 (Lombardi 2011). The AS flow rate during 2011 was higher than the 2010 AS flow rate (see Figure 7). Details of the bioreactor performance are summarized in Atlantic Richfield's year-end summary report (AMEC 2012).

Burleson's field parameter measurements showed the ASBR was effective at increasing the pH and reducing the oxidation state of Aspen Seep discharge (see Figure 8). Burleson measured ASBR effluent pH between 6.5 and 7.0 during the 2011 treatment season. The pH of ASBR effluent appears to have remained relatively stable during 2011. ORP is another key indicator of bioreactor performance. Burleson measurements show a decreasing trend in ASBR effluent ORP from June through September. The lowest ORP measurement coincides with bioreactor flushing.

The following improvements were made to the ASBR during 2011:

- Replacement of lead acid storage batteries with amalgamated glass mat storage batteries to reduce maintenance requirements.
- Construction of a separate battery room with a passive solar heating system in the electrical conex.
- Installation of an uninterruptible power supply (UPS) to improve power quality to ASB treatment system control panel.

Discharge of ASBR effluent from the infiltration pond to Aspen Creek continued during 2011. Disharge seeps through the downslope infiltration pond berm into Aspen Creek. Water also overflows from the northeastern corner of the infiltration pond down a steep slope into Aspen Creek.

2.2.2 Aspen Seep Bioreactor Sludge Removal

Prior to encountering the high AS flows in 2011, AMEC intended to forgo sludge removal during 2011. Due to the higher than anticipated AS flows encountered during 2011 (nearly twice the average flow rate) more than the anticipated quantity of solids accumulated within the bioreactors and sludge removal became necessary. AMEC removed and dewatered an estimated 185,000 gallons of sludge from the ASBR in 2011 yielding 86 wet tons (180 cubic yards with 16.3% solids or about 15 dry tons) for disposal (AMEC 2012). The sludge had accumulated in the pretreatment pond, settling ponds, and the biocells.

Sludge within the pretreatment ponds and settling ponds was pumped to the dewatering system beginning in late June. A centrifuge mobilized to the site did not adequately dewater ASBR sludge, and a belt filter press was mobilized to the site and used for dewatering. The dewatering effluent was then returned to the ASBR or discharged to Aspen Creek. Dewatered solids were characterized and disposed of off-site. Sludge dewatering was completed on September 2.

Bioreactors 1 and 2 underwent flow reversal and flushing in September (Atlantic Richfield October 2011 monthly report). Flow reversal is performed to minimize the development of preferential flow paths within the bioreactors, and flushing is completed to remove accumulated sludge.

Bioreactor flushing and sludge removal resulted in maintaining ASBR treatment performance as measured by pH and ORP (Figure 8).

2.2.3 Aspen Seep Bioreactor Infiltration Pond Investigation

The RAWP (AMEC 2011) described sediment sampling and analysis intended to provide information to allow evaluation of the ASBR infiltration pond. Infiltration pond sediment samples were collected for laboratory analysis on July 14. The analytical results were included in Atlantic Richfield's August 10, 2011 monthly report. The RAWP stated that the sediment analytical results would be evaluated to determine if modifications to the existing structure are deemed necessary.

Investigation activities completed during 2011 consisted of sediment sampling near the infiltration pond inlet and outlet. Sediment samples were analyzed for total metals,leachable metals, paste pH, total organic carbon and acid-base accounting. Total and leachable metals analyses results were below hazardous waste criteria (AMEC 2012). Results of acid-base accounting show that the infiltration pond sludge may be acid generating if it is allowed to oxidize.

This investigation was not completed during 2011because of the detection of elevated hydrogen sulfide concentrations that lead to restriction of site activity at the ASBR area.

2.2.4 Aspen Seep Bioreactor Hydrogen Sulfide

On October 7, during screening of the air space in manholes at the ASBR prior to commencing work, elevated levels of hydrogen sulfide were encountered. Hydrogen sulfide concentrations of 252 to 280 parts per million (ppm) were detected. These hydrogen sulfide concentrations were much higher than previously encountered at ASBR manholes, and about 2.5 times the immediately dangerous to life and health level of 100 ppm. Personnel were evacuated from the ASBR and all work at the ASBR was stopped pending approval of increased protective measures and collection of additional hydrogen sulfide measurements. After implementing training specifically for working around hydrogen sulfide, and providing all personnel working at the ASBR with 5-minute escape packs, normal operation and maintenance activities resumed at the ASBR by October 19.

Access to the ASBR was restricted to areas away from the biocells and the manholes after October 7. This restriction resulted in reducing the number of water quality measurements made by Burleson at the ASBR.

Increased monitoring for hydrogen sulfide was also implemented at the ASBR to provide information to assess the cause for the increased hydrogen sulfide concentrations.

3.0 CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD – LAHONTAN REGION SITE ACTIVITIES

This section describes activities conducted at Leviathan Mine by the Regional Board during the 2011 operating season. The Regional Board's work plan (Regional Board 2011) identified four activities planned for the 2011 operating season: acid drainage collection and treatment; road paving; site maintenance; and flow monitoring. In addition to activities described in the work plan, the Regional Board also completed spring season treatment at Pond 3 to prevent the overflow of untreated acid drainage to Leviathan Creek.

Information gained through Burleson's oversight of the Regional Board's site activities at Leviathan Mine in 2011 is presented in the following sections. Details about 2011 site activities are presented in the Regional Board's 2011 year-end report (Regional Board 2012).

3.1 POND WATER TREATMENT

The PUD and Adit drain to Pond 1 (Figure 3). The pond water treatment system (PWTS) is located at Pond 1. Pond 1 is connected to Pond 2 north (2N) and Pond 2 south (2S) via underground PVC pipes so that the level of water in each pond is the same. Water can be transferred between the ponds through these pipes. Overflow from Pond 1, Pond 2N, and Pond 2S enters Pond 3. Pond 3 overflows through a valve to Leviathan Creek or to Pond 4. Above average precipitation during the winter of 2010-2011 resulted in an increased filling of the evaporation ponds compared to the volumes observed in the pond the last three treatment seasons and contributed to above-average discharge rates from the Adit and PUD. Average daily flow rates for the Adit and PUD are presented in Figure 9. Because of the above average precipitation received through the winter, the pond system was projected to overflow to Pond 3 by late April.

The Regional Board contracted TKT, Inc. (TKT) to perform spring season treatment at Pond 3, and URS, Inc. (URS), to treat pond water at Pond 1 in 2011. Spring season treatment was necessary to prevent overflow of Pond 3 to Leviathan Creek. Pond water treatment was conducted during the summer to ensure sufficient storage capacity in the pond system to contain Adit and PUD discharges and precipitation received during the 2011-2012 winter.

3.1.1 Spring Season Treatment

TKT began clearing snow from the Nevada access road on April 1, and mobilized equipment, personnel, and materials to conduct spring season treatment to the site by April 5. Spring season treatment started on April 5 with neutralization of accumulated water in Pond 3. The first discharge of treated water from Pond 3 occurred on April 9. This first batch of treated water was very dilute (mostly precipitation) and had a pH of 4 prior to treatment. Subsequent batches of treated water were not as dilute because they consisted mostly of acid drainage accumulated since cessation of pond water treatment in 2010. Treatment was achieved through mixing of lime and oxygen (from the atmosphere) with acid drainage in a rotating cylinder treatment system (RCTS). RCTS effluent was discharged to Pond 3 where solids settled. RCTS effluent was batch discharged by pumping through the existing pipes to Leviathan Creek. Typically acid drainage was neutralized for two to three days, then treatment was suspended overnight to allow solids to settle in Pond 3 prior to discharge of the effluent. The RCTS operated continuously (24 hours per day except during settling periods) for 56 days, with the final discharge on May 31. About 8.2 million gallons of acid drainage were treated at Pond 3 at an average flow rate of 100 gpm. After drying through the summer, about 260 cubic yards (218 tons) of solids created during spring treatment were removed from Pond 3 in October for off-site disposal as hazardous waste. Photographs B-17 through B-20 in Appendix B show activities associated with spring season treatment in 2011.

RCTS performance was monitored based on field measurements of pH, and daily sampling for laboratory analysis during discharge. All discharges met removal action memorandum discharge criteria except for the May 27 discharge when dissolved iron exceeded the maximum daily discharge criterion (Regional Board 2012)

The RCTS operations required about 48,000 pounds of lime, 950 gallons of diesel fuel for generators, and 465 gallons of gasoline to power pumps. Spring treatment efforts successfully avoided overflow of untreated acid drainage from the ponds to Leviathan Creek in 2011.

3.1.2 Pond Water Treatment

Mobilization and field preparation for PWTS operations began in mid-June 2011. About 1,100 tons of dried sludge that was generated during pond water treatment in 2010 was removed from the pit clarifier (Curtis 2011). An excavator was used to remove the dried sludge. Excavated sludge was temporarily stockpiled adjacent to the pit clarifier within the mine pit before it was transferred to an off-site disposal facility. The Regional Board reestablished its on-site field laboratory and office trailer. Photographs B-21 through B-26 in Appendix B show activities associated with pond water treatment in 2011.

URS used lime slurry delivered by tanker truck during PWTS operations during 2011. URS also upgraded the PWTS electrical wiring and control systems to improve plant safety and make it more weather and rodent resistant.

The Regional Board began treating water through the PWTS in mid-July. The first treated water entered the pit clarifier on July 13, 2011. The PWTS operated 24 hours per day, 7 days per week during the 2011 treatment period. The Pond 1 daily discharge rate averaged approximately 100 gpm of discharge through most of the treatment period. Pond 1 treatment operations were stopped on August 25, 2011. Treated water continued to be discharged from the Pit Clarifier as the accumulated sludge drained. Pond water treatment was completed on August 25, 2011. Remaining effluent was discharged from the pit clarifier through the U-shaped underdrain immediately after treatment was completed. The discharge rate from the pit clarifier underdrain had decreased to less than 5 gpm by August 30.

During 2011, URS used a two point lime addition as in the 2007 treatment season. A process flow diagram for the PWTS is presented as Figure 10. PWTS effluent was first discharged from the pit clarifier to Leviathan Creek on July 15, 2011. Discharge occurred at a rate similar to the treatment rate to maintain a constant water level in the pit clarifier. Effluent was discharged through the decant structure in the central southern side of the pit clarifier and through the U-shaped underdrain. Discharge flowed through the weir and monitoring station established in 2003 and operated by the USGS. For 2011, the USGS's stage data were used to calculate treated effluent discharge volumes (Regional Board 2012). Discharge from the Pit Clarifier to Leviathan Creek occurred continuously, except for two maintenance periods (9-hours on August 16 and 3-hours on August 25). Periods of PWTS discharge from the pit clarifier and flow in Leviathan Creek are shown in Figure 5. The discharge rates presented on Figure 5 are based on information from the Regional Board 2011 Annual Report. The Regional Board collected effluent samples two times per week during discharge of treated water to Leviathan Creek.

The Regional Board treated an increased volume of evaporation pond water at the Pond 1 lime treatment plant during the 2011 treatment season compared to the volume of evaporation pond water treated during the 2010 treatment season (see Table 2). An estimated 9.8 million gallons of water from Ponds 1, 2-North, and 2-South was treated and discharged to Leviathan Creek (Regional Board 2012), leaving the ponds nearly dry. A comparison with volumes of water treated in previous years is presented in Table 2. Treatment system operators began winterizing the PWTS shortly after treatment was complete. The treatment system tanks were emptied and cleaned and sensitive equipment was secured for the winter. Valves were left in a position that allowed Ponds 1, 2-North, and 2-South to fill in equilibrium with Adit and PUD discharge and direct precipitation.

Burleson's field parameter measurements showed the pH of the effluent in the pit clarifier was between 7.0 and 7.8 for most of the treatment period. Previous data suggest that effluent generally meets discharge criteria in the RAM when effluent pH is between 7 and 8. Analytical results for the 15 daily samples of pit clarifier effluent collected during discharge in 2011 are included in the Regional Board's 2011 year-end report.

PWTS operations during 2011 consumed 198 tons of dry lime, 6,924 gallons of diesel fuel, 335 gallons of gasoline, and 147 gallons of liquid flocculent. The lime dosing rate to neutralize the pond water was about 4.8 grams per liter.

3.2 ROAD PAVING

Road paving occurred from mid to late July and included grading the road surfaces, installing concrete V-ditches along paved reaches of road, lime treating the road surface, and placing the asphalt-concrete pavement. Access road paving included paving about 0.75 miles of access road from near the California access gate to the vicinity of the Pond 3 entrance, and including the area around Pond 1 and the road into the Pit. The gate to the pit was replaced with a wider double gate, and a truck turnaround area was provided in the pit. Drainage improvements included installing 6 drop box inlets, 375 feet of 12-inch high density polyethylene (HDPE) culverts, removal and replacing 900 linear feet of concrete V-ditch, and adding about 1,160 feet of new concrete V-ditch. Photographs B-27 and B-28 in Appendix B show some of the paving completed during 2011.

Paving improved the road surfaces in and around the PWTS work area. Construction traffic associated with paving activities necessitated temporary closure of access through the California gate, and a temporary work stop at the Pond 4 area during peak traffic periods to prevent accidents.

This work was coordinated with Atlantic Richfield and EPA to ensure that all parties involved were aware of heavy traffic periods, and of times when site access was limited due to construction activity.

3.3 SITE MAINTENANCE

The Regional Board's work plan (Regional Board 2011) identified site maintenance activities in 2011 including invasive plant control, fence repair, evaporation pond liners, storm water conveyance cleanout, and Pond 3 concrete repair. Access road paving and drainage improvements were also planned for 2011. These activities are discussed in the subsections below.

3.3.1 Invasive Plant Control

The Regional Board's work plan (Regional Board 2011) identified invasive plant control as an objective in 2011. The El Dorado County Department of Agriculture (EDCDA) visited the Leviathan Mine in the 2002 through 2010 treatment seasons to spray for tall whitetop (Lepidium Latifolium). Tall whitetop was spot sprayed with herbicide (Telar®) by the EDCDA, on September 6, 2011.

Burleson's oversight visits in 2011 did not coincide with invasive plant control.

3.3.2 Fence Repair

The Regional Board is responsible for upkeep of the barbed wire perimeter fence around the Leviathan Mine. As a result of primarily natural conditions, the fence requires repairs on an annual basis (Regional Board 2011). The perimeter fence was inspected in mid-June, and repairs were made at numerous locations in August and September (Regional Board 2012).

3.3.3 Evaporation Pond Liner Maintenance

The Regional Board performed visual inspections of the evaporation ponds consisting of inspection for exposed areas of pond liner material. The Water Board staff noticed exposed pond liner at Pond 3, and the liner cover material was replenished to cover the exposed liner.

3.3.4 Storm Water Conveyance Cleanout

The V-ditches at Pond 3 were cleaned out.

3.3.5 Pond 3 Concrete Repair

The Regional Board's 2011 work plan identified repair of spalled concrete structures at Pond 3 during the 2011 field season (Regional Board 2011). This activity was not completed in 2011.

3.4 FLOW MONITORING

The Regional Board continued surface water flow measurements in 2011 (in cooperation with the USGS). Flow monitoring stations are located at: Stations 1, 15, and 23 in Leviathan Creek; at the PUD, Adit, CUD, and Aspen Seep; at the Pit Clarifier weir box, along the upper and lower tributaries to Leviathan Creek near Ponds 2N and 2S, 4L Creek; and at two storm water conveyance discharges to Leviathan Creek near Pond 1; Station 25 in Bryant Creek; and Station 22 in Aspen Creek (above Leviathan mine). Pond 1 and Pond 4 stage level recorders are also maintained by USGS (though the Pond 4 stage level recorder has not worked consistently since mid-2010). Flow monitoring data will be incorporated into the Leviathan Mine master database managed by Atlantic Richfield. Data summary reports are not generated.

4.0 U.S. ENVIRONMENTAL PROTECTION AGENCY SITE ACTIVITIES

This section describes activities EPA conducted at the Leviathan Mine during the 2011 operating season. EPA maintained a presence on site through oversight visits. EPA also provided site tours for Washoe Tribe representatives, Carson Water Subconservancy Board Members, and National Historic Preservation Act trustees. EPA laboratory personnel installed water quality monitoring equipment in the creek system, and performed macroinvertebrate surveys. EPA's oversight was conducted in part by Burleson and is presented in Section 5.0. Through a cooperative agreement with the US Department of Energy's National Renewable Energy Laboratory (NREL), EPA was able to have wind and solar energy monitoring equipment installed at the site during the 2010 field season to evaluate the potential for power generation at Leviathan Mine. EPA's site tours, water quality monitoring program, macroinvertebrate survey program, and a description of NREL progress are summarized below.

Natural Resource Damage stakeholders including the US Fish and Wildlife Service (USFWS) participated in the technical advisory committee meetings and various site tours. USFWS conducted two surface water sampling events during the 2011 field season: one during the treatment season, and one after treatment stopped and CUD and DS flows were returned to Leviathan Creek. USFWS collected surface water samples at various locations to enable completion of toxicity tests and for laboratory analysis to measure metals concentrations. Results of toxicity tests and laboratory analyses obtained by USFWS during 2011 are not yet available.

4.1 EPA SITE TOURS

EPA conducted a creek walk, and provided site tours for Washoe Tribe representatives, Carson Water Subconservancy Board Members, and National Historic Preservation Act trustees.

May 24 Creek Walk. EPA's creek walk provided participants an opportunity to observe the Bryant Creek watershed in mid-spring of a high precipitation year, as peak flows were diminishing. This walk also provided participants with a common basis for communicating about watershed features relevant to the eventual clean-up of Leviathan Mine. Participants hiked one-way along Bryant Creek from the California-Nevada state line to the East Fork Carson River. During the creek walk participants were acquainted with the presence of Washoe Tribe lands in the watershed, observed locations for ongoing macroinvertebrate sample collection, observed areas of sediment accumulation and erosion, discussed potential reference locations, discussed the benefits of ongoing seasonal water treatment at Leviathan Mine, discussed the need to consider antecedent conditions when evaluating monitoring results, observed hydrothermally altered rock in the watershed, and observed wildlife.

June 30 Tour for Washoe Tribe Representatives. EPA conducted this tour to familiarize Washoe representatives with the Leviathan Mine Site, and the activities being undertaken to address environmental effects of historical mining activities. After a safety orientation, EPA summarized the Leviathan Mine history and participants viewed the Pond 1 treatment area and open pit, Pond 4 area (including the Channel Underdrain and Delta Seep locations), and Aspen Seep Bioreactor overview area. Stops also occurred at the confluence of Aspen and Leviathan Creeks, confluence of Leviathan and Mountaineer Creeks, and near the California-Nevada state line for an overview of the Bryant Creek Canyon.

August 4 National Historic Preservation Act Compliance Scoping Tour. The tour visited the site and select downstream areas. The participants including USACE, Washoe Tribe and EPA noted that off property downstream intrusive activities should be coordinated with Washoe and US Forest Service historic preservation trustees, California and Nevada Historic Preservation Officers, and private land owners.

August 17 Tour for Carson Water Subconservancy Board Members. EPA conducted this tour to familiarize CWSD Board members with site activities. During the tour, participants viewed the PWTS and HDS plants, and the related acid mine drainage treatment technologies and operations were discussed. Participants also inquired as to how acid drainage is formed, and whether acid formed before mining at the site. EPA was also asked about the nature of more permanent solutions, and explained factors such as power supply, weather, and sources and migration of acid drainage that are being investigated to allow identification of long term solutions at Leviathan.

4.2 EPA WATER QUALITY MONITORING

EPA maintains Hydrolab water quality sondes (Hydrolab) at monitoring stations in the Leviathan Creek watershed. The Hydrolabs were installed to monitor water quality effects downstream from the Leviathan Mine during the treatment season. The Hydrolabs record temperature, pH, and SC readings every 30 to 60 minutes. EPA visited the site periodically to inspect and calibrate the units and retrieve stored data. Hydrolabs were used to monitor water quality at the following locations during 2011:

- Leviathan Creek above the beaver ponds and below the Delta Seep
- Leviathan Creek at Station 15
- Aspen Creek west of the unlocked cattle gate near the culvert that carries Aspen Creek under the Leviathan Mine road
- Bryant Creek at Station 25

Data recorded by the Hydrolabs are periodically communicated to a data repository via satellite. Hydrolab data document effects of Leviathan Mine activities on downstream water quality. Selected events that affected downstream water quality during 2011 and apparent in Hydrolab data at Station 15 are listed below and shown on Figure 11.

- Data sonde records show diurnal pH fluctuations throughout the year.
- Data sonde records record a drop in pH and increase in specific conductance through March.

- Data sonde records show a significant increase in pH with the start of RCTS treatment in April, and periodic increases in specific conductance associated with batch discharges of RCTS effluent containing sulfate and other salts.
- Data sonde records show a significant increase in specific conductance (from about 1 milliSiemen/cm to about 2.5 mS/cm) appeared to coincide with the Pond Water Treatment system discharge.
- Data sonde records show a decline of pH and specific conductance after operation of the HDS plant stopped, and CUD and DS flows returned to Leviathan Creek in early November.

4.2 EPA MACROINVERTEBRATE SURVEYS

EPA personnel perform macroinvertebrate sampling each spring/summer and fall in the Leviathan-Bryant watershed. This activity was started by Dr. David Herbst and is now being continued by EPA staff. Dr. Gene Mancini, under contract with Atlantic Richfield, also observes macroinvertebrate sampling. The following eight stream reaches are sampled:

- Bryant Creek at Stateline
- Bryant Creek at Station 25
- Bryant Creek above Doud Spring
- Leviathan Creek Above Leviathan-Mountaineer Confluence
- Mountaineer Creek at Station 24
- Upper Mountaineer Creek below Indian Spring
- Leviathan Creek at Station 15
- Aspen Creek at Station 16

The time frame from sample collection to reporting the data has historically been 2 years, and results of 2011 surveys are not available. The macroinvertebrate sampling data will be documented in a separate report.

4.3 EPA AND NREL PROJECT

EPA and NREL personnel are collaborating to evaluate potential sources of renewable energy at Leviathan Mine. If viable renewable energy generation could be achieved, such a source could reduce or possibly eliminate the need for use of fossil fuel-powered generators during long-term remediation at the site. During the week of November 1, 2010, NREL contractors installed a new data logger and anemometer on the existing wind tower; and installed a photovoltaic system to assess the solar energy potential at the open pit. The existing wind tower was also evaluated for potential use to collect additional wind speed and duration data. These sensors were maintained during the 2011 field season, data collection continued, and data analysis was started. Results of renewable energy evaluation will be documented in a separate report.

5.0 BURLESON SITE ACTIVITIES

This section describes activities Burleson conducted at the Leviathan Mine during the 2011 operating season. Burleson's field tasks included monitoring water quality in Leviathan and associated creeks, and collecting photographic documentation of site activities at the Leviathan Mine. Burleson also monitored water quality at the beaver ponds upstream from the Leviathan Canyon landslide. Burleson's site activities are summarized below.

5.1 WATER QUALITY PARAMETER MEASUREMENTS

Water quality measurements (pH, temperature, SC, and ORP) were collected along Leviathan and associated creeks. The purpose of water quality monitoring was to assess the effects of treatment on water quality in Leviathan and associated creeks during the 2011 treatment season. Similar data were collected during the 2001 through 2009 treatment seasons and are presented in the oversight summary reports (Tetra Tech 2002; 2003; 2004; 2005; 2006, 2007; USACE 2008; and Burleson 2009, 2010, and 2011). Water quality monitoring points are shown on Figure 2; data are presented in the oversight summary reports in Appendix A. Photographs B-29 through B-34 in Appendix B show surface water monitoring points during the 2011 treatment season.

5.1.1 Field Equipment and Calibration

Burleson used a Hanna HI 9828 multi-parameter meter to measure water quality during 2011 oversight. The meter was calibrated before use each day according to the manufacturer's instructions to ensure that measurements were accurate in reference to known standards. Calibration was checked at the end of the day or when readings were suspected to be erroneous. The high ionic strength and low pH of on-site waters can be damaging to sensitive field equipment. Daily field instrument calibration forms are provided in Appendix C. Water quality measurements collected during this investigation are field screening data.

5.1.2 Leviathan Creek Flow Stages in 2011

Burleson conducted water quality monitoring along the creek system 8 times from April 13 through November 9, 2011. Burleson measured water quality associated with two differing flow stages along Leviathan Creek during the 2011 treatment season, as shown in Table 3. The two flow stages identified during 2011 are pre/post-capture of CUD and DS flows (pre/post -capture), and discharge flow. Pre/post-capture stage flows are represented by two field oversight visits (April and November). The April measurements were dominated by seasonal runoff from snowmelt, and the November measurements represent conditions immediately after CUD and DS flows were returned to Leviathan Creek. Discharge stage flows represent periods when Station 15 flow is dominated by treatment system (HDS and/or PWTS) discharges. Discharge stage measurements were made during six site visits in 2011. Creek chemistry was dependent on the flow sources, which changed in response to contaminant source capture, effluent discharge, and water source (see Figure 5). The two creek flow stages are described below.

Pre/Post-Capture. The pre-capture measurements represent conditions before the seasonal ERAs began in 2011. Leviathan Creek flow during this period consisted of spring runoff and discharges from the CUD and DS. The pre-capture measurements were taken on April 13, 2011 before LAS capture or treatment began and during spring season treatment of water at Pond 3. At the time of these measurements, the EPA data sonde records showed that a decrease in pH and increase in SC in Leviathan Creek had just begun. Early capture of CUD and DS on May 13, 2011 prevented the lower pH typically observed after the decline of runoff and prior to capture that started later in the season in most years before 2009. Post-capture measurements were made on November 9, 2011 after CUD and DS flows returned to Leviathan Creek for the winter.

Figures 12 and 13 show pH measurements taken at Leviathan Creek monitoring stations throughout the 2011 field season. The range of pH measured in Leviathan Creek (5 to 8 SU) was much wider in pre/post discharge stage than during discharge stage measurements (about 6.25 to 7.25 SU). The average pre/post-capture stage pH reading in Leviathan Creek at Station 15 was 6.50. The near-neutral pH is attributed to acid drainage dilution by spring runoff after the winter in the pre-capture sample, and dilution of CUD and DS by increased base flow related to rainfall in the post season sample. The flow rate in Leviathan Creek decreased from a daily average of about 7,000 gpm in late April to a daily average of about 100 gpm by late-August 2011, and Figure 14 shows that the pH at Station 15 decreased below 5 as Leviathan Creek flow declined. Pre/post-capture stage SC measurements at Station 15 also show effects of dilution by seasonal runoff and benefit of early capture and treatment of CUD and DS (see Figure 14).

Discharge Flow. The discharge stage flow represents conditions in Leviathan Creek when stream flow consisted of creek base flow with or without discharges from the treatment systems, and the average daily stream flow as measured at Station 15 was above 100 gpm. Discharge flow stage measurements were taken during six oversight visits in June, July, August, September and October 2011. Discharge flow pH measurements ranged from 6.76 to 7.45 at Station 15. Field pH measurements were slightly higher in Leviathan Creek at several monitoring locations during discharge flow conditions than during base flow conditions (see Figure 12). The higher pH measured in Leviathan Creek at and above Station 15 during discharge flow conditions shows the benefits of removing and treating the CUD and DS on Leviathan Creek water quality. The SC measurements are slightly higher in Leviathan Creek below Station 1 during discharge than during pre-capture stage flows (see Figure 14). This is likely because of the lack of dilution after spring runoff and total dissolved solids discharged with treated water.

Stage Summary. Water quality in Leviathan Creek remained fairly high during 2011 (based on pH and SC measurements) as the flow rate in Leviathan Creek subsided from spring runoff conditions, as shown on Figure 13. USGS (2011) data show the flow rate at Station 15 decreased from more than 7,000 gpm in late April to about 100 gpm in late August. While the flows decreased, an associated decrease in pH and increase in SC were observed during August, September, and October in 2011. The pH in Leviathan Creek is improved by capture and treatment of CUD and DS flows and discharge of treatment system effluent. Water quality monitoring in Leviathan Creek also noted significant changes in SC during the 2011 treatment season. Pond 1 and Pond 4 treatment system effluents were relatively high in dissolved solids, and effluent discharge caused an increase in SC measured along Leviathan Creek (see Figure 14).

5.1.3 Water Quality Trends and Observations

Significantly above average precipitation was measured at Monitor Pass during the winter of 2010-2011. Discharge rates from the acid drainage sources on site during 2011 were similar to those observed during 2006, and historical flow rates, considering the amount of precipitation, as shown on Figures 7 and 9.

The range of pH measurements at the CUD and DS in 2011 was similar to the pH range observed during treatment seasons between 2001 and 2010, (see Figure 15). These pH trends may reflect flushing of oxidation products from the variably saturated volume of the subsurface materials during the high rainfall years (such as 2005 and 2006) and increased retention of material above the water table during drier years (such as 2007 and 2008).

5.2 VISUAL OBSERVATIONS

Visual observations were recorded during 2011 water quality monitoring to supplement field screening data. Visual observations included creek water clarity, the presence of unusual materials within the creek, and the presence of aquatic life.

High flows that occurred throughout the late winter and spring during 2011 were cloudy and turbid in comparison to the clearer water of Mountaineer Creek that is not affected by Leviathan Mine (see Figure 16).

The visual appearance of Leviathan Creek began to improve in late May 2011 after Atlantic Richfield began capturing CUD and DS discharge, and run off declined. Flow in Leviathan Creek downstream became clearer, and orange chemical staining in the creek bed began dissipating.

Burleson noted that seepage from the east bank of Leviathan Creek below and immediately up and downstream from the DS collection tank observed since 2008 continued through the 2011 treatment season. Seepage flowed freely into Leviathan Creek for about 10 feet along the stream bank, and red staining was evident in the stream bank sediment (See Photograph B-31, Appendix B). The presence of the seep suggests that shallow, acidic seepage is present that is not intercepted by the DS collection system.

Burleson also documented aquatic life in Leviathan and Bryant Creeks during 2011 oversight visits. Burleson observed trout in the pool within Leviathan Creek at Station 17. Burleson's aquatic life observations are qualitative; thorough documentation of aquatic communities was outside the scope of Burleson's oversight tasks. A separate ongoing aquatic macroinvertebrate study includes sampling in the Leviathan Mine watershed in the spring and late summer each year. The macroinvertebrate study quantifies the health of the aquatic community downstream from the mine.

5.3 BEAVER DAM AND POND IMPACTS

Beavers continued to erect a series of dams along Leviathan Creek at the upstream end of the Leviathan Creek landslide. The upstream-most dam observed was located in the Leviathan Creek channel where it breeches the old road bed. This dam has impounded Leviathan Creek creating a pond upstream from the old road. A new dam was observed at the approximate midpoint of the Leviathan Creek Landslide resulting in a linear pond along the toe of the landslide. Other dams present across Leviathan Creek appear to have been raised as much as two feet. The Landslide Pond has increased in size and depth and covers the portion of the Leviathan Creek channel downstream from the old road. Water is now impounded from the new dam to the dam at the landslide pond, inundating a sand/gravel bar.

Burleson measured water quality parameters to gain insight into the effects the beaver dams and ponds may have on water quality in Leviathan and associated creeks. Burleson measured the water quality parameters of the beaver ponds during three oversight visits from April 13, 2011 to November 9, 2011. The range of pH values recorded at the beaver ponds was 5.56 to 7.06 (Table 4). The Leviathan Creek Station 15 monitoring location is downstream from the beaver dams and ponds. Figure 17 shows the locations of the beaver dams and water quality measurement locations. Photographs B-35 through B-39 show beaver dams and ponds in Leviathan Creek.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Water treatment by the Regional Board and Atlantic Richfield in 2011 led to seasonal improvements in Leviathan Creek water quality downstream from the mine. Water quality monitoring and visual observations suggest that conditions in Leviathan Creek at the end of the 2011 treatment season were generally similar to conditions at the end of the 2010 treatment season. This summer was the eleventh consecutive season of CUD capture and treatment, and fifth consecutive season of DS partial capture and treatment.

Above average precipitation resulted in increased accumulations of water in onsite ponds compared to the accumulations observed the last couple of drier years, and resulted in increased discharge rates from acid sources during the 2010-2011 winter as compared to earlier years. The resulting increase in pond water levels did not restrict either the Regional Board or Atlantic Richfield from treatment system operations. Free-board capacity in Ponds 2, 2N, 2S and 3 was preserved, and overflow to Leviathan Creek prevented, by Spring Season treatment using an RCTS system. The storage capacity at Pond 4 was increased during the treatment season by removal of sludge.

The Regional Board treated all of the available water from Ponds 2N and 2S and Pond 1. The PWTS operated 24 hours per day, 7 days per week for the 43 day operating period in 2011 (see Table 2 for a comparison with other years). The switch to use of imported lime slurry in the PWTS resulted in increased truck traffic necessary to support treatment activity at Pond 1 during 2011 field activities.

Atlantic Richfield captured and treated CUD and DS discharges for 166 days in 2011 (see Table 1 for comparison with other years), which led to noticeable improvements in Leviathan Creek. Atlantic Richfield initiated capture of the CUD and DS flows on May 4, 2011 prior to observation of significant decrease of water quality at Station 15. The HDS treatment system was commissioned, and operated into early November before demobilization. At Aspen Seep, sludge was removed from the bioreactors, and dewatering via belt filter press was completed.

Burleson recommends the following actions for the 2012 treatment season:

- The surface of mine waste (overburden and waste rock) north of the pit should be evaluated to identify the feasibility of modifying the surface to minimize infiltration and promote runoff of water. This activity would likely reduce the amount of acid drainage requiring treatment.
- Impacts of storm related runoff events should be assessed to evaluate their contributions to discharge of sediment, salts, and metals to the Leviathan Creek watershed.
- Potential for remobilization of the Leviathan Creek landslide as the beaver ponds expand and pond levels (and associated pore water pressure within the landslide toe increases) should be monitored.
- Sediment accumulated at the vicinity of the beaver ponds is not well characterized. Chemical precipitates may also be accumulating within the beaver ponds. Consideration

to potential effects of these sediments on the Leviathan and Bryant Creek watershed in the event of a beaver dam failure should be made.

- Improvements to the storm water controls at the site should continue as necessary to prevent future damage to treatment systems, reduce damage to roads, and minimize interference of run-off with treatment activities.
- CUD and DS capture should begin as soon as practicable in the LAS during 2012 to minimize the impacts of CUD and DS discharges on Leviathan Creek as spring flows decrease from spring runoff peak flows.
- Monitoring of water chemistry and metal content should be performed during base flow conditions at the Beaver Ponds to evaluate the chemical conditions and the potential for a source of acidity in the area.
- Traffic to and from the site should continue to be coordinated between the Regional Board and Atlantic Richfield contractors to minimize the chance for accidents and/or spills.
- The Delta Seep capture system should be evaluated and improved. Seepage of acid drainage into Leviathan Creek below the existing collection tank demonstrates that the existing collection system remains only partially effective.
- Improvement of the DS capture system should include evaluation of methods to direct runoff and sediment around the capture system. This would prevent loss of capture during runoff due to overwhelming the pump system capacity and clogging of the inlet pipes to the capture tank.

7.0 REFERENCES

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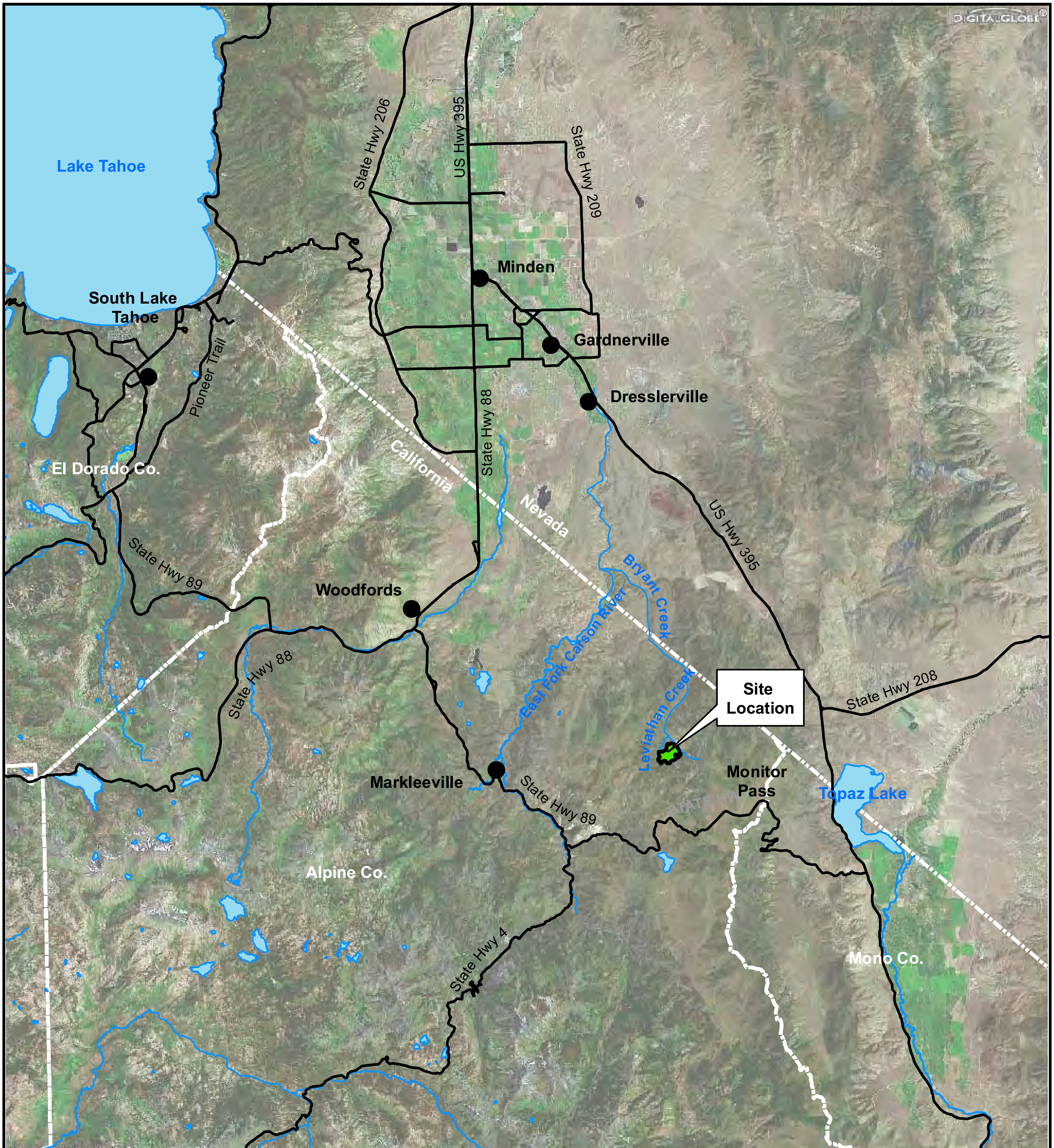
FIGURES



Legend

- Site Location
- Cities
- Roads
- Rivers and Creeks
- Lakes and Ponds

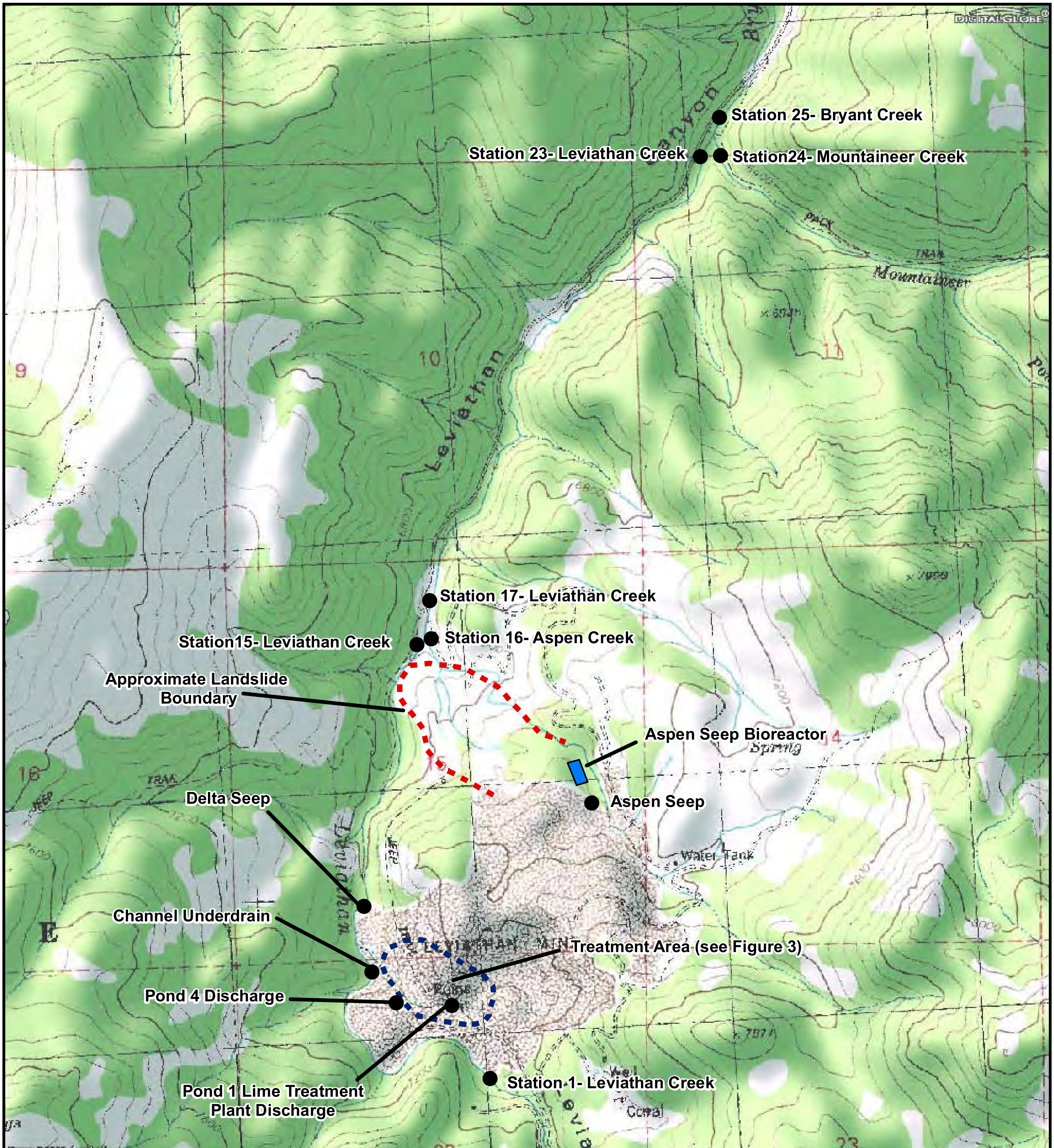
N

Figure 1

Site Location Map
Leviathan Mine Superfund Site
Alpine County, California

0 4 8 12
Miles

Burleson Consulting, Inc.



Legend

- ● point features
- Treatment Area
- Landslide Boundary

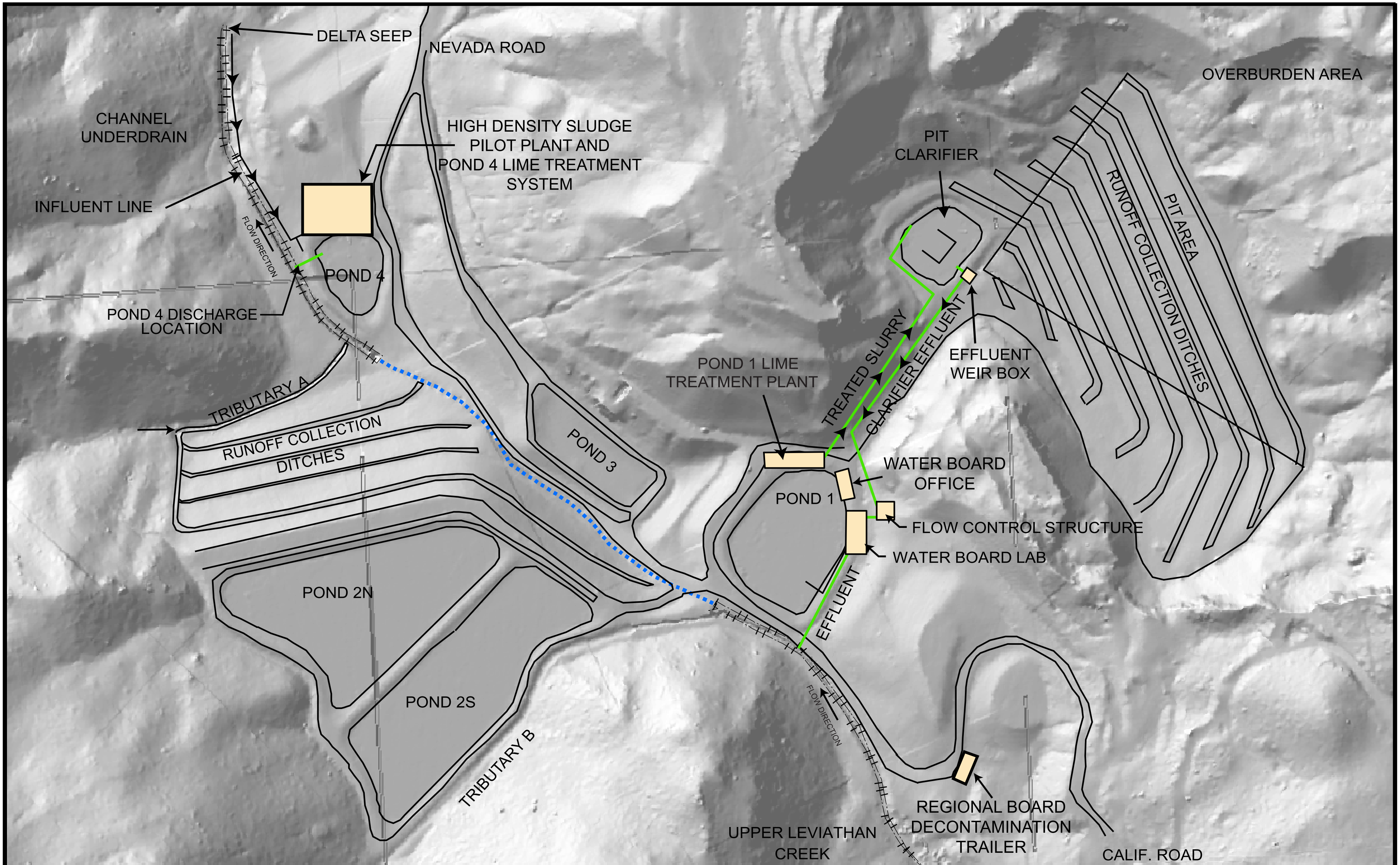
N

Figure 2

Site Map
Leviathan Mine Superfund Site
Alpine County, California

0 1,250 2,500 3,750
Feet

Burleson Consulting, Inc.



Legend

- Buildings
- Effluent Lines
- Leviathan Creek Underground
- Leviathan Creek Open Channel
- Unpaved Roads

N

Figure 3

Detailed Map of Site Features
Leviathan Mine Superfund Site
Alpine County, California

0 250 500 750
Feet

Burleson Consulting, Inc.

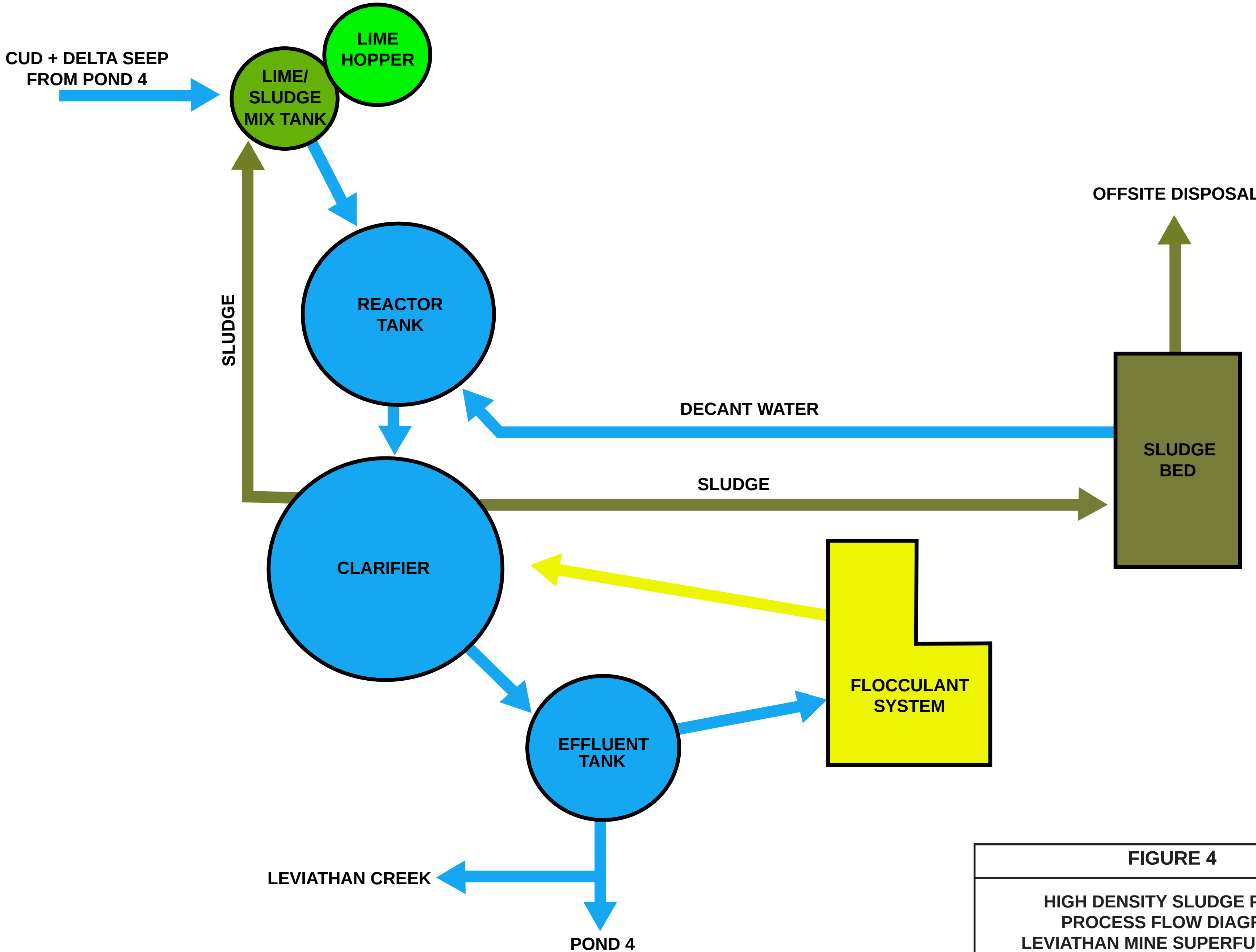
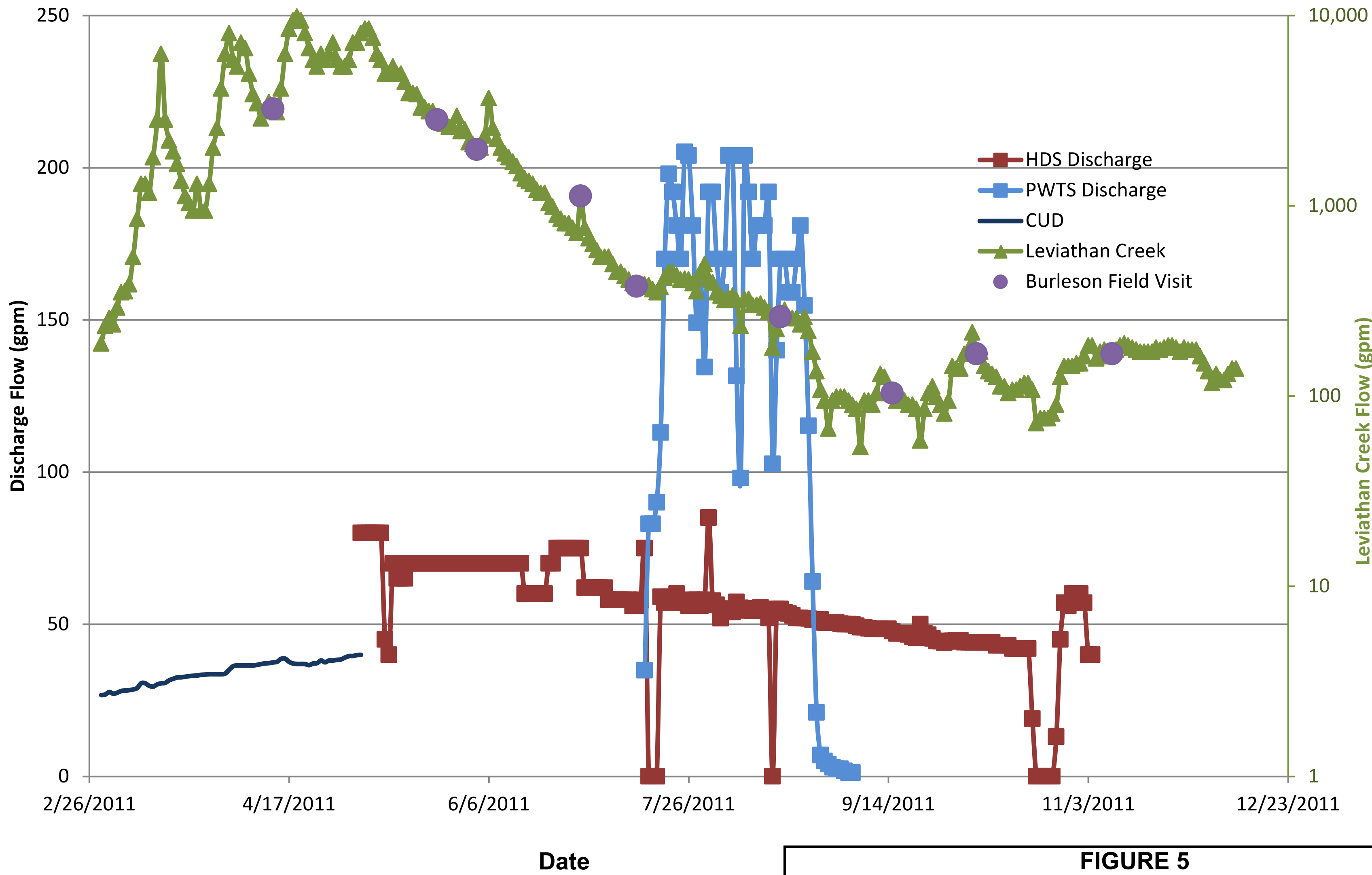


FIGURE 4

HIGH DENSITY SLUDGE PLANT
PROCESS FLOW DIAGRAM
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

Burleson Consulting, Inc.



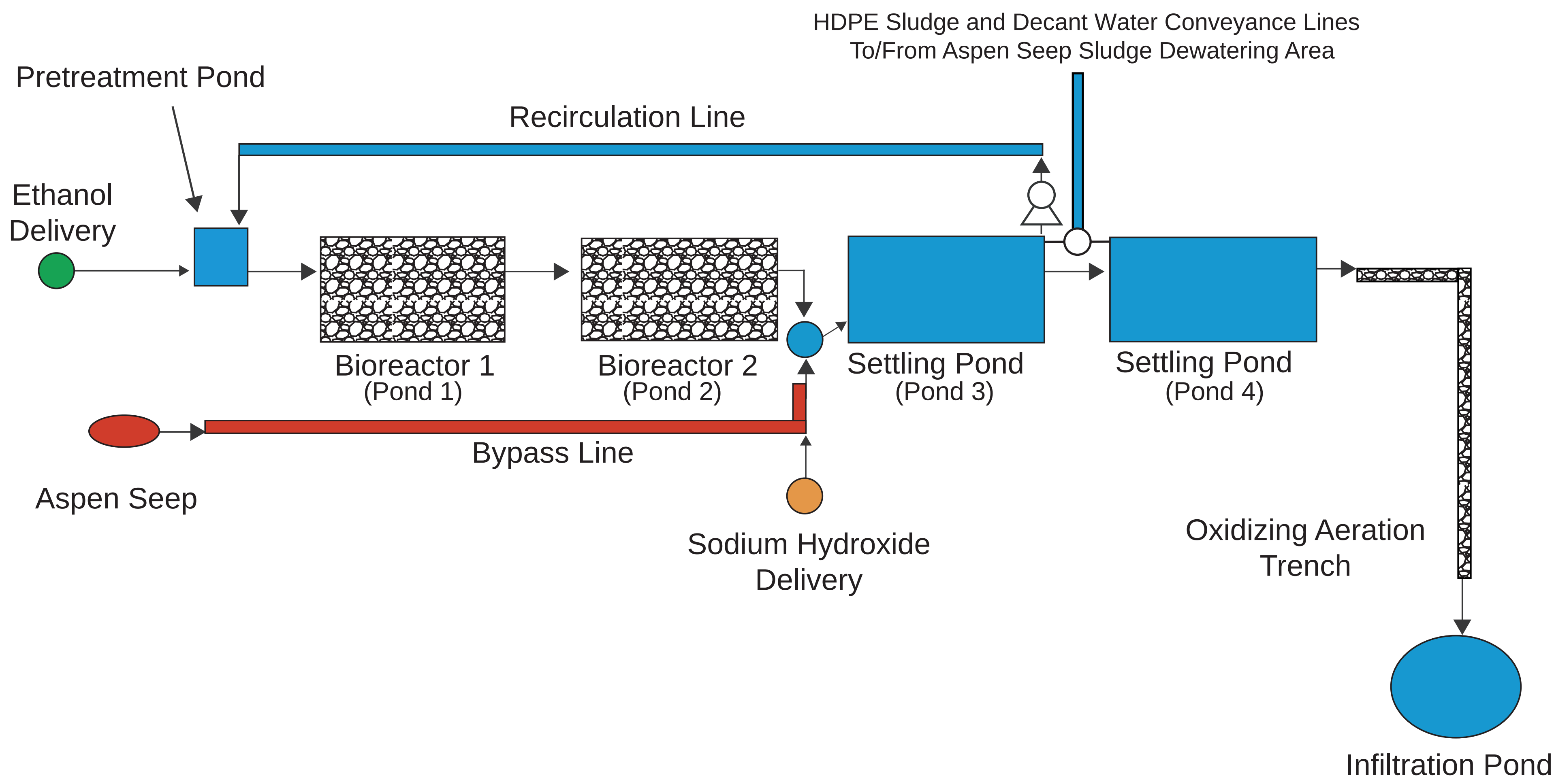
CUD and Leviathan Creek flow rates are from the U.S. Geological Survey 2011 and 2012.

Recent Daily Water for California, Accessed online at: http://waterdata.usgs.gov/ca/nwis/current?type=flow

FIGURE 5

TREATMENT SYSTEM DISCHARGE AND FLOW AT STATION 15 (LEVIATHAN CREEK)
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

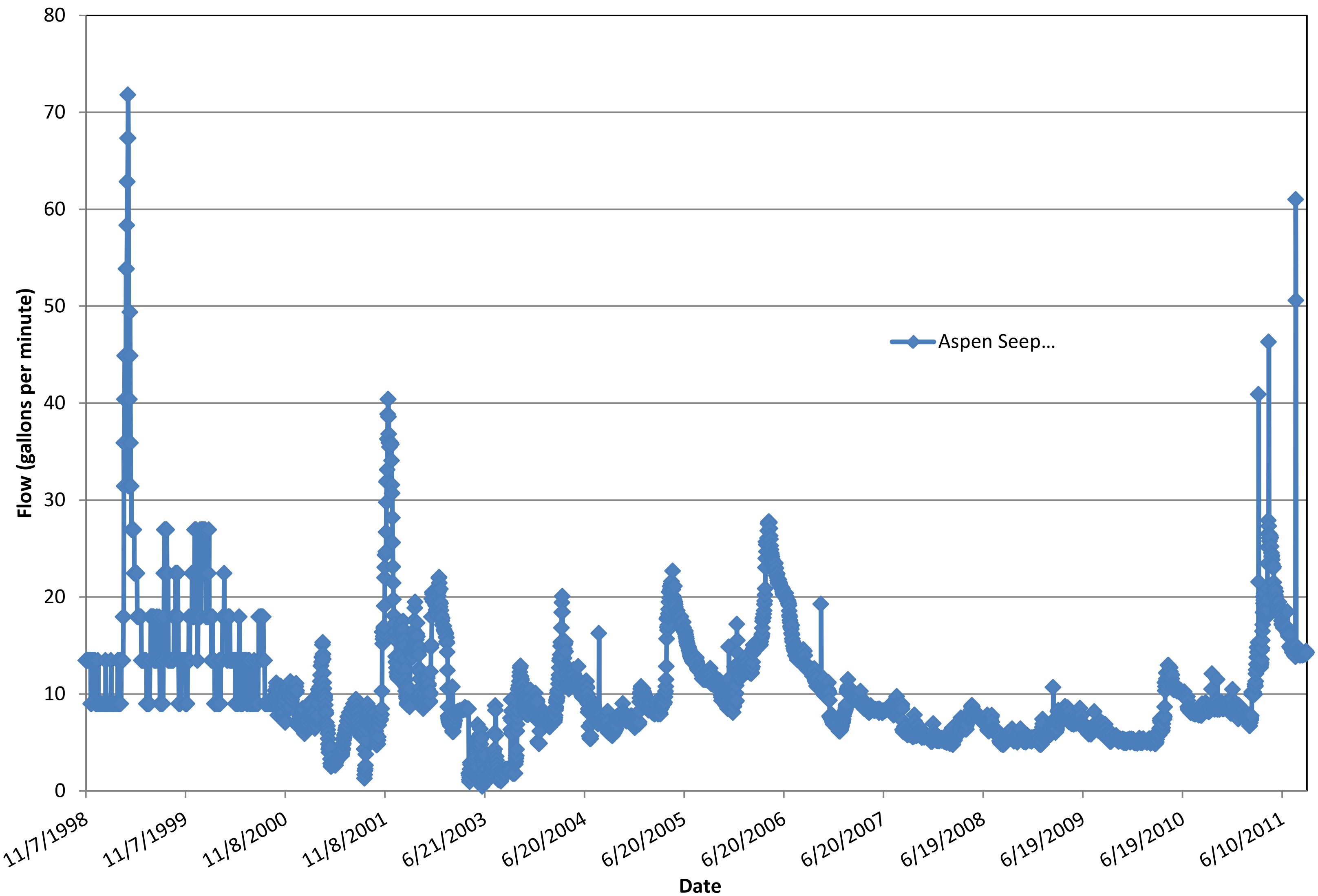


Modified from: Tsukamoto, Tim K. and Miller, Glenn C. 2005. "Draft Data Summary Report for Bioreactors at the Leviathan Mine, Aspen Seep 2004." August.

FIGURE 6

ASPEN SEEP BIOREACTOR OPERATION WITH RECIRCULATION LEVIATHAN MINE SUPERFUND SITE ALPINE COUNTY, CALIFORNIA

Burleson Consulting, Inc.



SOURCE: LEVIATHAN MINE DATABASE, QUARTERLY REPORTS
FROM USGS TO REGIONAL BOARD, AND ATLANTIC
RICHFIELD ANNUAL REPORTS

FIGURE 7

ASPEN SEEP FLOW (THROUGH SEPTEMBER 7, 2011)
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

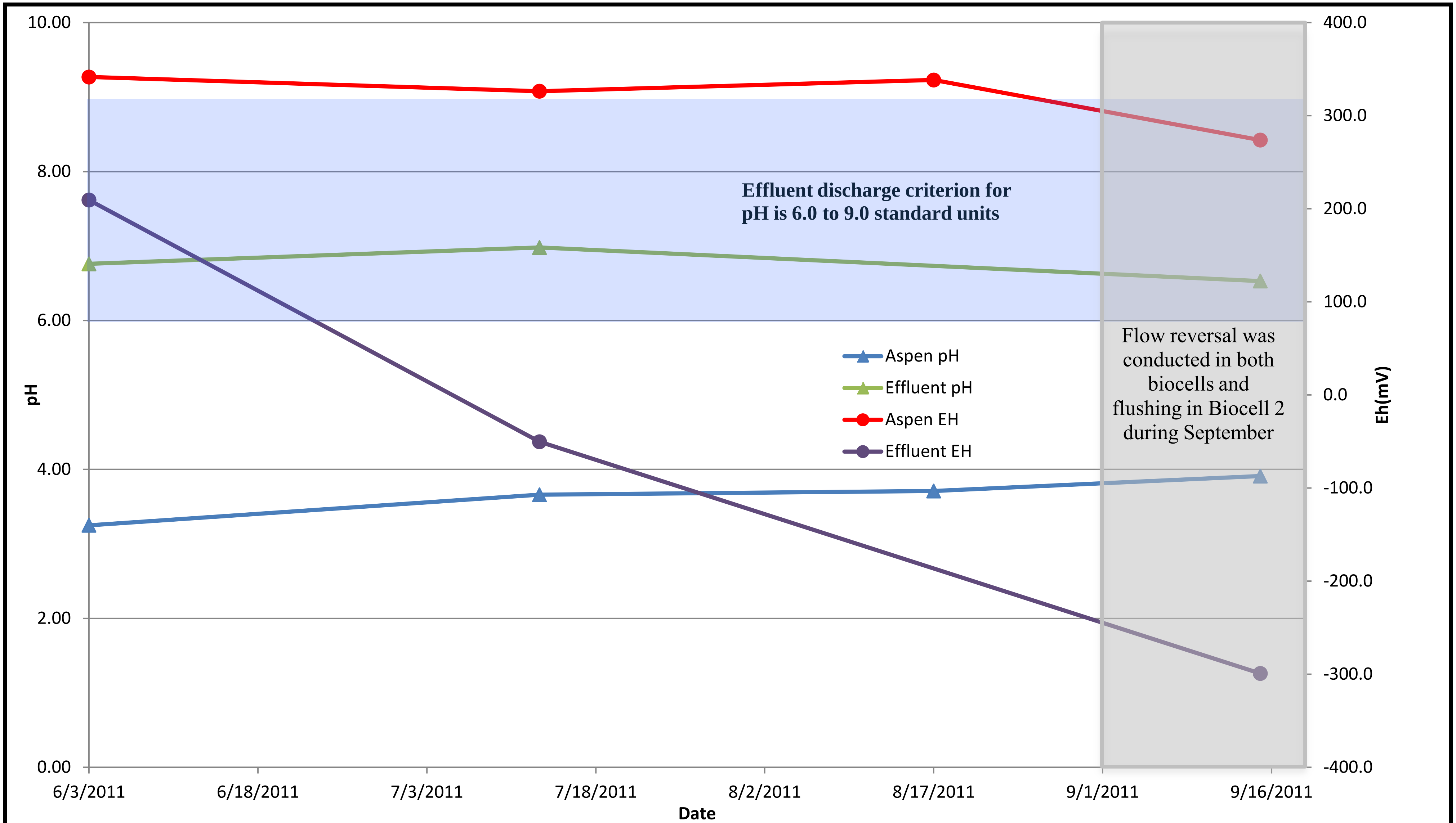
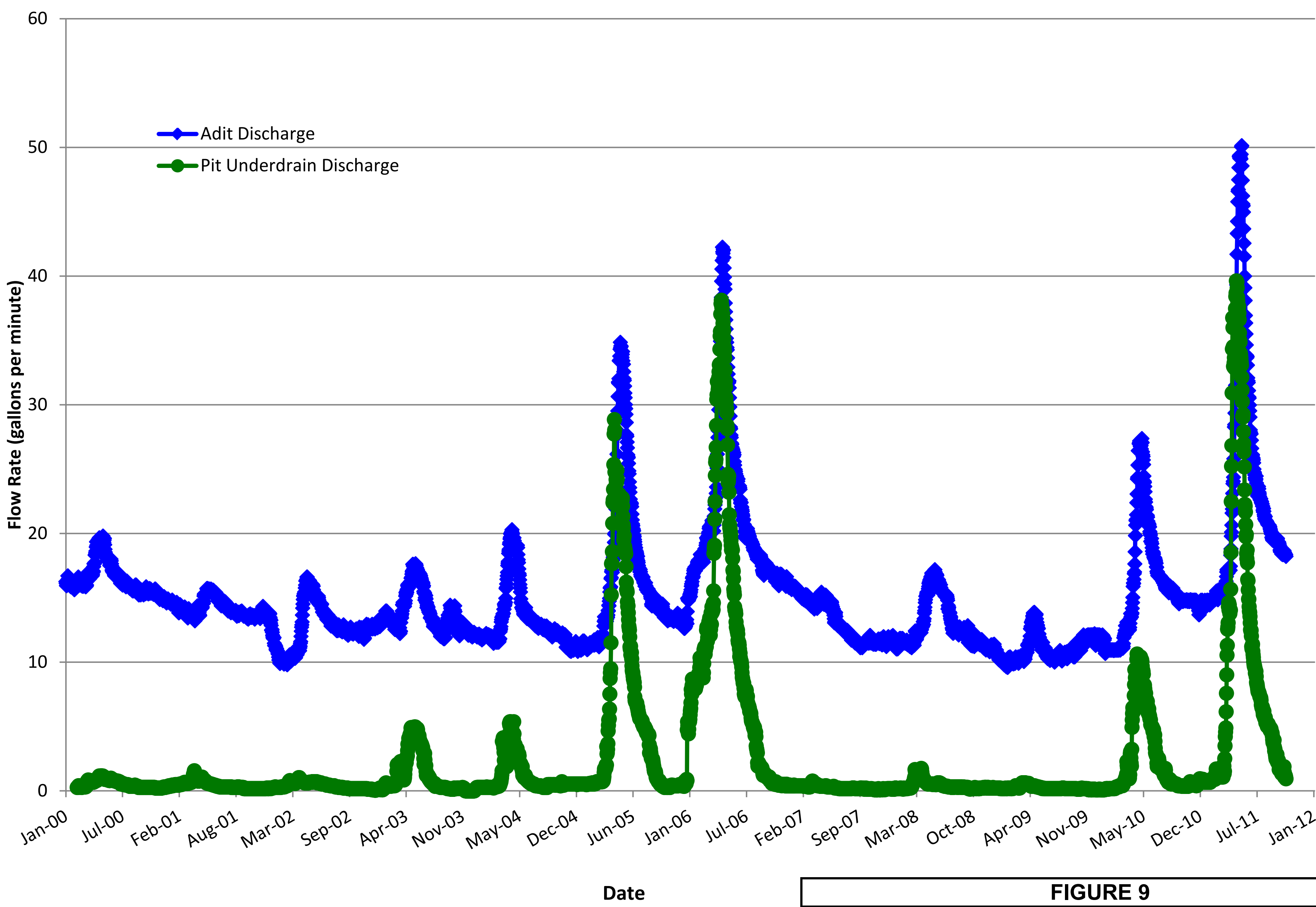


FIGURE 8

ASPEN SEEP BIOREACTOR PERFORMANCE 2011
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.



Data Sources:

U.S. Geological Survey. 2011. Recent Daily Water Data for California, Monitoring Station 10308784

Accessed online at: http://waterdata.usgs.gov/ca/nwis/uv/?site_no=10308784&amp.

U.S. Geological Survey. 2011. Recent Daily Water Data for California, Monitoring Station 10308785

Accessed online at: http://waterdata.usgs.gov/ca/nwis/uv/?site_no=10308785&amp.

FIGURE 9

ADIT AND PUD DISCHARGE RATES
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

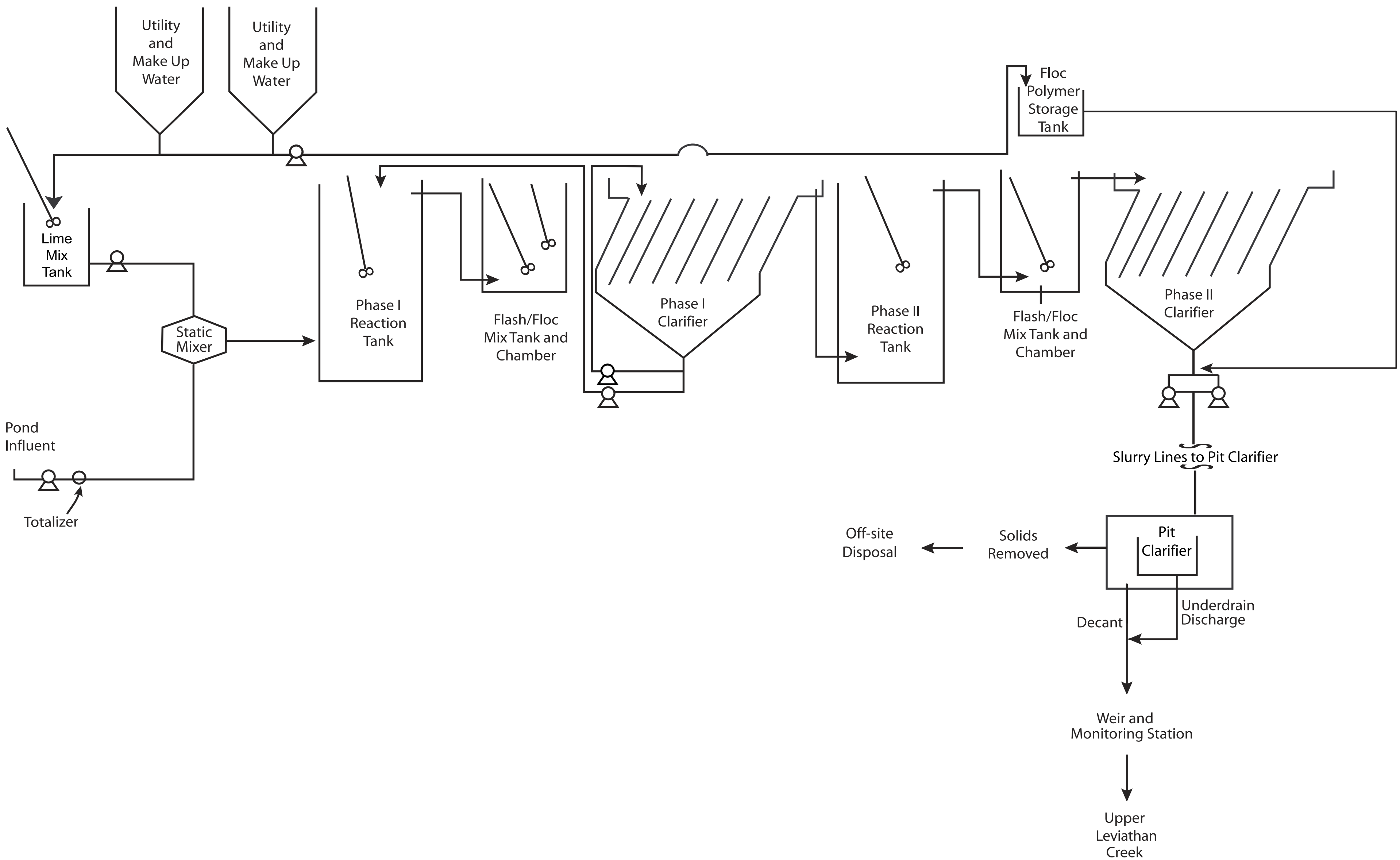


FIGURE 10

POND 1 LIME TREATMENT PLANT
PROCESS FLOW DIAGRAM
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

Burleson Consulting, Inc.

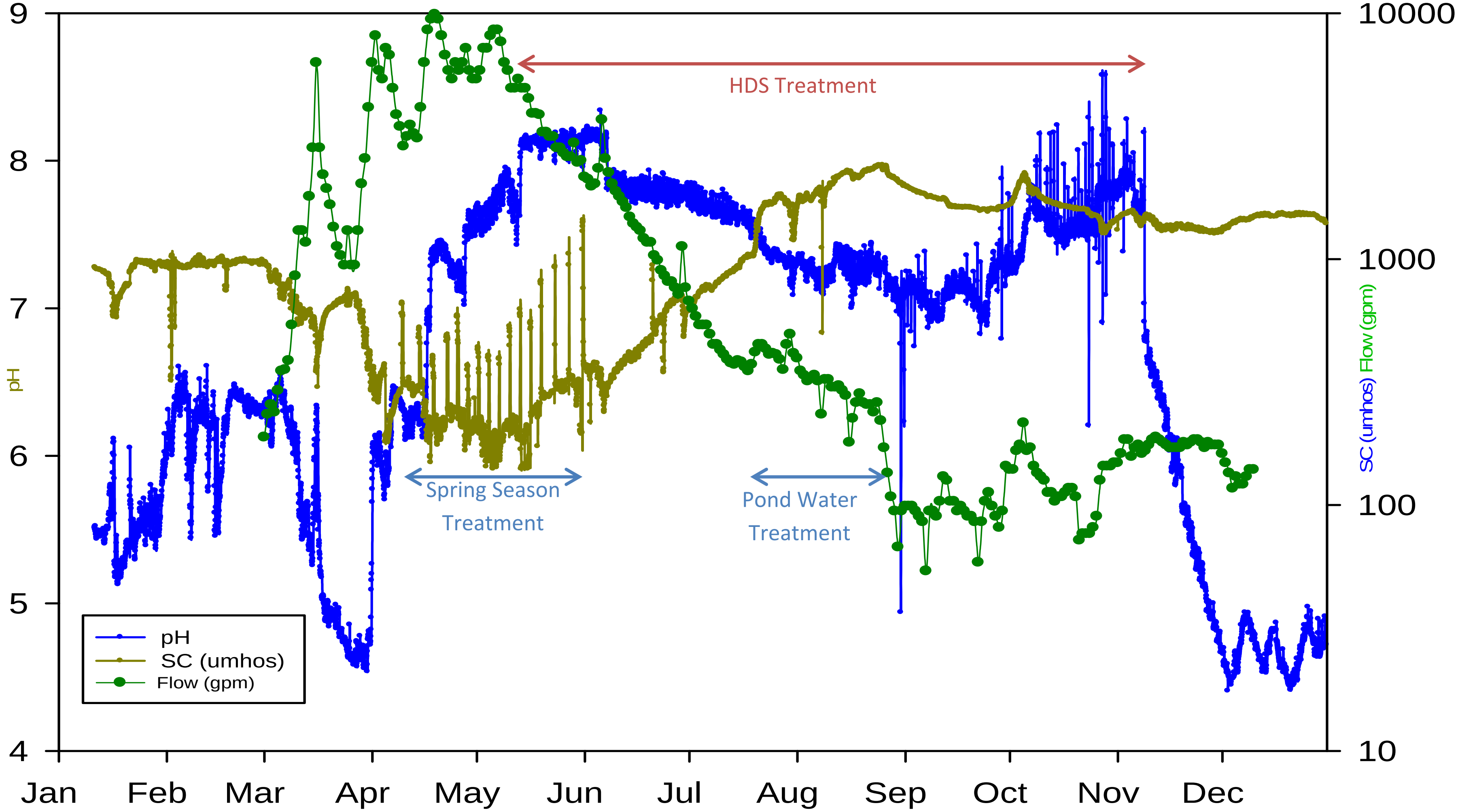


Figure 11

Station 15 Environet Water Quality Data and Flow During 2011

BURLESON CONSULTING, INC

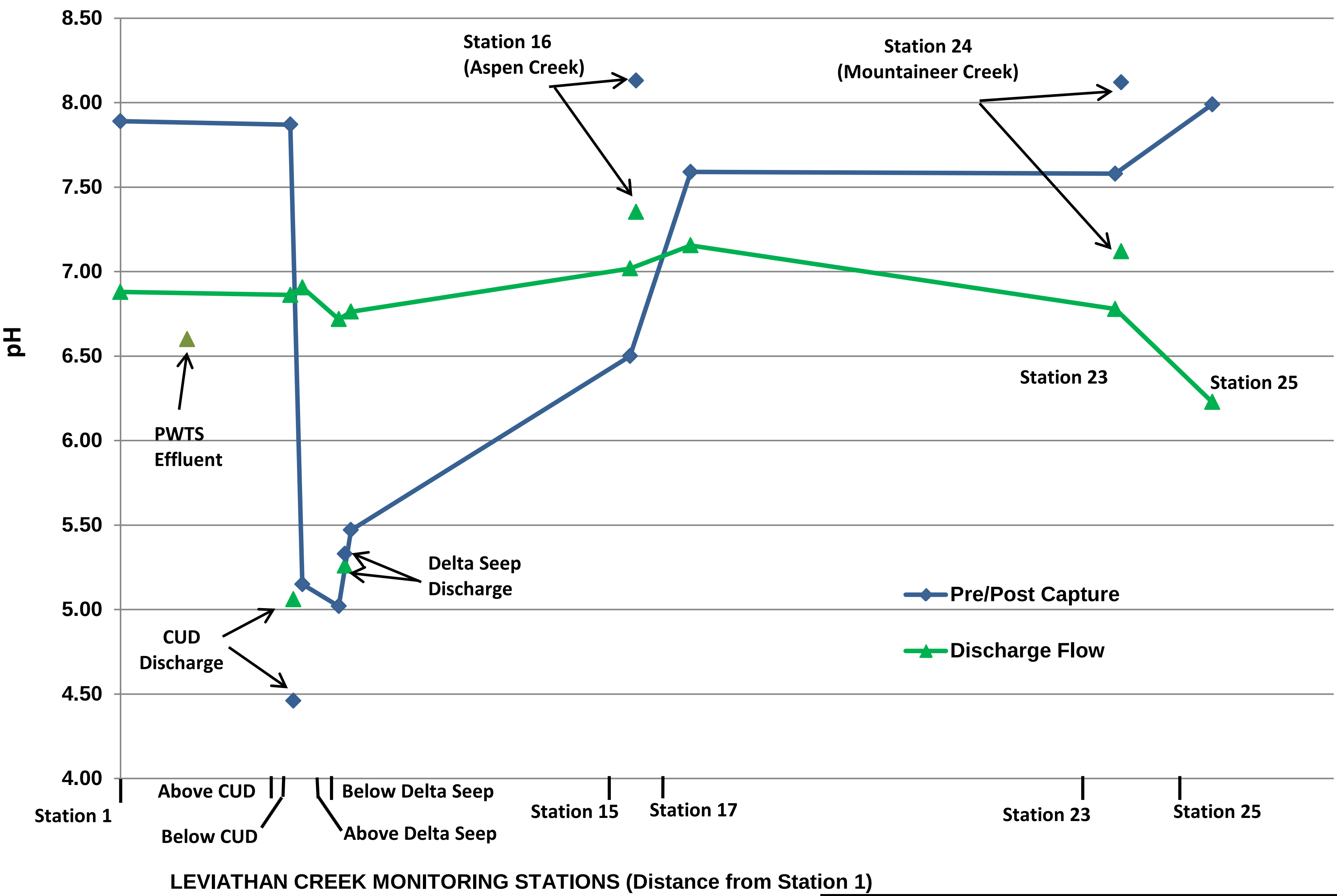
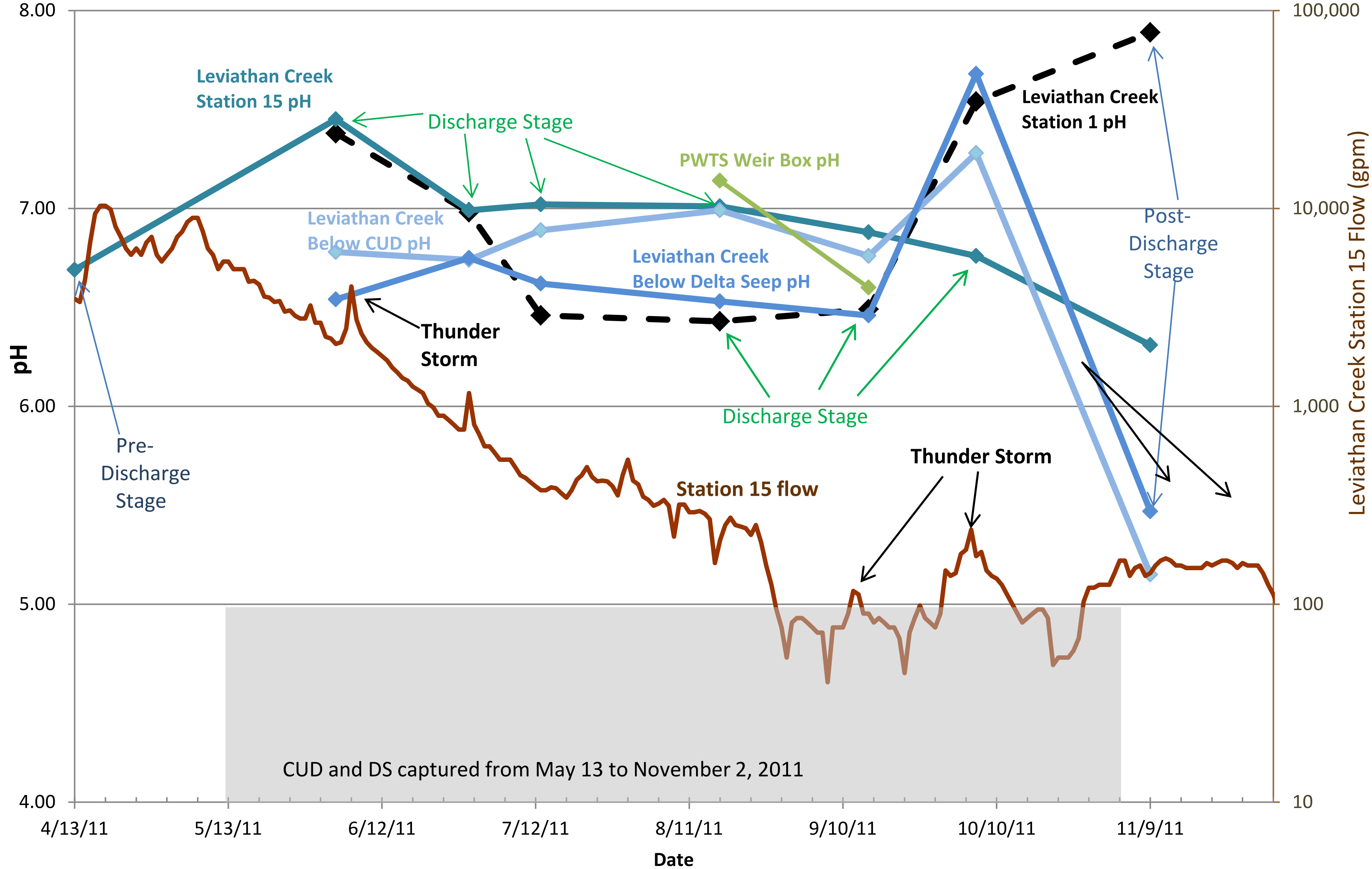


FIGURE 12

LEVIATHAN CREEK AVERAGE pH BY STAGE DURING 2011 TREATMENT
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

Notes:
CUD Channel Underdrain
PWTS Pond Water Treatment System



Notes:

CUD	Channel Underdrain
DS	Delta Seep
gpm	Gallon per minute

Dashed line represents upstream monitoring location not affected by mine drainage

Leviathan Creek data from U.S.G.S. 2011. Recent Daily Water Data for California, Monitoring Station 10308789. Accessed online at: http://waterdata.usgs.gov/ca/nwis/uv/?site_no=10308789&amp.

FIGURE 13

LEVIATHAN CREEK pH AND FLOW DURING 2011 TREATMENT LEVIATHAN MINE SUPERFUND SITE ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

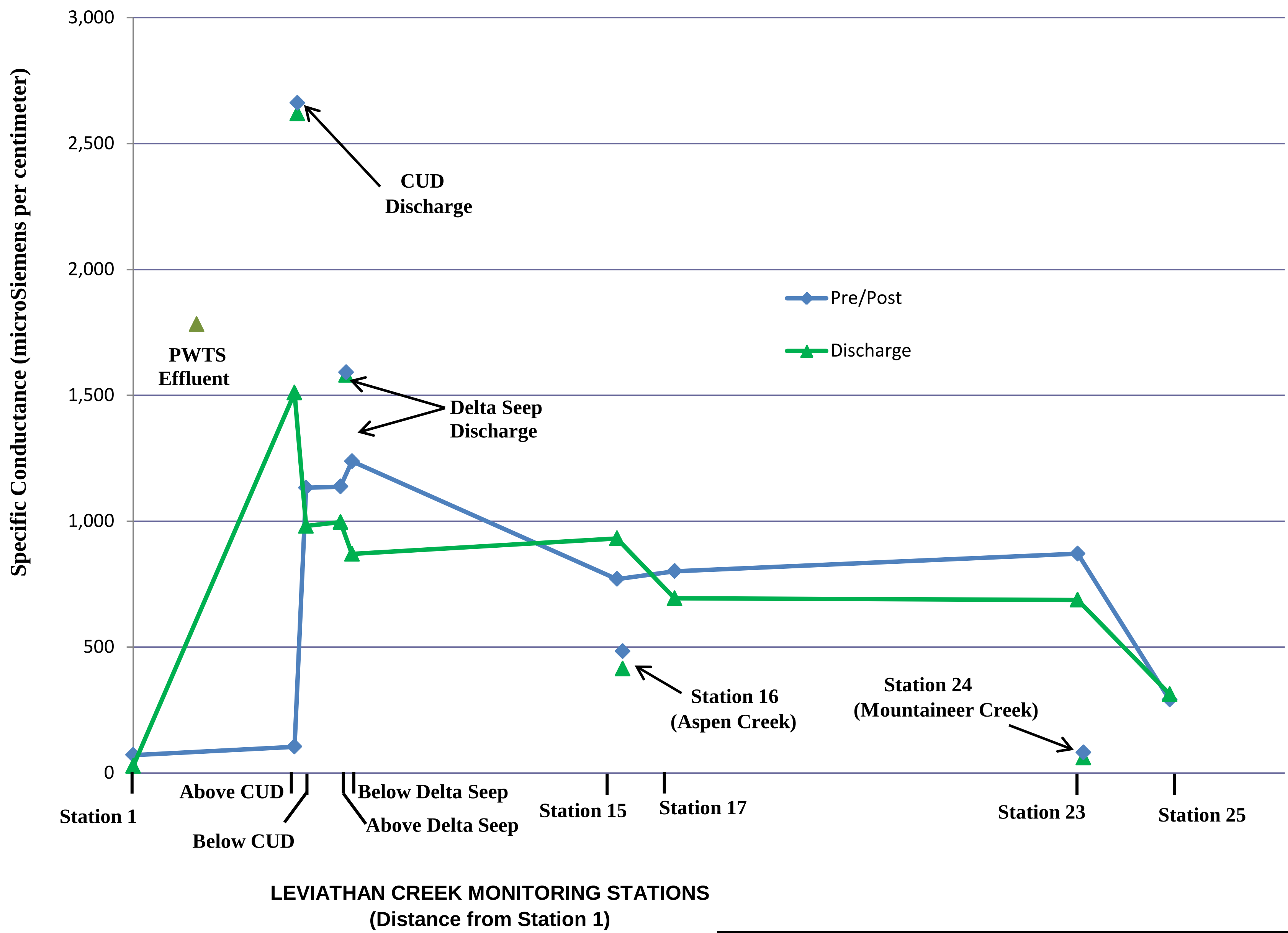
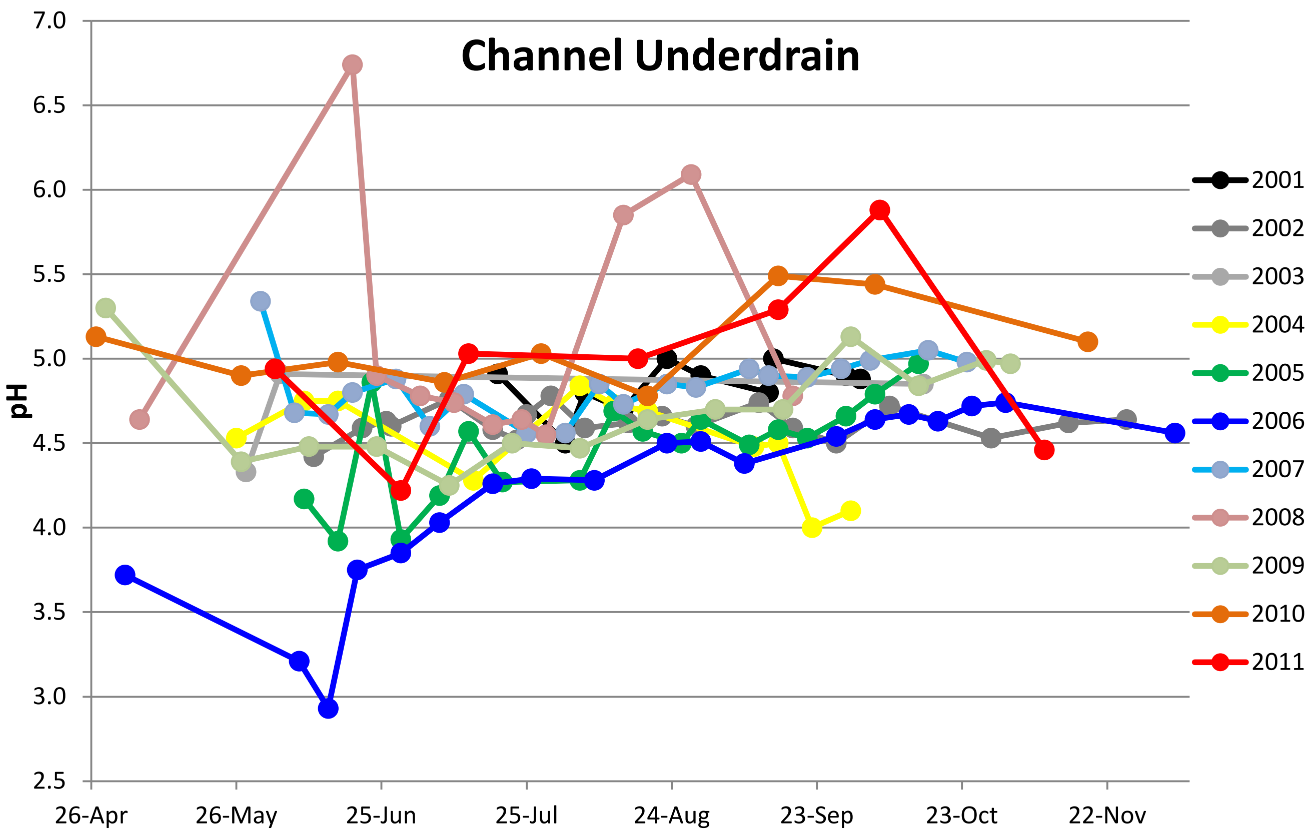


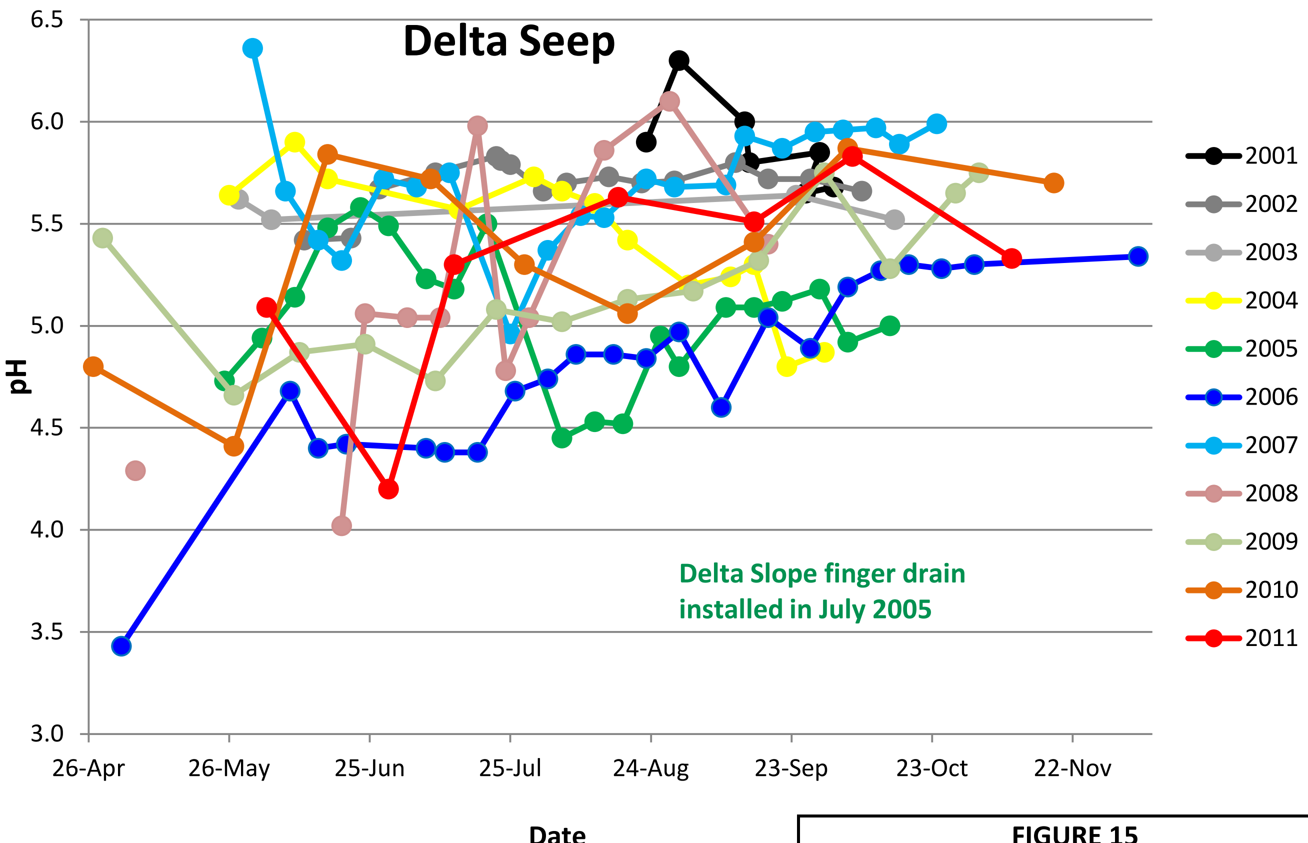
FIGURE 14

LEVIATHAN CREEK AVERAGE SPECIFIC CONDUCTANCE DURING 2011 FLOW STAGES
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

Notes:
CUD Channel Underdrain
PWTS Pond Water Treatment System





Note:
Delta Seep data since July 2005 represent the mixture of seepage and discharge from the Delta Slope finger drain.

FIGURE 15

CUD AND DELTA SEEP pH
LEVIATHAN MINE SUPERFUND SITE
ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC.

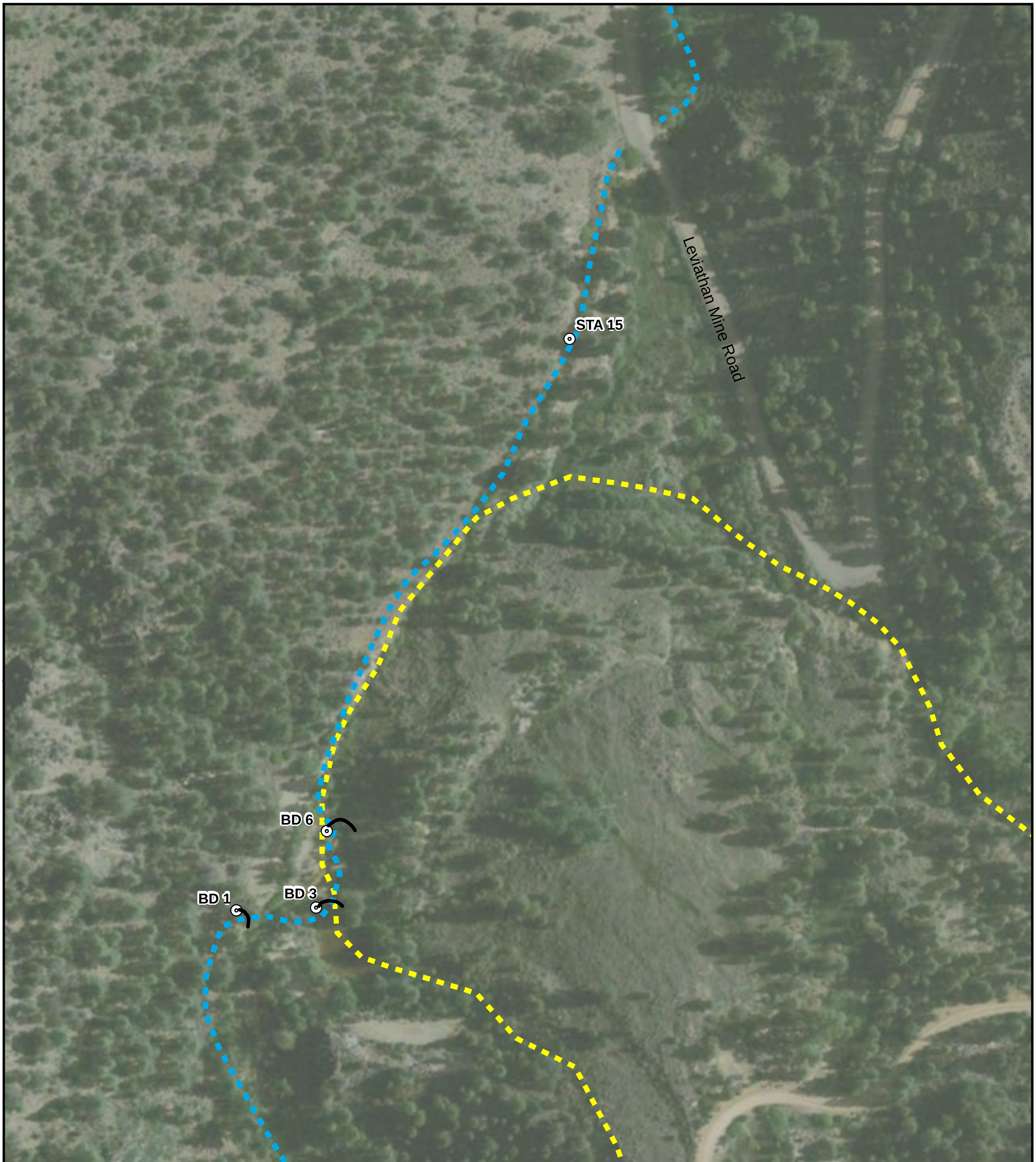
Mountaineer Creek (top creek) and Leviathan Creek, before capture of Channel Underdrain and Delta Seep, April 13, 2011

Mountaineer Creek (top creek) and Leviathan Creek, after capture and treatment of Channel Underdrain and Delta Seep, June 3, 2011

FIGURE 16

LEVIATHAN CREEK AT CONFLUENCE WITH MOUNTAINEER CREEK LEVIATHAN MINE SUPERFUND SITE ALPINE COUNTY, CALIFORNIA

BURLESON CONSULTING, INC



Legend

- Approximate Location of Beaver Dam
- Water Quality Measurement Location
- Leviathan Creek
- Approximate Leviathan Creek Landslide

N

Figure 17

Beaver Pond
Water Quality Survey Locations
Leviathan Mine Superfund Site
Alpine County, California

0 150 300
Feet

Burleson Consulting, Inc.

TABLES

Table 1. Channel Underdrain and Delta Seep Treatment Summary by Year

Source	Number of Days Source was Captured and Treated, by Year and Method										
	2001 - LNP[a]	2002 - LNP[a]	2003 - LNP[a]	2004 - LNP[a]	2005 - HDS[a]	2006 - HDS/LNP[a]	2007-RCTS[d]	2008-RCTS[b]	2009-RCTS/HDS[b]	2010-HDS[b]	2011-HDS[b]
Channel Underdrain	61	128	104	122	66	36/48	117	135	182	183	166
Delta Seep	0	4	100	73	0	0	96	135	180	180	166
Volume of Water Treated (million gallons)	1.4[b]	3.17[b]	4.72[b]	5.0[b]	2.9[b]	1.9/1.8[c]	3.2	6	6.9	10.6	13.8

Notes:

HDS High density sludge pilot plant
LNP Pond 4 lime neutralization plant
RCTS Rotating Cylinder Treatment System

a Values are from Tetra Tech EM Inc. oversight files, as reported in:
Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. February 2002.
2002 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2003.
2003 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. June 2004.
2004 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2005.
2005 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2006.
2006 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2007.

b Values are from Atlantic Richfield Company's annual Early Response Action completion reports:
Brown and Caldwell. 2002. *Leviathan Mine 2001 Early Response Action, Channel Underdrain Treatment Completion Report.* February.
Unipure Environmental. 2003. *Draft Leviathan Mine Site 2002 Early Response Action Completion Report.* March.
Unipure Environmental. 2004. *Draft Final Leviathan Mine Site, 2003 Early Response Action Completion Report.* April 27.
EMC^2. 2005. *Draft 2004 Early Response Action Completion Report.* May.
UniPure and EMC^2. 2006. *Draft 2005 Early Response Action Completion Report, Lime Neutralization Treatment System Using the High Density Sludge Pilot Study* . April.
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Amec Geomatrix. 2010. *2009 Annual completion Report: Channel Underdrain, Delta Seep and Aspen Seep Water Treatment Activities* . April.
Amec Geomatrix. 2011. 2010 *Annual completion Report: Channel Underdrain, Delta Seep and Aspen Seep Water Treatment Activities.* April.
Amec Geomatrix. 2012. 2011 *Annual completion Report: Channel Underdrain, Delta Seep and Aspen Seep Water Treatment Activities.* April.

c Value was provided by Atlantic Richfield Company's treatment system contractor at the Leviathan Mine Technical Advisory Committee Meeting on November 2, 2006.

d Values are from USACE oversight files, as reported in:
2007 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. June 2007.

Table 2. Evaporation Pond Water Treatment System Summary by Year

Treatment System Location		Treatment Year 2001	2002	2003	2004	2005	2006	2007[f]	2008[g]	2009[b]	2010[b]	2011[b]
Duration of Treatment[a] (days)	Pond 1	40	79[c]	17	32	48	47	16	41[c]	33	39	43
	Pond 3	0	0	0	0	10	84	0	0	0	0	56
Volume of Treated Water Discharged[b] (million gallons)	Pond 1	4	3.8	3.5	5.9	9.9	13.2	3.12	3.1	2.9	6.7	9.8
	Pond 3	0	0	0	0	0.53[e]	7.5[d]	0	0	0	0	8.2

Notes:

a Values are from Tetra Tech EM Inc. oversight files, as reported in:
Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. February 2002.
2002 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2003.
2003 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. June 2004.
2004 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2005.
2005 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. March 2006.

b Values are from California Regional Water Quality Control Board, Lahontan Region annual reports:
2001 Year-end Report for Leviathan Mine, Alpine County, California. February 2002.
2002 Year-end Report for Leviathan Mine, Alpine County, California. February 2003.
2003 Year-end Report for Leviathan Mine, Alpine County, California. February 2004.
Year-end Report for the 2004 Field Season at Leviathan Mine, Alpine County, California. February 2005.
Year-end Report for the 2005 Field Season at Leviathan Mine, Alpine County, California. February 2006.
Year-end Report for the 2009 Field Season at Leviathan Mine, Alpine County, California. March 2010.
Year-end Report for the 2010 Field Season at Leviathan Mine, Alpine County, California. February 2011.
Year-end Report for the 2011 Field Season at Leviathan Mine, Alpine County, California. February 2012.

c The treatment system was not operated 24 hours per day, 7 days per week during these years.
d Values were provided by the California Regional Water Quality Control Board,
e An additional 400,000 gallons of water was treated in Pond 3 and allowed to evaporate from the pond.
f Values are from USACE oversight files, as reported in:
2007 Oversight Summary Report, Leviathan Mine Superfund Site, Alpine County, California. June 2007.
g Kao, Chein. 2008. Presentation at the Leviathan Mine Superfund Site Technical Advisory Committee Meeting. November 18.

Table 3. Leviathan Creek Flow Stages during the 2011 Treatment Season

Creek Flow Stage	Components of Leviathan Creek Flow	Monitoring Dates
Pre/Post Capture	Spring runoff flow, CUD discharge, and Delta Seep discharge	April 13, 2011
		November 9, 2011
Discharge Flow	Base flow and treatment system discharge	June 3, 2011
		June 29, 2011
		July 13, 2011
		August 17, 2011
		September 15, 2011
		October 6, 2011

Note:

CUD Channel Underdrain

Table 4. Leviathan Mine Beaver Pond Water Quality Measurements

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
April 13, 2011					
BD-1	10:46	7.06	2.94	247	-23.2
BD-3	10:52	6.97	3.04	254	-33.5
BD-6	10:55	6.91	3.21	255	-29.2
June 29, 2011					
BD-1	15:20	6.86	12.53	387	-71.9
BD-3	15:27	6.49	11.57	372	-52.6
BD-6	15:32	6.90	12.41	377	-71.9
November 9, 2011					
BD-1	12:00	5.56	1.26	1,200	-49.1
BD-3	11:55	5.64	3.73	1,338	-51.1
BD-6	11:50	5.74	3.45	1,271	-50.4

°C	Degree Celsius	ORP	Oxidation-reduction potential
µS/	MicroSiemen per centimeter	SC	Specific conductance
gpr	Gallon per minute	T	Temperature
mV	MilliVolt		

Notes:

BD-1 - Upstream Beaver Dam

BD-3 - Main Beaver Dam

BD-6 - Downstream Beaver Dam

APPENDIX A: OVERSIGHT SUMMARIES **25 Pages**
(Presented on Compact Disc)

APPENDIX B: OVERSIGHT PHOTOGRAPHS **21 Pages**
(Presented in Hard Copy and on Compact Disc)

APPENDIX C: FIELD INSTRUMENT MEASUREMENT RECORDS **16 Pages**
(Presented on Compact Disc)

Appendix A
Leviathan 2011 Oversight Summary Report
Oversight Summaries

(25 Pages)

Leviathan Mine Superfund Site
April 13, 2011
Burleson Consulting, Inc. Oversight

Period of Oversight: 9:00 AM to 2:30 PM
Oversight Personnel: Greg Reller
Agency Personnel: Kevin Mayer, EPA, Ken Maas, USFS, Doug Carey, Regional Board

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- TKT under contract to the Regional Board was treating water from Pond 1.

Atlantic Richfield Company (Atlantic Richfield):

- AMEC, under contract to Atlantic Richfield was on site evaluating conditions at the High Density Sludge (HDS) system.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality at Station 15 in Leviathan Creek, and at the beaver ponds.
- Burleson inspected site access conditions, and observed water treatment activities at Pond 3.

The weather conditions varied from partly sunny, to overcast with snow flurries. The day was cold with an intermittent breeze. Snow (about 1 foot deep) covered the east and north facing slopes from the vicinity of the Aspen Creek-Leviathan Creek confluence. South and west facing slopes were bare of snow or contained snow patches. The site above the elevation of the Pond 4 area contained much more snow (about 2 to 4 feet deep) than lower elevation areas.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has varied from about 5 cubic feet per second (cfs) to about 50 cfs since early April. Also according to USGS, flows at Station 25 in Bryant Creek varied from about 15 cfs to about 70 cfs since early April. Flows vary significantly through each day with peak flows in the late afternoon and low flows in the early morning. This pattern appears to reflect diurnal temperature fluctuations.

Regional Board

Regional Board activities included delivery of dry lime to the site, and water treatment at Pond 3.

Lime Delivery: Dry lime was transported to near the California-Nevada border via semi-truck. The lime was off loaded from the semi-trailer at this point because access to the site via the road for a semi-truck and trailer would not be safe under current road conditions. Lime was staged on palates pending transport to the site on a stake-bed truck that could safely access the site. At the site, the lime was staged along the access road near the intersection with the road to Pond 3. Lime will be transported to Pond 3 via pickup truck as needed to support ongoing treatment operations.

The lime was delivered in paper bags stacked on wood pallets and covered with plastic tarps. As we left the site, an uncovered palate of dry lime was observed, the wind appeared to have blown the tarp off the palate.

Water Treatment: TKT, under contract to the Regional Board, is operating a rotating cylinder treatment system (RCTS) at Pond 3. Treatment operations are normally performed by two on-site personnel.

Water siphoned from Pond 1 is treated and discharged to Pond 3. In the last week, TKT was able to treat the water in Pond 3 and about one acre-foot of water from Pond 1. The treated water was then discharged to Leviathan Creek through the Pond 3 overflow pipe. The point of discharge is reportedly near the mid-point of the underground concrete culverts that conduct Leviathan Creek through the area between Ponds 2N and 2S and Pond 3. Treated water was mostly dilute with not much iron.

During the night preceding the site visit, more typical Pond 1 water containing iron and other metals began flowing to the treatment system. Valves between Pond 1 and Ponds 2N and 2S are currently open so that the pond water elevations are all the same. Therefore, lowering the elevation of Pond 1 also lowers the elevation of Ponds 2N and 2S.

The water siphoned from Pond 1 enters Pond 3 through the outlet from the Pond 1 overflow pipe. A sump pump is placed at the outlet, and this water is pumped into the RCTS mixing tank. A lime slurry is also pumped into the RCTS mixing tank. The pH of the mixing tank is monitored to control the lime slurry delivery rate. Lime slurry is mixed in a lime mixing tank using dry lime and Pond 3 water. Lime slurry of from 6% to 25% lime is used depending on the raw water characteristics. A grinder pump is used to transfer the slurry to the RCTS mixing tank. The grinder pump can function even when pellets of hard lime are present in the lime slurry.

Water flows by gravity from the mix tank into the RCTS reactors. There are two RCTS reactors running in parallel. The rotating cylinders aerate the lime-acid drainage solution, and provide additional mixing. RCTS effluent discharges by gravity to Pond 3. Solids settle in Pond 3. When the freeboard in Pond 3 reaches about 1 foot below the overflow inlet, the water is discharged by pumping. The decision to discharge is based on pH readings, with samples collected for laboratory analysis to confirm that the discharged water complies with requirements in the removal action memorandum.

To ensure that the water in Pond 3 is mixed, TKT directs the RCTS effluent parallel to one side of the pond, and uses a pump to direct a jet of Pond 3 water in the opposing direction along the other side of the pond.

Atlantic Richfield

Site Reconnaissance: AMEC personnel, under contract to Atlantic Richfield, were on site to evaluate site conditions and determine when mobilization for limited access season (LAS) treatment might begin. AMEC determined that site access is adequate to begin mobilization next week (assuming the weather remains cooperative). AMEC personnel identified a couple of areas along the access road where they hope to direct water away from the road surface, blade the road surface, and may resurface some areas of the road with new rock. Road work is planned to occur this week.

Burleson

On April 13, 2011 water in the Leviathan Creek channel at the confluence of Leviathan and Mountaineer creeks was tan, and the water was translucent to nearly opaque. The channel of Leviathan Creek upstream from the beaver dams contained orange and tan precipitates, and the water impounded by the beaver dams was translucent and had a tan color.

On April 13, 2011 Burleson measured water quality in Leviathan Creek at Station 15, and the beaver ponds to document conditions during 2011 spring runoff. Water quality readings taken by Burleson are presented in Table 1.

Table 1. Leviathan Mine Surface Water Quality Measurements on April 13, 2011

Location	Time	pH	T (°C)[1]	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 15	10:29	6.69	2.79	256	24.3
West Abutment of Downstream Dam	10:46	7.06	2.94	247	-23.2
West Abutment of Main Dam	10:52	6.97	3.04	254	-23.5
West Abutment of Upstream Dam	10:55	6.91	3.21	255	-29.2

Notes:

°C	Degree Celsius	ORP	Oxidation-reduction potential
µS/cm	MicroSiemen per centimeter	SC	Specific conductance
gpm	Gallon per minute	T	Temperature
mV	MilliVolt		

Upcoming Events:

- Regional Board plans to continue treating Pond 1 water, and continue batch discharges of treated water from Pond 3. The goal is to prevent discharge of untreated acid drainage to Leviathan Creek.
- Atlantic Richfield plans to complete road improvements and mobilize for LAS operation of the HDS plant beginning on April 18. The goal is to start HDS operations on or before May 1 to prevent a significant drop in the pH of Leviathan Creek this spring.

Leviathan Mine Superfund Site
May 24, 2011
Creek Walk

Period of Activity: 7:00 AM to 4:30 PM
Burleson Personnel: Greg Reller and Jimmy Steele
Agency Personnel: Kevin Mayer, Ned Black, and Peter Husby of EPA; John Erwin of USACE; Chuck Curtis of Regional Board; John Henderson, Toby McBride, and Kerensa King of USFWS, Joyce Peterson and Darryl Cruz of Washoe Tribe; Britt Jones of AMEC

Purpose: The Creek Walk provided participants an opportunity to observe the Bryant Creek watershed in mid-spring of a high precipitation year, as peak flows were diminishing. This walk provided participants with a common basis for communicating about watershed features relevant to the eventual clean up of Leviathan Mine.

Leviathan and Bryant Creek Flows: The creek walk occurred between about 8:15 AM and 4:30 PM. According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Bryant Creek at Station 25 (upstream from the creek walk starting point) varied from about 13 cubic feet per second (cfs) to about 17 cfs. Also according to USGS, flows in Bryant Creek upstream from the confluence with Doud Creek varied from about 17 cfs to about 20 cfs.

Summary of Creek Walk Activities: Prior to the Creek Walk, EPA staged two vehicles at the confluence of Bryant and Doud Creeks. Creek Walk participants congregated at the parking area adjacent to the intersection of Highway 395 and Leviathan Mine Road. Participants then car-pooled to the starting point for the Creek Walk along Bryant Creek at the California-Nevada state line.

Mr. Mayer provided a safety orientation to ensure that all participants were aware of the flow conditions, physical hazards, and potential interactions with wildlife. We also discussed the need to stay together as a group.

We then began the hike to the staged vehicles about 4 miles downstream. After reaching the vehicles, Dr. Black and Mr. Cruz departed in one of the vehicles and remaining participants ate lunch before proceeding to the Carson River. After our return from the Carson River, drivers were shuttled to their vehicles at state line, and then returned to shuttle the remaining participants to their vehicles at Highway 395.

During the walk many conversations were held, including the following topics:

Washoe Property and Resources. Mr. Cruz pointed out the Washoe Tribe property boundary signs that delineated pine nut allotments in the area. Mr. Cruz also described some of the types of cultural resources present along Bryant Creek.

Macroinvertebrate Sampling Locations. Dr. Black and Mr. Husby described macroinvertebrate sampling procedures and locations along Bryant Creek. Dr. Black pointed out that sampling at the Doud-Bryant confluence was discontinued because the data from early samples was dominated by the effects of cattle grazing. He also mentioned that samples were recently collected here after a period of cattle being excluded from the area.

Reference Locations. Water was flowing from Barney Riley Creek and the question was raised as to whether Barney Riley Creek would be a good reference stream. Dr. Black stated that Barney Riley Creek is intermittent and dries up during the summer months, significantly limiting the usefulness of any data for comparison with data from the perennial streams affected by the site.

Water quality and seasonal treatment (pH drop and SC spikes). Mr. Mayer shared graphs of water quality measurements (pH and specific conductance). The graphs showed that pH of Leviathan Creek at Station 15 had started to decline (from about 7.5 to about 6.8) as runoff declined and discharges from CUD and DS were no longer being diluted as much. The graphs also showed that on May 14, after CUD and DS were discharges were intercepted for treatment the pH increased to about 7.6, showing the benefits of CUD and DS capture.

The graphs also showed periodic sudden increases in conductance. These conductance 'spikes' are associated with the periodic discharge of treated water from Pond 3. The treated water contains sulfate, and other salts that contribute to elevated conductance in Leviathan Creek..

Need to Consider Antecedent Conditions during sampling (treatment, discharge, flow, weather). During a general discussion of sampling to assess aquatic biota the need to consider antecedent conditions was described. Such factors as the flow rates in the streams, the sources of the water in the streams, current and past site activities, and location with respect to possible contaminant sources were described. For example, collecting samples from EFCR a short distance upstream from the mouth of Bryant Creek, may not provide reference data. This is because Leviathan Creek water was used to irrigate ranch lands upstream from Bryant Creek, and this practice could potentially affect aquatic organisms in EFCR near Bryant Creek. Similarly the timing of sampling with respect to ongoing water treatment activities needs to be considered.

Sediment Accumulation. Features indicating erosion and sedimentation such as cut banks and longitudinal bars were observed and discussed. Impacts of RV travel on the stream channel were observed. And the lack of current-year large-scale sediment deposition was noted. Sediment deposit morphology (terraces, channels, and vegetated planar surfaces) indicative of multiple ages of sediment accumulation were observed.

Hydrothermal alteration. Hydrothermally altered rock near the confluence of Doud and Bryant Creeks was observed, and visual characteristics (white or tan and bright red colors) were noted, compared to the more muted brown coloration of un-altered rocks. Hydrothermal alteration was also contrasted with the iron-oxide cemented gravels present in the watershed and associated with mineral springs in the area.

Plant and Animal Observations. Various wildflowers (including phlox and pussy's feet), trees (including pinyon pine, willow, chokecherry, and apple), water cress, and various grasses and forbs were observed. A large raptor, possibly an Osprey was observed near Doud Creek. Turkey Vultures and other birds were also observed. Trout were observed in Bryant Creek.

The remnants of a beaver dam were present downstream from the USGS gauging station near Doud Creek. The dam appeared to have been damaged by high water earlier this year. An accumulation of sediment (sand and gravel) was present immediately upstream from the dam location.

Leviathan Mine Superfund Site

June 3, 2011

Burleson Consulting, Inc. Oversight

Period of Oversight: 9:30 AM to 3:30 PM

Oversight Personnel: Greg Reller and Jimmy Steele

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- No Regional Board or Contractor Personnel were observed on site.

Atlantic Richfield Company (Atlantic Richfield):

- AMEC, under contract to Atlantic Richfield was on site operating the High Density Sludge (HDS) system.
- AMEC was maintaining the Aspen Seep Bioreactor.
- AMEC was constructing foundations for stormwater sampling station equipment as part of the RI.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan and associated Creeks.
- Burleson inspected site access conditions, and conducted reconnaissance in the area of a reported historic mill site.

The weather conditions varied from partly sunny, to overcast; the day was cool with a gentle breeze. Snow patches were encountered on north and east facing slopes only at the higher elevation areas of the site.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has declined from about 10 cubic feet per second (cfs) to about 4 cfs since mid-May. This declining trend is punctuated by daily flow maxima that appear to coincide with daily temperature cycles and precipitation.

Regional Board

Regional Board activities were not observed. No contractors or Regional Board personnel were encountered by Burleson during the oversight visit. The Regional Board changing trailer and out house were present along the access road above Pond 1. The treatment system at Pond 1 remained winterized with no evidence of preparation for seasonal treatment. The RCTS treatment system was present and inactive at Pond 3. The Pond 1 overflow inlet appeared to be more than one foot above the pond water elevation.

The Pond 3 liner is exposed over an approximate 10 feet length to the east of the overflow inlet from Ponds 2.

Atlantic Richfield ERAs

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were on site operating the HDS plant to treat intercepted water from the Delta Seep (DS) and Channel Underdrain (CUD). CUD and DS flows are mixed in Pond 4 and then pumped into the HDS plant. The methane generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit.

Aspen Seep: AMEC was at the ASBR evaluating the power control systems. The ASBR appeared to be operating in recirculation mode. The elevation of Pond 4 was low compared operating levels during prior years. The infiltration pond water was cloudy with a milky color.

Atlantic Richfield RI Activities

Britt Jones of AMEC stated that there were no RI activities on the day of the site visit other than preparing for installation of stormwater sampling stations. A crew was excavating the foundation for a sampler along the Leviathan Creek tributary at the bottom of the slope below Ponds 2 during Burleson's visit.

Flags and paint were present on the ground at several locations in the Pond Area of the site indicating the presence of buried utilities. These markers were from utility location efforts in preparation for geophysical surveys.

Burleson

On June 3, 2011 Burleson measured water quality in Leviathan Creek and associated creeks Water quality readings taken by Burleson are presented in Table 1. Burleson drove over the Leviathan bypass road to evaluate road conditions. The road surface on the California entrance side of the pit contained gullies. The bypass road is readily passable with a high clearance vehicle.

Table 1. Leviathan Mine Surface Water Quality Measurements on June 3, 2011

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 1	9:55	7.38	3.89	24	26.4
Pond 1	10:17	4.23	11.9	4,137	400.6
Pond 3	10:25	6.66	8.71	1,693	214.8
Leviathan Creek, Above CUD	10:58	6.95	6.39	852	234.2
CUD	10:50	4.94	8.57	3,105	221.5
Leviathan Creek, Below CUD	11:04	6.78	6.04	229	234.4
Leviathan Creek, Above Delta Seep	11:18	6.35	6.13	234	227.9
Delta Seep	11:13	5.09	8.27	1,757	220.3
Leviathan Creek, Below Delta Seep	11:22	6.54	6.22	246	218.4
Aspen Seep Influent Weir Box	12:43	3.25	10.39	2,645	341.5
Aspen Seep Bioreactor Settling Pond 2	12:55	6.76	11.07	2,906	209.4
Aspen Seep Oxidation Channel	13:10	7.58	11.96	2,832	-210.3
Aspen Seep Infiltration Pond	13:04	7.26	13.36	2,832	-37.2
Former Leviathan Creek Channel	14:25	7.15	10.18	1,147	-93.9

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 15	14:20	7.45	8.52	247	-62.6
Aspen Creek, Station 16	14:12	7.74	10.58	498	-72.9
Leviathan Creek, Station 17	14:05	7.67	8.67	303	-72.2
Leviathan Creek, Station 23	13:40	7.22	8.09	265	-40.8
Mountaineer Creek, Station 24	13:47	7.79	7.96	74	-73.4
Bryant Creek, Station 25	13:53	7.79	8.08	214	-75.9

Table 1 Notes:

°C Degree Celsius
ORP Oxidation-reduction potential
mV MilliVolt
µS/cm MicroSiemen per centimeter
SC Specific conductance
gpm Gallon per minute
T Temperature

Upcoming Events:

- Regional Board plans to mobilize to the site in late June to prepare for Pond 1 treatment operations, and to pave the road around Pond 1.
- Atlantic Richfield ERAs: Continue HDS and ASBR operations. Mobilize sludge dewatering equipment to the ASBR.
- Atlantic Richfield RI: *Weeks of June 6 and June 13:* measure groundwater elevations, conduct groundwater monitoring, install storm water monitoring equipment, map erosional features, perform geophysical surveys, begin pond leak detection surveys.

  Week of June 20: Begin electrical leak detection surveys at Pond 1, Pond 2N, and Pond 2S, and install meteorological stations and evaporation pans.
- Burleson will coordinate future oversight activities with USACE and EPA. The next visit is tentatively scheduled for after June 22.

Leviathan Mine Superfund Site

June 29, 2011

Burleson Consulting, Inc. Oversight

Period of Oversight: 10:10 AM to 4:45 PM

Oversight Personnel: Greg Reller (Burleson) and Gary Riley (EPA)

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- URS, under contract to the Regional Board, was preparing the pond water treatment system (PWTS) for seasonal treatment.

Atlantic Richfield Company (Atlantic Richfield):

- AMEC, under contract to Atlantic Richfield, had a limited on-site presence due to weather.
- The HDS plant and associated capture systems, and the Aspen Seep bioreactor (ASBR) were operating.
- AMEC personnel were evaluating recently installed stormwater sampling equipment.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan and associated Creeks.
- Burleson inspected site access conditions, and discussed site activities with on-site personnel.

The weather conditions varied from rainy to partly cloudy; the day was cool and breezy.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has declined from about 10 cubic feet per second (cfs) to about 1.5 cfs since early June. This declining trend is punctuated by daily flow maxima that appear to coincide with daily temperature cycles, precipitation and discharge of treated water from Pond 3. Similarly flow at Station 25 in Bryant Creek has declined from above 20 cfs to about 4 cfs with a diurnal cycle.

Regional Board

Regional Board personnel were not on-site. Personnel from URS under contract to the Regional Board were present at Pond1. URS is rewiring the PWTS to enclose the wires in metal conduit and provide weather tight control panel enclosures. The new wiring will require fewer control panels. Delivery of bins for pit clarifier sludge removal was postponed because the access roads were too slippery, and to prevent damage to the road surface from truck traffic. Delivery of the bins is anticipated after July 4.

The RCTS treatment system was removed from Pond 3. The Pond 1 overflow inlet appeared to be more than one foot above the pond water elevation.

Atlantic Richfield ERAs

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were operating with minimal on-site personnel because of the weather conditions. The HDS plant and associated Channel Underdrain (CUD) and Delta Seep (DS) capture systems appeared to be operating normally. The diesel powered generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit. Marc Lombardi of AMEC stated that the delivery of bins for Pond 4 sludge removal was interrupted by the rain and wet road conditions, and that the delivery of the crane and floating dredge for removing Pond 4 sludge was anticipated later in July. Marc also explained a change to the capture system that will be necessary during Pond 4 sludge removal. The dredge cannot operate for a prolonged period in acidic water. To be able to use the dredge, AMEC plans to mobilize a storage tank to Pond 4 and direct captured CUD and DS water to the storage tank. The pond water pH would then be adjusted to about neutral pH and dredging would commence. The storage tank would be plumbed to overflow to Pond 4, and Pond 4 would still receive HDS plant effluent in the event of a system upset.

Aspen Seep: Aspen seep was not visited because of road conditions. Marc Lombardi explained that the centrifuge mobilized to dewater Aspen Seep Bioreactor (ASBR) sludge did not function properly. Repeated adjustments and modifications to the centrifuge system including addition of a flocculent to the sludge failed to improve centrifuge performance. A belt filter press will be mobilized later in July to dewater ASBR sludge.

Atlantic Richfield RI Activities

Marc Lombardi of AMEC explained that because of the rain, RI activities were limited to inspection and trouble shooting of the recently installed stormwater sampling devices. A crew was inspecting and assessing the performance of each automatic sampler to identify modifications necessary to improve sampler performance.

A drill rig and support vehicles were staged along the Pond 3 access road east of the main road. Marc explained that driller orientation and the start of the drilling program were delayed because of the rain and resulting site conditions.

Geophysical surveys are completed and results are anticipated within a couple of weeks.

Pond liner leak detection surveys are in progress.

To access the slope below Ponds 2N and 2S for piezometer installation, AMEC is considering using a track mounted drill rig secured to a piece of heavy equipment along the Pond 2 access road and equipped with a winch and cable system. This would minimize damage to stormwater conveyances on the slope, and minimize the need to remove trees on the slope.

Burleson

On June 29, 2011 Burleson and EPA measured water quality in Leviathan Creek and associated creeks. Water quality readings taken are presented in Table 1.

Observation of the beaver ponds along Leviathan Creek detected a new dam to the north of prior dams. In addition, the previously north-most dam appeared to have been raised, inundating the area upstream all the way to the main dam (formerly the middle dam).

Table 1. Leviathan Mine Surface Water Quality Measurements on June 29, 2011

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 1	13:55	6.98	10.32	36	-40.9
Leviathan Creek, Above CUD	14:20	7.01	13.24	1,287	-81.3

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
CUD	14:15	4.22	8.62	2,997	-35.8
Leviathan Creek, Below CUD	14:25	6.74	12.73	422	-71.3
Leviathan Creek, Above Delta Seep	14:44	6.62	12.64	462	-106.2
Delta Seep	14:31	4.20	9.16	1,819	154.3
Leviathan Creek, Below Delta Seep	14:47	6.75	12.63	474	-101.2
Beaver Dam 1	15:32	6.90	12.41	377	-80.9
Beaver Dam 3	15:27	6.49	11.57	372	-52.6
Beaver Dam 6	15:20	6.86	12.53	387	-71.9
Leviathan Creek, Station 15	15:40	6.99	12.71	378	-80.6
Aspen Creek, Station 16	15.48	7.34	14.84	388	-83.2
Leviathan Creek, Station 17	15:55	6.80	13.26	396	-60.9
Leviathan Creek, Station 23	10:30	6.74	9.47	440	-18.3
Mountaineer Creek, Station 24	10:43	7.05	8.92	41	-27.8
Bryant Creek, Station 25	10:50	7.54	9.28	291	-65.4

Table 1 Notes:

°C Degree Celsius — ORP Oxidation-reduction potential — mV MilliVolt

µS/cm MicroSiemen per centimeter — SC Specific conductance

gpm Gallon per minute — T Temperature

Upcoming Events:

- Regional Board plans to begin sludge removal from the pit clarifier in the week after July 4.
- Regional Board hopes to begin PWTS operations later in July, and then begin paving the roads near Pond 1.
- Atlantic Richfield ERAs: Continue HDS and ASBR operations. Mobilize belt filter press to the ASBR and begin sludge dewatering. Mobilize floating dredge to Pond 4 and begin sludge removal.
- Atlantic Richfield RI: Improve stormwater monitoring equipment installations based on inspections, complete pond leak detection surveys, begin drilling deep boreholes, review geophysical survey results and adjust drilling and well locations if necessary, install meteorological stations and evaporation pans.
- Burleson will coordinate future oversight activities with USACE and EPA. The next visit is tentatively scheduled for after July 11.

Leviathan Mine Superfund Site

July 13, 2011

Burleson Consulting, Inc. ERA Oversight

Period of Oversight: 10:00 AM to 3:30 PM

Oversight Personnel: Greg Reller and Jimmy Steele (Burleson)

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- URS, under contract to the Regional Board, was operating the pond water treatment system (PWTS) at Pond 1.
- Regional Board staff were present conducting a site visit with California Department of General Services personnel and supervising URS.

Atlantic Richfield Company (Atlantic Richfield):

- The HDS plant and associated capture systems, and the Aspen Seep bioreactor (ASBR) were operating.
- AMEC personnel were performing remedial investigation activities.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan and associated Creeks.
- Burleson inspected site access conditions, and discussed site activities with on-site personnel.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has declined from about 1.5 cubic feet per second (cfs) to about 0.7 cfs since early July. Also according to USGS, flows at Station 25 in Bryant Creek have declined from about 4.5 cfs to about 3 cfs since early July. Flows at both stations show a diurnal pattern.

Regional Board

Personnel from URS under contract to the Regional Board were present at Pond1 and operating the PWTS. Regional Board personnel were on-site supervising the PWTS operations. The first treated water from the PWTS discharged to the Pit Clarifier during the oversight visit.

Doug Carey of the Regional Board was conducting a site visit with California Department of General Services personnel.

Atlantic Richfield ERAs

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were operating the HDS plant. The HDS plant and associated Channel Underdrain (CUD) and Delta Seep (DS) capture systems appeared to be operating normally. The diesel powered generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit. Storage bins for Pond 4 sludge removal were staged adjacent to the HDS building. Baker tanks for storage of raw CUD and DS influent were staged at the south side of the HDS plant. A floating dredge for removing Pond 4 sludge was staged at the south end of Pond 4. AMEC personnel were changing the HDS plant capture system to direct the raw influent to the Baker tanks in preparation for sludge removal operations.   The pond water pH would then be adjusted to about neutral pH and the pond water elevation raised enough so that dredging could commence. The storage tanks are being plumbed to overflow to Pond 4, and Pond 4 would still receive HDS plant effluent in the event of a system upset.

Aspen Seep: The ASBR appeared to be functioning in recirculation mode during the site visit. The water levels in Settling Ponds 1 & 2 were very low during the site visit. Personnel were preparing and monitoring the belt press mobilized to dewater Aspen Seep Bioreactor (ASBR) sludge in an effort to begin sludge removal and dewatering operations.

Burleson

On July 13, 2011 Burleson measured water quality in Leviathan Creek and associated creeks. Water quality readings taken are presented in Table 1. During water quality measurements at Station 17, two mature (about 8-inch long) trout were observed in the pool below the culvert.

Table 1. Leviathan Mine Surface Water Quality Measurements on July 13, 2011

Location	Time	pH	T (°C)	SC (μS/cm)	ORP (mV)
Leviathan Creek, Station 1	10:22	6.71	7.88	36	-18.9
Leviathan Creek, Above CUD	11:30	7.04	13.18	1,953	-67.7
CUD	11:15	5.03	8.66	3,025	25.9
Leviathan Creek, Below CUD	11:35	6.89	15.72	782	-72.9
Leviathan Creek, Above Delta Seep	11:55	6.58	15.23	817	86.6
Delta Seep	11:43	5.30	10.32	1,841	62.9
Leviathan Creek, Below Delta Seep	12:01	6.62	15.41	828	-85.1
Aspen Seep (influent weir box)	12:50	3.66	15.74	2,756	326.3
Aspen Bioreactor Settling Pond	13:15	6.98	19.20	3,447	-50.3
Leviathan Creek, Station 15	14:57	7.02	18.19	689	-101.4
Aspen Creek, Station 16	14:45	7.65	18.39	530	-116.4
Leviathan Creek, Station 17	14:39	7.41	18.90	648	-115.4
Leviathan Creek, Station 23	14:11	6.99	16.97	622	-88.3
Mountaineer Creek, Station 24	14:15	7.00	14.01	80	-84.9
Bryant Creek, Station 25	14:25	7.22	15.28	308	-95.6
Aspen Seep Infiltration Pond	13:23	7.19	25.28	3,047	-515.8

Table 1 Notes:

°C Degree Celsius — ORP Oxidation-reduction potential — mV MilliVolt

μS/cm MicroSiemen per centimeter — SC Specific conductance

gpm Gallon per minute — T Temperature

Upcoming Events:

- Regional Board plans to begin paving the roads near Pond 1.
- Atlantic Richfield ERAs: Continue HDS and ASBR operations. Continue sludge dewatering at the ASBR. Begin Pond 4 sludge removal.

- Burleson will coordinate future oversight activities with USACE and EPA. The next RA oversight visit is tentatively scheduled for early August.

Leviathan Mine Superfund Site

August 17, 2011

Burleson Consulting, Inc. ERA Oversight

Period of Oversight: 9:30 AM to 4:30 PM

Oversight Personnel: Greg Reller and Jimmy Steele (Burleson), Gary Riley (EPA)

Summary of Site Activities:

U.S. Environmental Protection Agency

- Gary Riley accompanied Burleson staff to observe ERA and RI activities.
- EPA conducted a tour of the PWTS and HDS plant for members of the Carson Water Subconservancy District (CWSD).

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- URS, under contract to the Regional Board, was operating the pond water treatment system (PWTS) at Pond 1.
- URS was discharging treated water from the Pit Clarifier to Leviathan Creek.
- URS was pumping water from Pond 2 South to Pond 1.
- Pond 2 North is dry.

Atlantic Richfield Company (Atlantic Richfield):

- The HDS plant and associated capture systems, and the Aspen Seep bioreactor (ASBR) were operating.
- The ASBR was conducting sludge removal of Settling Pond 2.
- AMEC personnel were performing remedial investigation activities.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan and associated Creeks.
- Burleson inspected new stormwater flow paths created by the addition of a culvert adjacent to Pond 3 with Marc Lombardi, and discussed site activities with on-site personnel.
- Burleson accompanied EPA and CWSD of tour conducted at PWTS and HDS plant.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has declined from about 0.7 cfs to about 0.1 cfs since mid July. Also according to USGS, flows at Station 25 in Bryant Creek have declined from about 3 cfs to about 2 cfs since mid July. Flows at both stations show a diurnal pattern.

Regional Board

Personnel from URS under contract to the Regional Board were present at Pond1 and operating the PWTS. Regional Board personnel were on-site supervising the PWTS operations. Pond 2 north is dry. URS was pumping water from Pond 2 South to Pond 1.

Doug Carey and Chuck Curtis were on-site to discuss RI activities and results with Kevin Mayer and Marc Lombardi.

Atlantic Richfield ERAs

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were operating the HDS plant. The HDS plant and associated Channel Underdrain (CUD) and Delta Seep (DS) capture systems appeared to be operating normally. The diesel powered generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit. Storage bins for Pond 4 sludge removal were in the process of being moved and staged along the Nevada road just northeast of the Delta Slope for sludge disposal. The floating dredge for removing Pond 4 sludge was non-operational due to the waiting period of the sludge settling process.

Aspen Seep: ASBR personnel were conducting sludge dewatering operations of sludge accumulated in Pond 4. The water level in Pond 3 was very low during the site visit.

Marc Lombardi of AMEC expressed concern of new stormwater flow paths created by the addition of a culvert installed by the Regional Board. The culvert redirects previous stormwater flow paths that originally conveyed stormwater around the east end of Pond 3, through a culvert north of Pond 3 that flows to Leviathan Creek just east of the Delta seep. The new stormwater flow paths direct the stormwater down the newly paved road between Pond 3 and Pond 4 and into Pond 4. The concern raised by AMEC is the ability of Pond 4 to retain the additional amount of water without exceeding capacity during significant rainfall events.

Burleson

On August 17, 2011 Burleson measured water quality in Leviathan Creek and associated creeks. Water quality readings taken are presented in Table 1. Burleson accompanied the EPA and CWSD during a tour to familiarize CWSD personnel with the site and removal action operations conducted at the site. During the tour, the PWTS and HDS plant were visited and the related acid mine drainage treatment technologies and operations were discussed.

Table 1. Leviathan Mine Surface Water Quality Measurements on August 17, 2011

Location	Time	pH	T (°C)	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 1	10:00	6.43	7.32	1	-2.9
Pit Clarifier	11:06	7.47	16.75	1,842	-60.2
PWTS Discharge Weir Box	10:53	7.14	15.70	1,963	-48.3
Leviathan Creek, Above CUD	11:58	7.20	19.28	1,564	-76.6
CUD	11:45	5.00	8.93	2,091	-15.5
Leviathan Creek, Below CUD	12:05	6.99	20.01	1,577	-71.8
Leviathan Creek, Above Delta Seep	12:25	6.50	18.67	1,575	-62.1
Delta Seep	12:15	5.63	10.29	1,234	-11.7
Leviathan Creek, Below Delta Seep	12:30	6.53	18.63	1,546	-67.5
Aspen Seep (influent weir box)	13:11	3.71	14.82	2,566	338.3
Leviathan Creek, Station 15	15:00	7.01	19.21	1,637	-77.1
Aspen Creek, Station 16	14:50	7.28	17.40	301	-69.6
Leviathan Creek, Station 17	14:43	7.14	18.79	1,219	-75.7
Leviathan Creek, Station 23	14:16	6.49	16.02	1,181	-26.4
Mountaineer Creek, Station 24	14:21	7.14	18.79	1,219	-75.7
Bryant Creek, Station 25	14:27	7.43	13.96	488	-72.1

Table 1 Notes:

°C Degree Celsius   ORP Oxidation-reduction potential   mV MilliVolt

µS/cm MicroSiemen per centimeter   SC Specific conductance

gpm Gallon per minute   T Temperature

Upcoming Events:

- Atlantic Richfield ERAs: Continue HDS and ASBR operations. Continue sludge dewatering at the ASBR.
- Burleson will coordinate future oversight activities with USACE and EPA. The next RA oversight visit is tentatively scheduled for late September.

Leviathan Mine Superfund Site

September 15, 2011

Burleson Consulting, Inc. ERA Oversight

Period of Oversight: 9:45 AM to 3:30 PM

Oversight Personnel: Jimmy Steele (Burleson)

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- Seasonal pond water treatment activities are complete. The Pond Water Treatment System (PWTS) at Pond 1 appeared to be winterized. URS personnel were not observed on-site.
- The Pit Clarifier was dry and a small volume of water was flowing through the Pit Clarifier wier box.

Atlantic Richfield Company (Atlantic Richfield):

- The HDS plant and associated capture systems, and the Aspen Seep bioreactor (ASBR) were operating.
- The ASBR sludge dewatering system was demobilized.
- AMEC personnel were conducting bioreactor enhancement sampling and analysis.
- AMEC personnel were testing valves and measuring flow rates in CUD and DS pump systems.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan and associated Creeks.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has declined from about 0.7 cfs to about 0.2 cfs since mid August. Also according to USGS, flows at Station 25 in Bryant Creek have declined from about 2.5 cfs to about 1.8 cfs since mid August. Flows at both stations show a diurnal pattern.

Regional Board

The seasonal pond water treatment activities are complete. The PWTS appeared to be winterized with valves covered in plastic, and enclosures in place over control panels. URS personnel were not observed on-site. Water was not visible in the Pit Clarifier and the surface of the solids is crossed by cracks. About four gallons per minute of water continues to drain through the Pit Clarifier weir box.

Diversion of water from Leviathan Creek at Station 1 has been stopped.

Atlantic Richfield ERAs

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were operating the HDS plant. The HDS plant and associated Channel Underdrain (CUD) and Delta Seep (DS) capture systems appeared to be operating normally. The diesel powered generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit. The floating dredge for removing Pond 4 sludge was operational. Storage bins for

Pond 4 sludge removal were in the process of being filled with Pond 4 sludge. AMEC personnel were conducting a routine inspection of CUD and DS conveyance lines. The inspection consisted of checking valves to identify scale build up and measuring collection pump flow rates.

Aspen Seep: The ASBR sludge dewatering centrifuge system was demobilized from the site. AMEC personnel were conducting enhancement sampling for analysis of water quality parameters and analytes including dissolved organic carbon (DOC), ethanol blend and ethanol dose rate. AMEC personnel were replacing the battery that serves the electrical conex trailer.

Burleson

On September 15, 2011 Burleson measured water quality in Leviathan Creek and associated creeks. Water quality readings are presented in Table 1.

Table 1. Leviathan Mine Surface Water Quality Measurements on September 15, 2011

Location	Time	pH	T (°C)	SC (μS/cm)	ORP (mV)
Leviathan Creek, Station 1	10:05	6.49	8.15	20	-31.7
PWTS Discharge Weir Box	10:26	6.60	12.74	1,782	-50.5
Leviathan Creek, Above CUD	11:08	6.61	12.23	1,669	-74.4
CUD	10:49	5.29	8.68	2,085	-42.9
Leviathan Creek, Below CUD	11:16	6.76	15.52	1,120	-79.2
Leviathan Creek, Above Delta Seep	11:40	6.69	13.62	1,082	-81.2
Delta Seep	11:30	5.51	10.21	1,319	-11.2
Leviathan Creek, Below Delta Seep	11:55	6.46	13.27	1,038	-79.4
Aspen Seep (influent weir box)	12:30	3.91	12.49	2,457	273.8
Leviathan Creek, Station 15	14:20	6.88	17.36	1,203	-97.9
Aspen Creek, Station 16	14:10	7.19	15.71	386	-102.3
Leviathan Creek, Station 17	14:00	7.05	16.80	757	-103.9
Leviathan Creek, Station 23	13:22	6.55	13.82	722	-70.8
Mountaineer Creek, Station 24	13:35	6.92	11.99	72	-76.0
Bryant Creek, Station 25	13:45	7.39	12.63	265	-104.7

Table 1 Notes:

°C Degree Celsius
μS/cm MicroSiemen per centimeter
gpm Gallon per minute
ORP Oxidation-reduction potential
SC Specific conductance
T Temperature
mV MilliVolt

Upcoming Events:

- Atlantic Richfield ERAs: Continue HDS and ASBR operations.
- Burleson will coordinate future oversight activities with USACE and EPA. The next ERA oversight visit is tentatively scheduled for early October.

Leviathan Mine Superfund Site
October 6, 2011
Burleson Consulting, Inc. Oversight

Period of Oversight: 10:30 AM to 2:00 PM
Oversight Personnel: Greg Reller (Burleson), Jimmy Steele (Burleson), Gary Riley (EPA)

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- No activities were observed.

Atlantic Richfield Company (Atlantic Richfield):

- The High Density Sludge (HDS) system appeared to be operating and treating water at Pond 4.
- Atlantic Richfield staff and contractors operated treatment systems at the site for half a work day due to inclement weather.

Burleson Consulting, Inc. (Burleson)

- Burleson visited Leviathan on a cold day which included snow. The NRCS Snotel precipitation data at Monitor Pass recorded rainfall of 1.0 inches on October 6, 2011.
- Burleson measured water quality in Leviathan and associated creeks.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has varied from about 0.2 cubic feet per second (cfs) to about 0.8 cfs since early September. Also according to USGS, flows at Station 25 in Bryant Creek varied from about 1.5 cfs to about 3.0 cfs since early September. Flows at both stations show a diurnal pattern. The maximum flows occurred during the recent precipitation and snow events on September 25 and October 5 through October 6.

Regional Board

Regional Board staff was not observed on-site.

Atlantic Richfield

Pond 4: AMEC personnel, under contract to Atlantic Richfield, were operating the HDS plant. The HDS plant and associated Channel Underdrain (CUD) and Delta Seep (DS) capture systems appeared to be operating normally. The diesel powered generators at the HDS plant were operating. Pumps at the DS mid-tank and HDS intake pumps were operating during the oversight visit. Pond 4 water level was low and may have been drained due to sludge removal.

AMEC personnel left the site early due to inclement weather as a precautionary safety measure.

Aspen Seep: The ASBR was not visited due to inclement weather and potentially unsafe road conditions associated with the snow.

Burleson

On October 6, 2011 Burleson measured water quality in Leviathan Creek and associated creeks. Water quality readings taken by Burleson are presented in Table 1.

Table 1. Leviathan Mine Surface Water Quality Measurements on October 6, 2011

Location	Time	pH	T (°C)[1]	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 1	12:50	7.54	2.58	48	-68.5
Leviathan Creek, Above CUD	11:45	6.36	6.43	1,735	-69.6
CUD	11:36	5.88	8.64	2,414	-87.8
Leviathan Creek, Below CUD	11:50	7.28	5.53	1,756	-70.2
Leviathan Creek, Above Delta Seep	12:03	7.57	5.41	1,810	-58.4
Delta Seep	11:58	5.83	8.14	1,510	-35.3
Leviathan Creek, Below Delta Seep	12:08	7.68	5.44	1,088	-63.6
Leviathan Creek, Station 15	11:14	6.76	7.09	1,437	-72.1
Leviathan Creek, Station 16	11:06	6.92	5.16	378	-77.7
Leviathan Creek, Station 17	11:00	6.86	6.08	840	-73.1
Leviathan Creek, Station 23	10:45	6.68	4.61	895	-62.9
Mountaineer Creek, Station 24	10:50	6.82	4.23	31	-56.9
Bryant Creek, Station 25	10:55	6.79	4.39	311	-54.1
Drain Outlet at Delta Seep	12:13	7.51	5.19	2,900	236.21

Notes:

°C Degree Celsius
µS/cm MicroSiemen per centimeter
gpm Gallon per minute
mV MilliVolt
ORP Oxidation-reduction potential
SC Specific conductance
T Temperature

Upcoming Events:

- Atlantic Richfield ERAs: Continue HDS and ASBR operations
- Burleson will coordinate future oversight activities with USACE and EPA. The next ERA oversight visits tentatively scheduled for early November.

Leviathan Mine Superfund Site
November 9, 2011
Burleson Consulting, Inc. Oversight

Period of Oversight: 10:30 AM to 3:30 PM
Oversight Personnel: Greg Reller (Burleson), Jimmy Steele (Burleson)

Summary of Site Activities:

California Regional Water Quality Control Board, Lahontan Region (Regional Board):

- No activities were observed.

Atlantic Richfield Company (Atlantic Richfield):

- The High Density Sludge (HDS) system was being winterized.

Burleson Consulting, Inc. (Burleson)

- Burleson measured water quality in Leviathan, associated creeks, and the beaver ponds.

Leviathan and Bryant Creek Flows: According to the USGS website (http://waterdata.usgs.gov/ca/nwis/current?type=flow), flow in Leviathan Creek at Station 15 has varied from about 0.1 cubic feet per second (cfs) to about 0.4 cfs since mid October. Also according to USGS, flows at Station 25 in Bryant Creek varied from about 1.5 cfs to about 3.0 cfs since mid October. Flows at both stations show a diurnal pattern. Flows from both stations have shown a recent increase in flow that is likely related to the return of CUD and Delta Seep flows.

Regional Board

Regional Board staff was not observed on-site.

The pond water treatment system was winterized, and the road around Pond 3 was cleaned off since sludge was removed from the pond.

Atlantic Richfield

HDS Operations: CUD and Delta Seep flows were returned to Leviathan Creek on November 2. LAS treatment at the HDS plant has stopped. Site personnel were performing winterization activities in preparation for demobilization.

Aspen Seep: The ASBR was not visited due to AMECs concerns for worker safety. The ASBR is designated as an exclusion zone and required the use of a self contained breathing apparatus (SCBA) due to concerns about H_2S detected at the manholes.

Burleson

Burleson personnel identified surface water controls implemented by AMEC in early November. Burleson identified two water bars installed on the Upper Road (from Pond 3 to Pond 4) that were designed to direct runoff from the road surface and to the southwest into a drainage ditch that conveys the flow to Leviathan Creek upstream from the CUD. Burleson also identified two water dips on the Crusher Road which were designed to direct surface water flows to the northeast, into a drainage ditch which conveys the flows through a culvert and into Leviathan Creek downstream from the Delta Seep. Burleson identified an access restriction at the entrance of Pond 3 from the Upper Road which was installed to minimize traffic on the berms around Pond 3.

Burleson personnel observed a tan precipitate existing along the creek bed of Leviathan Creek at locations below the CUD and upstream and downstream of the Delta Seep.

On November 9, 2011 Burleson measured water quality in Leviathan Creek, associated creeks, and the beaver ponds. Water quality readings taken by Burleson are presented in Table 1.

Table 1. Leviathan Mine Surface Water Quality Measurements on November 9, 2011

Location	Time	pH	T (°C)[1]	SC (µS/cm)	ORP (mV)
Leviathan Creek, Station 1	13:45	7.89	0.26	71	-59.1
Leviathan Creek, Above CUD	12:45	7.87	0.29	104	-65.1
CUD	12:40	4.46	8.75	2,661	-58.3
Leviathan Creek, Below CUD	12:48	5.15	3.10	1,133	-59.9
Leviathan Creek, Above Delta Seep	13:00	5.02	3.27	1,137	-52.3
Delta Seep	12:55	5.33	6.61	1,591	-60.0
Leviathan Creek, Below Delta Seep	13:05	5.47	3.61	1,238	-52.5
Leviathan Creek, Station 15	11:35	6.31	3.24	1,284	-48.1
Leviathan Creek, Station 16	11:30	8.13	0.12	483	-43.8
Leviathan Creek, Station 17	11:25	7.59	1.16	801	-44.4
Leviathan Creek, Station 23	11:00	7.58	0.14	871	-43.8
Mountaineer Creek, Station 24	11:05	8.12	0.13	81	-43.1
Bryant Creek, Station 25	11:10	7.99	0.17	291	-43.4
Beaver Pond "Lower" Dam	11:50	5.74	3.45	1,271	-50.4
Beaver Pond Main Dam	11:55	5.64	3.73	1,338	-51.1
Beaver Pond "Upper" Dam	12:00	5.56	1.26	1,200	-49.1
Aspen Creek above entrance road	14:58	8.29	2.01	401	-71.3

Notes:

°C	Degree Celsius	ORP	Oxidation-reduction potential
µS/cm	MicroSiemen per centimeter	SC	Specific conductance
mV	MilliVolt	T	Temperature

Upcoming Events:

- Atlantic Richfield ERAs: Continue HDS winterization and demobilize from the site by November 18.
- Burleson will coordinate future oversight activities with USACE and EPA. The next ERA oversight visit is tentatively scheduled for April 2012.

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

(21 Pages)

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-1	View of Pond 4 before the 2011 treatment season. Note ice/snow covering Pond 4. View to northwest. April 13, 2011	
B-2	View of Pond 4 before the 2011 treatment season. View to southwest. May 27, 2010	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-3	View of HDS at Pond 4. Note orange sludge rim around pond. View to Northwest. June 3, 2011	
B-4	Pond 4 before sludge removal started. June 3, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-5	Floating Dredge before use to remove sludge at Pond 4. View to Northwest. July 13, 2011	
B-6	Floating dredge operating at Pond 4. View to Northwest. Note red tank, this was used to store captured CUD and DS flows prior to treatment during sludge removal. September 15, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-7	Dredge after use to remove sludge at Pond 4. September 29, 2011	
B-8	Pond 4 after sludge removal. View to north. October 19, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-9	View of Pond 4 and winterized HDS plant. View to Northwest. November 9, 2011	
B-10	Water bars along the Upper Road. November 9, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-11	Water Dip across the Crusher Road. November 9, 2011	
B-12	Aspen Seep Bioreactor overview. View to Northwest. June 3, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-13	Aspen Seep Bioreactor Settling Pond. Note black sludge in middle-left. View to West. June 3, 2011	
B-14	Aspen Seep Bioreactor infiltration pond. View to North. June 3, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-15	Aspen Seep Bioreactor sludge dewatering equipment. View to Northeast. July 13, 2011	
B-16	Aspen Seep Bioreactor settling pond prepared for sludge removal. August 18, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-17	RCTS at Pond 3. View to West April 13, 2011	
B-18	Pond 1 water source (middle left) during spring season treatment. View to Northeast. April 13, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-19	Rotating Cylinder Treatment System at Pond 3 during spring season treatment. View to West. April 13, 2011	
B-20	Pond 3 after spring season treatment was completed. View to West. June 29, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-21	Pond water treatment system during mobilization. View to Northeast. June 29, 2011	
B-22	Sludge Removal at the Pit Clarifier before start of Pond water treatment June 29, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-23	First discharge of effluent to the Pit Clarifier. View to West. July 13, 2011	
B-24	Pit Clarifier with piccolo drain in foreground. View to West. August 18, 2011	

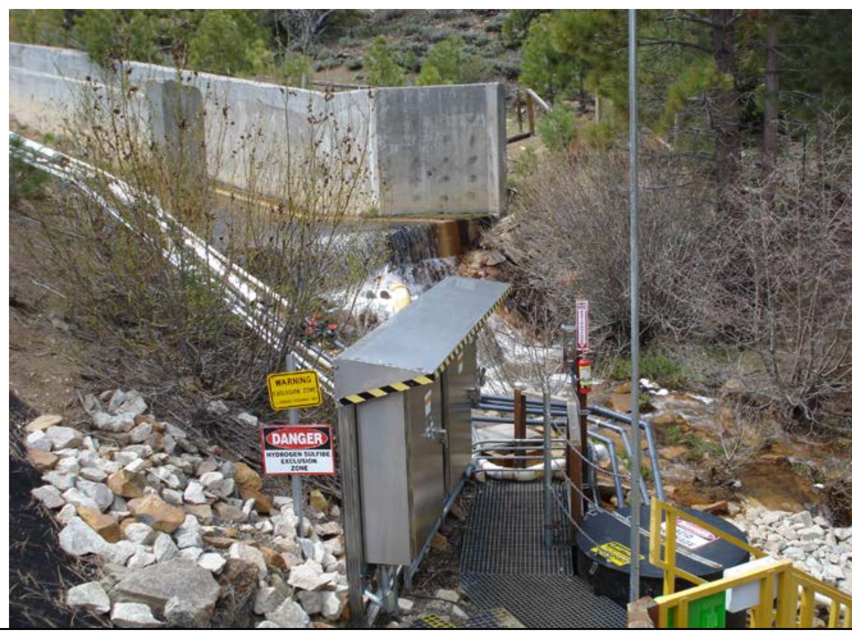
Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-25	Pit Clarifier after pond water treatment completion. View to Southwest. September 15, 2011	
B-26	Winterized pond water treatment system. View to northwest. November 9, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-27	New pavement on Upper Road and repaired culvert at entrance to Pond 3. View to southeast. August 17, 2011	
B-28	New pavement and concrete V-ditch along entrance road above (to southeast of) Pond 1. View to North. August 17, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-29	Station 1 at Leviathan Creek. View to West. June 3, 2011	
B-30	End of Leviathan Creek concrete channel at Channel Underdrain. View to South. June 3, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-31	Delta Seep collection tank at Leviathan Creek. View to southeast. September 15, 2011	
B-32	Aspen Seep Weir Box. View to Northeast. June 3, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-33	Station 15 at Leviathan Creek. View to Southeast. April 13, 2011	
B-34	Confluence of Leviathan Creek (foreground) with Mountaineer Creek. View to East. April 13, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-35	Lower Beaver Dam. View to South. April 13, 2011	
B-36	Lower Beaver Dam. View to South. June 29, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-37	Main Beaver Dam. View to West. April 13, 2011	
B-38	Main Beaver Dam. View to West. June 29, 2011	

Appendix B
Leviathan 2011 Oversight Summary Report
Oversight Photographs

Photo Number	Photo Description	Photo
B-39	Main Beaver Dam. View to Southwest. November 9, 2011	

Appendix C
Leviathan 2011 Oversight Summary Report
Field Instrument Measurement Records

(16 Pages)

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration: Greg Reller		Date: 13 APRIL 11
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	8269 / 8-26-11
(2) pH meter	pH = 4.00	7979 / 5-18-11
(3) pH meter	pH = 10.00	8035 / 6-1-4
(4) pH meter	pH = 6.89	
(5) Specific conductance meter	______ µS/cm	
(6) Specific conductance meter	______ µS/cm	
(7)		
(8)		
(9)		
(10)		
(11)		

Instrument Calibration Data

Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
10:15	4.01	4.89	4.00	13.35				
	7.01	6.57	7.00					
10:21	10	9.63	10.10	14.40				

Review

Greg J Reller — On-Site Health and Safety Officer — Date: 13 APR 11

Greg J Reller — Site Manager/Project Manager — Date: 13 APR 11

Action

04/12/11 10:13 AM

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 13 APRIL 11 **Weather Conditions:** COLD - P.C. - BREEZY **Personnel:** GJR/KM/DC/K. MAAS

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
STA-15	10:29	6.69	2.79	256	24.3	
N-MST RD. BASE OF PINE TREES	10:46	7.06	2.94	247	-23.2	LEV TRIB FLOWS INTO POND AT W. ABUTT.
W. ABUTT MAIN DAM	10:52	6.97	3.04	254	-33.5	
W. ABUTT. DAM IN GAP	10:55	6.91	3.21	255	-29.2	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration: Jimmy Steele		Date: 6-3-11
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	3/15/2012 / # 8763
(2) pH meter	pH = 4.00	# 8712 / 2-18-2012
(3) pH meter	pH = 10.00	# 8035 / 6-1-2011
(4) Specific conductance meter	________ µS/cm	
(5) Specific conductance meter	________ µS/cm	
(6) Oxidation reduction potential meter	________ mV	
(7) DO meter		
(8)		
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	9:48	pH = 7.00	7.45	7.05					
2		pH = 4.00	4.42	4.00					
3		pH = 10.00							
4	9:50	Hanna HI = 9828	pH = 6.96						Calibrate
5			SC = 4959						Calibrate
6	14:34	pH = 7.00	7.09						
7									
8									
9									
10									
11									

Review

________________________ __________

On-Site Health and Safety Officer Date

________________________ __________

Site Manager/Project Manager Date

Action

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 6-3-11 **Weather Conditions:** Overcast, Hazy **Personnel:** JS & GR

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	9:55	7.38	3.89	24	26.4	
Pit Clarifier						NO FLOW } PWTS NOT OPERATING
PWTS Discharge Weir Box						NO FLOW
Leviathan Creek upstream from the CUD	10:58	6.95	4.39	852	234.2	
CUD	10:50	4.94	8.57	3105	221.5	
Leviathan Creek downstream from the CUD	11:04	6.16	6.04	~~154~~ 229	234.4	
Leviathan Creek upstream from Delta Seep	11:18	6.35	6.13	234	227.9	
Leviathan Creek downstream from Delta Seep	11:22	6.54	6.22	246	218.4	
Delta Seep (collection tank)	11:13	5.09	8.27	1757	220.3	
Aspen Seep (influent weir box)	12:00	4.39	9.60	2484	317.3	Check pH probe & calibrate
Aspen Bioreactor Settling Pond	12:15	6.76	11.07	2,906	209.4	Eh looks high
Leviathan Creek, Station 15	14:20	7.45	8.52	247	-62.6	
Aspen Creek, Station 16	14:12	7.74	10.58	498	-72.9	
Leviathan Creek, Station 17	14:05	7.67	8.67	303	-72.2	
Leviathan Creek, Station 23	13:40	7.22	8.09	265	-40.8	
Mountaineer Creek, Station 24	13:47	7.79	7.96	74	-73.4	
Bryant Creek, Station 25	13:53	7.79	8.08	214	-75.9	
PWTS Pond 1	10:17	4.23	11.90	4137	400.6	
Pond 3	10:25	6.46	8.71	1693	214.8	in the mud (pH probe)
D. Stoll Storm Drain Outlet		4.44	5.98	2,904	307.5	- Standing water at outlet pipe
Aspen Seep (weir box)	12:43	3.25	10.39	2645	341.5	
Infiltration Lagoon	13:04	7.26	13.36	2832	-37.2	
Bottom AS oxidation channel	13:10	7.58	11.96	2084	-210.3	ORP was still dropping

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 29 JUN 11 Weather Conditions: CLOUDY, RAIN Personnel: GJR, GARZ RILEY

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	13:55	6.98	10.32	36	-40.9	STAFF GAGE 4.03
Pit Clarifier						No Flow
PWTS Discharge Weir Box						
Leviathan Creek upstream from the CUD	1420	7.01	13.24	1287	-81.3	
CUD	14:15	4.22	8.62	2997	-35.8	
Leviathan Creek downstream from the CUD	14:25	6.74	12.73	422	-71.3	
Leviathan Creek upstream from Delta Seep	14:44	6.62	12.64	462	-106.2	
Leviathan Creek downstream from Delta Seep	14.47	6.45	12.63	474	-101.2	
Delta Seep (collection tank)	1431	4.20	9.16	1819	154.3	
Aspen Seep (influent weir box)						
Aspen Bioreactor Settling Pond						
Leviathan Creek, Station 15	1540	6.99	12.71	378	-80.6	
Aspen Creek, Station 16	1548	7.34	14.84	388	-83.2	
Leviathan Creek, Station 17	1555	6.80	13.26	396	-60.9	
Leviathan Creek, Station 23		6.74	9.47	440	-18.3	7.14 - STAFF GA.
Mountaineer Creek, Station 24	1045	7.05	4.92	41	-27.8	
Bryant Creek, Station 25	1050	7.54	9.28	291	-65.4	4.22 STAFF GAGE
N-DAM	1520	6.86	12.53	387	-71.9	U.S FROM INFLOW OF TRIB THAT IS USUALLY DRY
MAIN BEAVER DAM	1527	6.49	11.57	372	-57.6	
LOWER DAM	1532	6.90	12.41	377	-80.9	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of
Employee Performing Calibration: GREG RELLER		Date: 29 JUNE 11
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	
(2) pH meter	pH = 4.00	
(3) pH meter	pH = 10.00	
(4) pH meter	pH = 6.89	HI 9828-0 L072321 EXP 4-20-15
(5) Specific conductance meter	__________ μS/cm	
(6) Specific conductance meter	__________ μS/cm	
(7)		
(8)		
(9)		
(10)		
(11)		

Instrument Calibration Data

Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
10:17	6.89	7.47	6.87	13.04				
16:00	6.89	6.41						4324 μS

Review

____________________________ ____________

On-Site Health and Safety Officer Date

____________________________ ____________

Site Manager/Project Manager Date

Action

06/28/11 02:29 PM

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration: Jimmy Steele		Date: 7-13-11
Instruments: Hanna HI 9828	Standards:	Lot Number and Expiration Date:
(1) pH meter	pH = 7.00	
(2) pH meter	pH = 4.00	
(3) pH meter	pH = 10.00	
(4) Specific conductance meter	________ µS/cm	
(5) Specific conductance meter	________ µS/cm	
(6) Oxidation reduction potential meter	________ mV	
(7) DO meter		
(8) Quick Cal	pH=6.80 / SC≈5,000	Lot #2321 Exp-04-2015
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	10:10	Quick Cal	pH=6.81 SC=4613	pH=6.85 SC=5,005					
2	12:34	pH=4.00	pH=4.02						pH Check
3	15:03	pH=7.00	pH=6.61						pH check
4									
5									
6									
7									
8									
9									
10									
11									

Review

_______________________________ Date ________
On-Site Health and Safety Officer

_______________________________ Date ________
Site Manager/Project Manager

Action

08/04/09 11:07 AM

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 7-13-11 **Weather Conditions:** Sunny, DH, clear **Personnel:** Jimmy Steele / Greg Keller

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	10:20	6.46	7.88	36	-18.9	pH 7.1 @ 2nd time
Pit Clarifier						
PWTS Discharge Weir Box						
Leviathan Creek upstream from the ~~CUD~~ Delta Seep	11:55 ~~11:45~~	6.58 ~~6.38~~	15.33 ~~10.32~~	817	86.6	
CUD	11:15	5.03	8.66	3025	25.9	
Leviathan Creek downstream from the CUD	11:35	6.89	15.72	782	-72.9	
Leviathan Creek upstream from ~~Delta Seep~~ CUD	11:30	7.04	13.18	1953	-67.7	upstream of CUD
Leviathan Creek downstream from Delta Seep	12:01	6.62	15.41	828	-85.1	
Delta Seep (collection tank)	11:43	5.30	10.32	1841	62.9	
Aspen Seep (influent weir box)	12:50	3.66	15.74	2756	324.3	
Aspen Bioreactor Settling Pond	13:15	6.98	19.20	3447	-50.3	eh Declining
Leviathan Creek, Station 15	14:57	7.02	18.19	639	-161.4	
Aspen Creek, Station 16	14:45	7.65	18.39	530	-116.4	
Leviathan Creek, Station 17	14:39	7.41	18.90	648	-115.4	
Leviathan Creek, Station 23	14:11	6.99	16.97	422	-88.3	
Mountaineer Creek, Station 24	14:15	7.00	14.01	80	-84.9	
Bryant Creek, Station 25	14:25	7.22	15.28	308	-95.6	
Black Lagoon	13:23	7.19	25.29	3047	-515.8	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration:		Date: 8-15-11 / 8-17-11
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	Lot # 8763 Exp - 3/15/12
(2) pH meter	pH = 4.00	
(3) pH meter	pH = 10.00	
(4) Specific conductance meter	________µS/cm	
(5) Specific conductance meter	________µS/cm	
(6) Oxidation reduction potential meter	________mV	
(7) DO meter		
(8) Hanna Auto Cal HI 9828-0	pH = 6.89 / SC ≈ 5,000	Lot# 2321 Exp - 04/2015
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	15:57	HI 9828-0	pH = 6.49 SC = 6609	pH = 6.86 SC = 5,015	22.83		Quick CAL		8-15-11
2	9:47	HI 9828-0	pH = 6.88 SC = 4785		21.06		Check		8-17-11
3	12:56	HI 9828-0	pH = 6.82 SC = 3980	pH = 6.85 SC = 5049	27.07		Quick CAL		8-17-11
4	15:09	pH = 7.00	pH = 7.01				check		
5									
6									
7									
8									
9									
10									
11									

Review

________________________ On-Site Health and Safety Officer ________ Date

________________________ Site Manager/Project Manager ________ Date

Action

08/04/09 11:07 AM

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 8-17-11 **Weather Conditions:** clear, sunny **Personnel:** Jimmy Steele, Greg Reller, Gary Riley

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	10:00	6.43	7.32	1	-2.9	
Pit Clarifier	11:06	7.47	14.75	1842	-60.2	
PWTS Discharge Weir Box	10:53	7.14	15.70	1963	-48.3	
Leviathan Creek upstream from the CUD	11:58	7.20	19.28	1564	-76.6	
CUD	11:45	5.00	8.93	2091	-15.5	
Leviathan Creek downstream from the CUD	12:05	6.99	20.01	1577	-71.6	
Leviathan Creek upstream from Delta Seep	12:25	6.50	18.67	1575	-62.1	
Leviathan Creek downstream from Delta Seep	12:30	6.53	18.63	1546	-67.5	
Delta Seep (collection tank)	12:15	5.63	10.29	1234	-11.7	
Aspen Seep (influent weir box)	13:11	3.71	14.82	2566	338.3	
Aspen Bioreactor Settling Pond						No water in pond 4, conducting sludge removal
Leviathan Creek, Station 15	15:00	7.01	19.21	1637	-77.1	
Aspen Creek, Station 16	14:50	7.28	17.70	301	-69.6	
Leviathan Creek, Station 17	14:43	7.19	18.79	1219	-75.7	
Leviathan Creek, Station 23	14:14	6.49	16.02	1181	-26.4	
Mountaineer Creek, Station 24	14:21	7.14	12.77	64	-41.7	
Bryant Creek, Station 25	14:27	7.43	13.96	488	-72.1	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration: Jimmy Steele		Date: 9-15-11
Instruments: Hanna HI 9828	Standards:	Lot Number and Expiration Date:
(1) pH meter	pH = 7.00	Lot # 8763 EXP - 03-15-2012
(2) pH meter	pH = 4.00	
(3) pH meter	pH = 10.00	
(4) Specific conductance meter	________ µS/cm	
(5) Specific conductance meter	________ µS/cm	
(6) Oxidation reduction potential meter	________ mV	
(7) DO meter		
(8) HI 9828-0 Quick Cal Solution	pH = 6.89 SC ≈ 5,000	Lot # 2321 Exp-04/2015
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	10:00	HI 9828-0	pH = 6.99 SC = 6028	pH = 6.89 SC = 5037					
2	12:15	"		pH = 6.89 SC = 5,000					Quick Cal
3	14:25	pH = 7.00	6.82						
4									
5									
6									
7									
8									
9									
10									
11									

Review

____________________ Date ________
On-Site Health and Safety Officer

____________________ Date ________
Site Manager/Project Manager

Action

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 9-15-11 **Weather Conditions:** clear, sunny **Personnel:** [illegible] Steele, Greg Keller

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	10:05	6.49	8.15	20	-31.7	
Pit Clarifier						DRY
PWTS Discharge Weir Box	10:26	6.60	12.74	1782	-50.5	
Leviathan Creek upstream from the CUD	11:09	6.61	12.23	1669	-74.4	
CUD	10:49	5.29	8.68	2085	-42.9	
Leviathan Creek downstream from the CUD	11:16	6.76	15.52	1120	-79.2	
Leviathan Creek upstream from Delta Seep	11:40	6.69	13.42	1082	-81.2	
Leviathan Creek downstream from Delta Seep	11:55	6.46	13.27	103.8	-79.4	
Delta Seep (collection tank)	11:30	5.51	10.21	1319	-11.2	
Aspen Seep (influent weir box)	12:30	3.91	12.99	2457	273.8	
Aspen Bioreactor Settling Pond	12:46	6.53	15.20	2659	-299.2	
Leviathan Creek, Station 15	14:20	4.88	17.36	1203	-97.9	
Aspen Creek, Station 16	14:10	7.19	15.71	386	-102.3	
Leviathan Creek, Station 17	14:00	7.05	16.80	757	-103.9	
Leviathan Creek, Station 23	13:22	6.55	13.82	722	-70.8	
Mountaineer Creek, Station 24	13:35	6.92	11.99	72	-78.0	
Bryant Creek, Station 25	13:45	7.39	12.63	265	-104.7	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration:		Date: 10-6-2011
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	
(2) pH meter	pH = 4.00	Lot # 8933 Exp 05-09-2012
(3) pH meter	pH = 10.00	
(4) Specific conductance meter	______ µS/cm	
(5) Specific conductance meter	______ µS/cm	
(6) Oxidation reduction potential meter	______ mV	
(7) DO meter		
(8) HI 9828 - 0	pH = 6.89 SC = 5000 µS/cm	Lot 3099 Exp = 03/2016
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	10:40	HI9828-0		pH = 6.75 SC = 5001					Quick CAL
2	13:10	pH = 4.00	pH = 4.76	~~pH = 4.76~~					pH check
3									
4									
5									
6									
7									
8									
9									
10									
11									

Review

On-Site Health and Safety Officer ______________________ Date __________

Site Manager/Project Manager ______________________ Date __________

Action

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 12-6-11 **Weather Conditions:** Overcast, cold, snowy **Personnel:** JS, GR, Gary Riley

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	12:58	7.84	2.50	48	-68.5	
Pit Clarifier						
PWTS Discharge Weir Box						
Leviathan Creek upstream from the CUD	11:45	6.34	6.43	1735	-69.6	
CUD	11:36	5.80	8.64	2414	-87.8	
Leviathan Creek downstream from the CUD	11:50	~~5.33~~ 7.20	5.53	1756	-70.2	
Leviathan Creek upstream from Delta Seep	12:03	7.57	5.41	1810	-58.4	
Leviathan Creek downstream from Delta Seep	12:08	7.68	5.44	1068	-63.4	
Delta Seep (collection tank)	11:58	5.83	9.14	1510	-35.3	
Aspen Seep (influent weir box)						
Aspen Bioreactor Settling Pond						
Leviathan Creek, Station 15	11:14	6.76	7.09	1437	-72.1	
Aspen Creek, Station 16	11:06	6.92	8.16	378	-77.7	
Leviathan Creek, Station 17	11:00	6.86	6.08	840	-73.1	
Leviathan Creek, Station 23	10:45	6.68	4.41	895	-62.9	
Mountaineer Creek, Station 24	10:50	6.92	4.23	31	-56.9	
Bryant Creek, Station 25	10:58	4.79	4.39	311	-54.1	
D1 at DS	12:13	7.51	5.19	2900	236.2	

FIELD INSTRUMENT CALIBRATION RECORD

Leviathan Mine

Calibration Code:		Sheet 1 of 1
Employee Performing Calibration: Jimmy Steele		Date: 11-9-11
Instruments:	**Standards:**	**Lot Number and Expiration Date:**
(1) pH meter	pH = 7.00	Lot # 8713 Exp 02-18-2012
(2) pH meter	pH = 4.00	Lot # 8712 Exp 02-18-2012
(3) pH meter	pH = 10.00	Lot Exp 01-07-2012
(4) Specific conductance meter	1413 µS/cm	Lot # 6597 Exp 01-06-2012
(5) Specific conductance meter	____ µS/cm	
(6) Oxidation reduction potential meter	____ mV	
(7) DO meter		
(8) Calibration Solution HI 9828-0	pH ≈ 6.89 SC ≈ 5,000	Lot # 3099 Exp 03/2016
(9)		
(10)		
(11)		

Instrument Calibration Data

Inst. No.	Time	Standard Solution	Response As Found	Response As Left	Solution Temp. (C)	Zero	Battery Check	Alarm Point	Notes
1	10:40	HI9828-0	pH = 6.81 SC = 4700	→					Quick Cal
2	10:45	pH 4.00	pH = 3.62						
3	10:47	pH 7.00	pH = 6.66	7.08					3-point Cal
4		pH = 4.00	4.48	4.01					
5		pH = 10.00		10.18					
6		pH = 7.00	~~7.09~~						pH = 7.04
7	10:55	SC = 1413 µS/cm	1120	1433					
8	15:06	pH = 7.00	pH = 7.04						pH check
9									
10									
11									

Review		*Action*
On-Site Health and Safety Officer ______	Date ______	
Site Manager/Project Manager ______	Date ______	

LEVIATHAN MINE
WATER QUALITY MONITORING

Date: 11-9-11 **Weather Conditions:** Clear, cold **Personnel:** JS & GR

Location	Time	pH	Temperature (C)	Specific Cond. (µS/cm)	Eh (mV)	Comments
Leviathan Creek, Station 1	13:45	7.89	0.26	71	-59.1	
Pit Clarifier						
PWTS Discharge Weir Box						
Leviathan Creek upstream from the CUD	12:45	7.87	0.29	104	-65.1	
CUD	12:40	4.46	8.75	2661	-58.3	
Leviathan Creek downstream from the CUD	12:48	5.15	3.10	1133	-59.9	
Leviathan Creek upstream from Delta Seep	13:00	5.02	3.27	1137	-52.3	
Leviathan Creek downstream from Delta Seep	13:05	5.47	3.41	1238	-52.5	
Delta Seep (collection tank)	12:55	5.33	6.41	1391	-60	
Aspen Seep (influent weir box)						
Aspen Bioreactor Settling Pond						
Leviathan Creek, Station 15	11:35	6.31	3.24	1284	-48.1	
Aspen Creek, Station 16	11:30	8.13	0.12	4823	-43.8	
Leviathan Creek, Station 17	11:25	7.59	1.16	901	-44.4	
Leviathan Creek, Station 23	11:00	7.98	0.14	871	-43.8	measured from water flowing under ice
Mountaineer Creek, Station 24	11:05	8.12	0.13	81	-43.1	
Bryant Creek, Station 25	11:10	7.99	0.17	291	-43.4	
Beaver Pond "Lower" Dam	11:50	5.74	3.45	1271	-50.4	
Beaver Pond Main Dam	11:55	5.64	3.73	1338	-51.1	
Beaver Pond upper Dam	12:00	5.56	1.26	1200	-49.1	
Aspen Creek above road	14:58	8.29	2.01	401	-71.3	