ANACONDA EVAPORATION PONDS REMOVAL ACTION CHARACTERIZATION DATA SUMMARY REPORT REVISION I

YERINGTON MINE SITE

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LIST OF ACRONYMS AND ABREVIATIONS

AOC	Administrative Order of Consent
ARC	Atlantic Richfield Company
ASTM	American Society of Testing and Materials
BLM	Bureau of Land Management
COC	Chain of Custody
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DSR	Data Summary Report
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ESI	Environmental Standards, Inc.
FEP	Finger Evaporation Pond
FSAP	Field Sampling and Analysis Plan
FSS	Final Status Survey
GPS	Global Positioning System
LEP	Lined Evaporation Pond
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
MWMP	Meteoric Water Mobility Procedure
NDEP	Nevada Division of Environmental Protection
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PETG	Polyethylene Terepthalate Glycol
PRG	Preliminary Remediation Guideline
QAPP	Quality Assurance Project Plan
RAC	Removal Action Characterization
RI/FS	Remedial Investigation / Feasibility Study
RSL	Regional Screening Levels
SCS	Soil Conservation Service
SEM	Sierra Environmental Monitoring Laboratory, Inc.
SLV	Screening Level Value
SOW	Scope of Work
SPLP	Synthetic Precipitation Leaching Procedure
SWCC	Soil Water Characteristic Curve
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
UEP	Unlined Evaporation Pond
VLT	Vat Leach Tails
VSP	Visual Sample Plan

ac ft/yr	acre-feet per year
bgs	below ground surface
bcy	bank cubic yards
cm	centimeters
cm/sec	centimeters per second
ft	foot
g	gram
g/cc	gram/cubic centimeter
g/l	grams per liter
gpm	gallons per minute
kg	kilogram
KPa	kilopascals
L	liter
mg	milligram
ml	milliliter
mm	millimeter
m/s	meter per second
m/yr	meters per year
^{o}C	degrees Centigrade
pCi	picoCurie
s.u.	standard units
µg	microgram
ug/L	microgram liter
µR	micro Roentgen
µR/hr	micro Roentgens per hour
µS	microSiemen

EXECUTIVE SUMMARY

The Atlantic Richfield Company (ARC) has prepared this Anaconda Evaporation Ponds Removal Action Characterization Data Summary Report (RAC DSR) pursuant to the Anaconda Evaporation Ponds Removal Action Characterization Work Plan (RAC Work Plan), which was approved for implementation by the U.S. Environmental Protection Agency – Region 9 (EPA) and implemented in October 2008. The RAC Work Plan was developed to assist in decision-making regarding the removal action for the inactive Anaconda evaporation ponds (Ponds) to be performed pursuant to an Administrative Order on Consent and Scope of Work (AOC/SOW). In addition to supporting the removal action, these activities will also support a future Remedial Investigation and Feasibility Study (RI/FS) of the Evaporation Ponds/Sulfide Tailings Operable Unit 4 (OU-4) under the Administrative Order for the Anaconda/Yerington Mine Site (Site) issued by EPA to ARC in January 2007. The following activities were performed:

- Drilling of 17 boreholes, using direct push Geoprobe and hollow-stem auger drilling methods, for the collection and laboratory analysis of shallow and deep vadose zone soil samples and groundwater grab samples;
- Collection of 16 groundwater grab samples for laboratory analysis from hydropunch or temporary well screen using a hand bailer;
- Collection of soil samples from each of the 17 boreholes for geochemical analysis from shallow soils beneath overlying pond sediments and from deep soils immediately above the groundwater table;
- Collection of soil samples from 8 of the 17 boreholes for geotechnical soil characterization from shallow and deep intervals within the vadose zone;
- Collection of shallow soil samples from 8 of the 17 boreholes for leachate testing using the Meteoric Water Mobility Leaching Procedure (MWMP) to determine the potential for metals and contaminants to leach from the underlying soils;
- Collection of pond sediment, vat leach tailings (VLT, where present) and shallow sub-surface soil samples beneath the pond sediments from 43 locations using a hand coring system and geochemical analysis of those materials; and
- Completion of a 100 percent-coverage, MARSSIM level gamma radiological survey on the surface of the finger evaporation ponds (FEPs including the Thumb Pond), the lined evaporation pond (LEP) and the unlined evaporation pond (UEP).

Evaporation Pond Sediments

Pond sediment thickness varies depending on the age and use of the pond. The ‘younger’ ponds, such as the lined evaporation pond (LEP) and the four finger ponds (FEPs 1-4), contain relatively uniform and thin accumulations of sediments that average approximately 0.40 feet thick, with a maximum thickness of 1.0 feet. The unlined evaporation pond (UEP) is an ‘older’ pond with an average thickness of 1.8 feet and a range from 0.5 to 6 feet. The area of greatest thickness is in the semi-detached small pond area at the southern tip of the UEP. Variations in UEP sediment thickness appear to have resulted in part from wind erosion and re-deposition. The Thumb Pond (FEP-5) has an average sediment thickness of about 4.2 feet and exhibits the greatest variability in sediment thickness, with a range from 0.1 to 11.5 feet. The area of thickest sediments is along the southeastern side of the Thumb Pond and, in general, the sediments become thinner toward the west (i.e., upslope) side of the pond which was constructed on a gently sloping foundation.

Analytical Results

Analytical results for VLT are consistent for homogeneous spent ore materials (e.g., elevated copper concentrations). Some geochemical variability was observed for Pond sediments sampled from the different Ponds, most notably a difference between the red sediments collected from the Thumb Pond in relation to the yellow sediments found in the other Ponds. In addition, two samples were collected in the UEP from a deep layer of red sediments that were similar to sediments in the Thumb Pond. The red sediments, found primarily in the Thumb Pond, consistently demonstrate higher concentrations of the following analytes compared to the yellow sediments found in the other Ponds: antimony, arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, thallium, thorium, uranium, zinc, and radium-226 and -228. For most of the metals, concentrations in the red sediments are 2 to 50 times higher that those found in the yellow sediments, with concentrations of the following metals at least 10 times greater in the red sediments than in the yellow sediments: antimony, arsenic, barium, chromium, lead, mercury, nickel, selenium, uranium, and zinc. In contrast, the red sediments exhibit consistently lower concentrations for salt components (calcium, magnesium, potassium and sodium).

As described in Section 3.3 and graphically illustrated in Appendix E-2 of this RAC DSR, the comparison of pond sediment and underlying shallow soil chemistry indicates that pond sediments generally have: 1) higher concentrations of copper, selenium, thorium, and uranium compared to underlying shallow soils; and 2) lower concentrations of zinc relative to underlying shallow soils. Concentrations of arsenic in the FEP and UEP sediments are generally similar to concentrations in the underlying soils, while arsenic concentrations in the LEP sediments are generally lower than in the underlying soils. Concentrations of manganese, magnesium and molybdenum in pond sediments and underlying soils do not exhibit any clear trends, as illustrated in Appendix E-2.

Leach testing of shallow soils underlying the Pond areas, using the MWMP, indicate the following results:

- Arsenic was detected in only two of the eight leachate samples from soils underlying the UEP and the Thumb Pond.
- Chromium was detected in five of the eight leachate samples.
- Copper was detected in all leachate samples, with the highest value from the soil sample beneath the northern portion of the 'wet area' of the LEP.
- Iron was detected in six of the eight leachate samples, with the highest values from soil samples below the northern portion of the 'wet area' of the LEP and FEP-4.

- Manganese was detected in all leachate samples with the highest values beneath the northern and southern portions of the LEP 'wet' area.
- Nickel was detected in all leachate samples with the highest values beneath the northern portion of the LEP 'wet' area and FEP-4.
- Uranium was detected at concentrations that exceeded the MCL in all samples with the highest concentrations under the northern portion of the LEP 'wet' area, the northwest portion of the UEP, and FEP-4.
- Combined radium-226/228 exceeded the MCL in the soil samples from beneath FEP-4.

Analytical results for groundwater grab samples (not directly correlative to nearby monitor well geochemical data that are sampled using low-flow methods, with the exception of sulfate) generally indicate that the highest concentrations of chemicals in groundwater occur beneath the north-central portion of the UEP. The following analytes generally or locally exceed maximum contaminant levels (MCLs) or drinking water standards (primary or secondary) beneath the northwestern portion of the UEP and, in some cases, beneath the adjacent Thumb Pond: sulfate, arsenic, cadmium, copper, iron, selenium, uranium, and radium-226/-228.

Radiometric Survey Results

The majority of the Ponds did not exhibit significant gamma levels (i.e., are less than 50 μR/hr) with the exception of the northwestern corner of the UEP, which exhibited areas with gamma dose rates up to approximately 250 μR/hr. Broader areas extending out toward the center of the UEP have dose rates ranging from 50 to 100 μR/hr, with limited areas between 100 to 150 μR/hr. The Thumb Pond, which has previously been capped, exhibited elevated gamma radiation levels in locations where the VLT cap had been eroded and/or originally placed as a thin layer.

ARC anticipates that a one-foot thick cap would result in an eight-fold reduction in the gamma levels (e.g., a one-foot thick cap would reduce the maximum measured dose rate, 240 μR/hr, to approximately 30 μR/hr). The radiological survey, intended to support the removal action for the Ponds, will also support future radiological characterization activities in accordance with MARSSIM requirements for the Final Status Survey (FSS) of the Ponds.

Geotechnical Results and Vadose Zone Modeling

Geotechnical samples were submitted for the analysis of the following unsaturated hydraulic properties: grains size; in-situ moisture content; bulk density; saturated hydraulic conductivity (Ksat); Atterberg limits; soil suction versus moisture content relationships; and soil water characteristic curves. Additional samples of Pond sediments were submitted for grain size analysis, bulk density measurements, and Ksat measurements. These hydraulic properties, and climate data, were input into the vadose zone models for the soils underlying the Ponds.

Atmospheric input data for the model simulations included precipitation, potential evaporation, monthly average relative humidity and temperature obtained through the Western Regional Climate Center. A 35-year record was initially chosen for the simulations. Because simulation times for this period were excessive and soil water flux characteristics within the soil column stabilized in a shorter time frame (0 to 5 years), a shorter (but still representative) climate record was used for the simulations. The 15-year period includes the range of average annual precipitation rates expected at the Site.

The variably-saturated modeling code SVFlux™ was used to perform the vadose zone model simulations for the soil profiles underlying the Ponds. Lateral boundary conditions in the model were designated as no-flow boundaries. Each of the five profile models (FEPs, Thumb Pond, UEP, LEP 'wet' and LEP 'dry') was assigned an upper boundary that represented (and simulated) atmospheric conditions and a lower boundary that consisted of either a gradient boundary (FEPs) or the water table (remaining profiles).

The comparison of observed and simulated saturation percentages in the vadose zone model profiles indicates that the simulations achieved the 'reasonable agreement' target of within 30 percent (all results yielded comparison percentages from zero to 30 percent). The simulations also indicated the importance of the near-surface condition in a number of the Ponds with mineral salt crusts termed 'osmotic suction limit', which affects the evaporation rate from the surface of the Ponds.

Vadose zone model results are summarized below (values presented in meters, input and output unit of measurement in the SVFlux™ modeling code):

- The LEP 'wet' areas simulation indicated a fairly constant downward net flux of soil water toward the water table. The cumulative flux at the deepest flux line in the profile was approximately 0.16 meters after 5 years of simulation (approximately 3.2E-02 meters per year when averaged over the simulation period).
- LEP 'dry' (non-ponded) areas simulation indicated a small downward net flux of water, approximately 0.013 meters after 15 years of simulation (approximately 8.7E-04 meters per year when averaged over the simulation period). Because the same soil moisture conditions for the 'wet' areas simulation was used for the 'dry' areas simulation, and because the soil moisture conditions for the 'dry' areas of the LEP are more likely to be similar to the conditions observed in the UEP, the numerical simulation likely over-predicts downward flux to the water table.
- The UEP simulation indicated a continuous upward net flux of water. The cumulative flux at the deepest flux line in the model was approximately 1.8 meters for 15 years of simulation (approximately 0.12 meters per year when averaged over the 15-year simulation period). For the 10-year period following the equilibration of the model, the cumulative flux was approximately 1.5 meters (approximately 0.15 meters per year).
- The Thumb Pond simulation indicated a very small upward net flux of water. The cumulative flux rate was approximately 4.0E-04 meters after 15 years of simulation (approximately 2.7E-05 meters per year when averaged over the simulation period). The simulation indicated both upward and downward flux of soil water in the upper portion of the profile, and a relatively constant upward flux in the deeper portion of the profile.

- The vadose zone simulation for the FEPs indicated a small downward flux of soil water during the 15-year simulation period, with a cumulative flux rate at the deepest flux line in the profile of approximately 0.043 meters after 15 years (approximately 2.9E-03 meters per year when averaged over the simulation period).

Integration of these estimated flux rates over the Pond acreages result in the following annual estimated volumes of soil water that could potentially flux to groundwater:

- Approximately 0.31 acre-feet per year (ac-ft/yr) for the LEP 'dry' areas, based on an estimated flux rate of 0.0012 m/yr and an area of 79.5 acres, equivalent to 0.19 gallons per minute (gpm);
- Approximately 1.13 ac-ft/yr for the LEP 'wet' areas, based on an estimated flux rate of 0.016 m/yr and an area of 21.5 acres, equivalent to 0.70 gpm; and
- Approximately 0.15 ac-ft/yr for FEP 1-4, based on an estimated flux rate of 0.0026 m/yr and an area of 17.8 acres, equivalent to 0.09 gpm.

A total of 14 sensitivity analyses for the 'dry' LEP and UEP profiles performed to test the effect of input parameter changes (osmotic suction limit, storm intensity, evaporation pan factor, use of gradient vs. water table boundary) on model results indicated that the vadose zone models were:

- relatively sensitive to changes in model input parameters that influence the evaporative flux (i.e., the osmotic suction parameter and the potential evaporation);
- very sensitive to the type of lower boundary condition; and
- relatively insensitive to the storm intensity distribution.

<u>Updated Conceptual Site Model</u>
The conceptual model for the Ponds is presented in four time periods: pre-mining, Anaconda mining, Arimetco mining, and post-mining to the present:

Pre-Mining Period
Pre-mining conditions for the Site (1938 aerial photo; Figure 2-1) indicated that the area of the future Ponds has been affected by previous agricultural operations, specifically an area of white-colored soils, interpreted to be the result of irrigation tail water deposition and evaporation, located topographically below the agricultural fields. This area resembles an elongated playa, observed in other portions of northern Nevada. The geometry and orientation of the white-colored soils indicates that the tail water filled a topographic low that trended north-northwest, close to the margin of the alluvial fan of the Singatse Range. The position and trend of the white-colored soils in the area of the northern Site boundary are coincident with the orientation of the 'wet' areas of the LEP. Potential impacts of flood irrigation on soil chemistry within the Walker River drainage basin are not currently known. A study conducted by two scientists with

the U.S. Geological Survey in the Carson Desert terminus area of the Carson River drainage basin indicated the following results, which may be applicable to this portion of the Site:

- Shallow groundwater in the southern Carson Desert (i.e., to a depth of 50 feet bgs) is divided into two areas: 1) aquifers beneath agricultural land, termed the 'lateral flow area'; and 2) groundwater in the 'upward flow area' (i.e., playa environments).
- The ultimate source of arsenic and uranium in shallow groundwater in the Carson Desert is the Carson River, which flows through basin fill sediments derived from volcanic and granitic sources rocks. Naturally occurring concentrations of these constituents are typically in excess of 100 micrograms per Liter (ug/L).
- Large differences in arsenic and uranium concentrations over small vertical and horizontal distances were observed in the Dodge Ranch lateral flow area of the Carson Desert (e.g., arsenic concentrations increased from 30 ug/L to more than 2,600 ug/L over a distance of less than 5,000 feet).
- Geochemical processes that affect groundwater chemistry in the shallow aquifer include evaporative concentration (evapotranspiration by plants and soil evaporation), redox and dissolution reactions and, to a lesser extent, adsorption.

Anaconda Mining Period

Aerial photos for the Site during Anaconda operations indicate that spent process solutions discharged to the area of the future Sulfide Tailings impoundment and the future Ponds, and subsequently to the Ponds themselves, created a condition of constant standing water, which would have resulted in the infiltration of the solutions to underlying soils and the shallow alluvial aquifer, less the amount that would have been evaporated. Evaporation of the solutions would not have been significant during winter months, and the chemistry (i.e., high salt content) of the solutions would have limited evaporation rates (relative to fresh water) from the discharge areas and the Ponds.

Given estimated discharge rates of up to 1,000 gallons per minute (gpm), percolation of the process solutions and the mounding effect would have created a groundwater mound and affected groundwater flow in the northern portion of the Site. The chemical character of the solutions (i.e., acidic with elevated concentrations of sulfate, metals and radiochemicals) also impacted underlying soils and shallow groundwater. Although the nature and extent of these hydraulic and chemical effects cannot be quantified, chemical effects are indicated by the following results:

- The background concentration limit for arsenic is 13 mg/kg. The median value of arsenic in soils under the LEP is 15 mg/kg, 37 mg/kg for soils under the UEP, 6.8 mg/kg for soils under FEPs 1-4, and 86 mg/kg for soils under the Thumb Pond.
- The background concentration limit for copper is 58 mg/kg. The median value of copper in soils under the LEP is 190 mg/kg, 110 mg/kg for soils beneath the UEP, 41 mg/kg for soils beneath FEPs 1-4 and 44/mg/kg beneath the Thumb Pond.

- The background concentration limit for iron is 19,502 mg/kg. The median value of soils underlying the LEP is 25,000 mg/kg, 32,000 mg/kg for soils under the UEP, 26,000 mg/kg for soils beneath FEPs 1-4, and 17,000 mg/kg for soils beneath the Thumb Pond.
- The background concentration limit for mercury is 0.031 mg/kg. The median value of mercury in soils under the UEP is 0.085 mg/kg, and 0.19 mg/kg for soils under the Thumb Pond. The median values of mercury in soils under the LEP and FEPs 1-4 are unknown because of the large number of mercury results reported as below laboratory detection limits. The average value for mercury under the LEP is 0.08 mg/kg.
- The background concentration limit for molybdenum is 1.7 mg/kg. The median value of molybdenum in soils under the LEP is 3.1 mg/kg, 3.7 mg/kg for soils under the UEP, 1.2 mg/kg for soils under the FEPs, and 1.6 for soils under the Thumb Pond.
- The background concentration limit for selenium is 0.8 mg/kg. Median values of selenium in soils under the LEP are 0.84 mg/kg, 1.2 mg/kg in soils under the UEP, and 7.9 mg/kg in soils under the Thumb Pond. Selenium was not detected in soils under the FEPs.
- The background concentration limit for thallium is 0.61 mg/kg. The median value of thallium is 0.55 mg/kg in soils beneath the LEP, 1.7 mg/kg in soils beneath the UEP and 17 mg/kg in soils beneath the Thumb Pond. Thallium detections were limited in soils beneath the FEPs.
- The background concentration limit for uranium is 2.9 mg/kg. The median value of uranium in soils underlying the LEP is 8.32 mg/kg, 7.08 mg/kg in soils beneath the UEP, 3.95 mg/kg in soils beneath FEPs 1-4, and 30.4 mg/kg in soils beneath the Thumb Pond.

Shallow groundwater beneath the Pond areas exhibit chemical concentrations that exceed MCLs and preliminary background values established for sulfate and uranium. Based on groundwater data collected to date from Site monitor wells, the shallow hydrostratigraphic zone of the alluvial aquifer beneath the Ponds, particularly the UEP, exhibits the highest observed concentrations of chemicals within the boundaries of the Site.

Arimetco Mining Period

Soil and groundwater impacts resulting from Arimetco's Phase IV – VLT Heap Leach Pad and Pond (monitor well MW-5 area), located immediately to the southwest of the UEP, appear to have occurred. Limited information is available to assess such impacts.

Post-Mining Period (to the Present)

Soil moisture content and saturation conditions for Pond solids (sediments, caps and liner sub-base materials), and subjacent alluvial soils, as of October 2008 were discussed above in the Geotechnical Results and Vadose Zone Modeling section. The conceptual model for the Ponds under current conditions may be summarized as follows: 1) direct precipitation as rain or snow, or surface water run-on, will either directly infiltrate through the pond solids (primarily composed of precipitates from process solutions) or create standing water; 2) standing water in the LEP will remain on the surface until the water percolates through Pond solids or is evaporated, and may persist up to six months when evaporation rates are lowest (Pond sediments in the LEP 'wet' areas are conceptualized to remain saturated throughout the year); 3) no standing water occurs in the UEP, FEPs or Thumb Pond; 4) Pond sediment and soil moisture will migrate either upward to the atmosphere or downward toward the water table as a result of ambient atmospheric conditions, hydraulic pressure gradients and material properties (e.g., grain size distribution, degree of saturation and unsaturated hydraulic conductivity) in the vadose zone, and the presence or absence of standing water on the Pond surfaces.

Vadose zone modeling results indicate that: 1) the Thumb Pond and UEP exhibit an upward vertical flux of soil moisture to the atmosphere (i.e., no cumulative flux of soil moisture toward groundwater); and 2) the 'wet' areas of the LEP and FEPs 1-4 exhibit a cumulative downward flux of soil moisture toward the water table. Model results for the dry (peripheral) portions of the LEP indicate: 1) a net evaporative flux to the atmosphere; and 2) a downward flux of soil moisture during the latter third of the simulation period, resulting from wetter climate conditions.

In addition to atmospheric conditions and material hydraulic properties, the direction and/or flux rate of soil moisture movement throughout the profiles can vary as a result of changes in the elevation of the water table. The elevation of the water table beneath the Ponds responds to: 1) local seasonal fluctuations of up to four feet associated with groundwater irrigation pumping and the application of both surface and groundwater to the agricultural fields located to the east of the Ponds; and 2) longer-term climate patterns.

Conceptually, depending on climate conditions (e.g., strongly evaporative conditions) and soil hydraulic properties (e.g., fine grained, well sorted alluvial fan materials), a shallow water table would tend to drive soil moisture up toward the surface where it would be 'wicked' into the atmosphere. Conversely, depending on climate conditions (high precipitation periods) and soil hydraulic properties (e.g., coarser grained and poorly sorted alluvial fan materials), soil water would migrate more quickly toward the water table.

For Pond areas that exhibit the potential for soil moisture to migrate toward the water table (the LEP and the FEPs, with a greater potential from the LEP), MWMP results suggest that the following chemicals may be sourced to groundwater under existing conditions: chromium, copper, iron, manganese, nickel, uranium and radium-226 and -228. For the LEP and the FEPs, with hydraulic properties that indicate the potential for ongoing, but not necessarily continuous, sourcing of chemicals to groundwater under existing conditions, the attenuation and release mechanisms that may be occurring within the vadose zone include: 1) sorption interactions with mineral or organic solids; 2) mineral precipitation and dissolution processes; 3) acid/base reactions; 4) redox reactions; and 5) complexation, in which the solubility of some chemicals can increase after forming a complex ion pair.

<u>Conclusions</u>

Partial filling of the LEP and UEP, and capping of the Thumb Pond, using VLT materials from the Oxide Tailings OU will achieve the removal action objectives and will be consistent with all potential cap designs that may be implemented as part of a final remedy for the Ponds. The final remedy for the Ponds is anticipated to be a closure cap that utilizes soil moisture storage and atmospheric wicking characteristics such as the approximate 10:1 ratio of evaporation to precipitation rates observed at the Site. These characteristics have been successfully integrated into the closure caps constructed at many mine sites in portions of Nevada subject to arid climate conditions. This type of closure cap does not require an impermeable layer to be constructed either beneath, or on top of, the evaporation cap. The use of VLT for the interim covers is based on: 1) the proximity of these materials to the Pond areas; 2) the past widespread use of VLT by Anaconda, Arimetco, NDEP and EPA for dust control interim response actions on the Site; 3) VLT geotechnical properties indicate that these materials would wick soil moisture into the atmosphere; and 4) VLT materials exhibit radiological characteristics that are consistent with Site and off-Site background gamma radiation, and do not pose a human health risk.

VLT materials to be used as fill for the interim cover over the evaporation ponds have the potential to leach metals (e.g., copper), as presented in Section 5.0 of the DSR. If the proposed VLT cover and underlying soils have the potential to allow incidental precipitation or other meteoric water to migrate through the vadose zone to the water table, potential minor groundwater impacts could occur. However, as presented in the DSR, the soil moisture characteristics beneath the Thumb Pond, the UEP and the 'dry' portions of the LEP where seasonal standing water occurs indicate that incidental precipitation does not flux to groundwater under average or above-average precipitation conditions. Based on grain size distribution and porosity data for the VLT materials, the proposed 18-inch thickness of the VLT cover over the Thumb Pond, UEP and the 'dry' portions of the LEP will provide adequate moisture storage that coupled with soil evaporation will prevent a large percentage of incidental precipitation from reaching the underlying soils. The greater thickness of VLT materials to be placed on the LEP 'wet areas' (i.e., 30 inches pending the results of more detailed geotechnical investigations): 1) could be adequate to provide sufficient near surface soil moisture storage capacity to almost completely eliminate the flux of meteoric water through the vadose zone to groundwater; and 2) will certainly reduce the current estimated flux of meteoric water to groundwater under existing (non-covered) conditions associated with the LEP 'wet areas'.

The design of the VLT cover for the LEP and Sub-Area A will also prevent the current condition of low-pH/metalliferous seasonally ponded water in these areas that may pose a potential threat to wildlife, including migratory water fowl (no ponded water has been observed in the UEP). Based on the proposed design, limited occurrences of minor amounts of standing water may occur on the surface of the VLT cover. These occurrences will not last for any extended period of time (i.e., a few days or less) and will not exhibit the same poor water quality currently observed for the LEP and Sub-Area A. The duration and water quality for any ephemeral standing water will be similar to other locations on the Site where VLT materials have either been used to construct berms, or on the surface of the Oxide Tailings Area. As described in the previous paragraph, incidental precipitation and other meteoric water will infiltrate the VLT covers and be stored as soil moisture.

Based on the technical framework established in the RAC DSR, and in accordance with data quality objectives to be established in a future RI Work Plan for the Evaporation Ponds and Sulfide Tailings OU (OU-4), technical investigations that may be performed include:

- Installation of groundwater monitor wells within the current footprint of the Ponds, and associated groundwater grab sampling and analysis (monitor wells may be installed as part of the OU-1 RI Work Plan for Site-wide groundwater).
- Performance (i.e., vadose zone) monitoring of Pond fill materials (VLT) and underlying Pond sediments and soils. Additional materials sampling and associated analysis of hydraulic properties, and vadose zone modeling, may also be performed.
- Baseline assessment of human health and ecological risk assessment associated with the Ponds.

SECTION 1.0
INTRODUCTION

The Atlantic Richfield Company (ARC) has prepared this *Anaconda Evaporation Ponds Removal Action Characterization Data Summary Report* (RAC DSR) pursuant to the *Anaconda Evaporation Ponds Removal Action Characterization Work Plan* (RAC Work Plan; Brown and Caldwell, 2008) dated September 15, 2008. The RAC Work Plan was approved for implementation by the U.S. Environmental Protection Agency – Region 9 (EPA) in a letter dated October 3, 2008 and field implementation commenced on October 5, 2008. The RAC Work Plan was developed to assist in decision-making regarding a removal action for the inactive Anaconda evaporation ponds (Ponds). The removal action is: 1) required under the Administrative Order on Consent (AOC) and associated Scope of Work (SOW)[1] (AOC/SOW), issued to the Atlantic Richfield Company (ARC) by the U.S. Environmental Protection Agency - Region 9 (EPA), dated April 21, 2009 (effective date May 1, 2009); and 2) consistent with the Administrative Order for the Anaconda/Yerington Mine Site (2007 Order; EPA Docket No. 9-2007-0005) issued by EPA to ARC on January 12, 2007.

Activities conducted in the area of the inactive Anaconda Evaporation Ponds (Ponds) consisted of: 1) a radiometric survey; 2) sampling and laboratory analysis of pond sediments, underlying alluvial soils and, where present, vat leach tailings (VLT) materials; and 3) groundwater grab sampling and laboratory analysis. The Ponds are located in the northern portion of the Yerington Mine Site (Site). The field and laboratory data, and interpretation of the data, presented in this RAC DSR will, along with other related Site information, be presented in a future work plan for the Remedial Investigation and Feasibility Study (RI/FS) of the Evaporation Ponds/Sulfide Tailings Operable Unit (OU-4), as required under the 2007 Order.

[1] Administrative Order on Consent and Settlement Agreement for Removal Action and Past Response Costs Anaconda Copper Mine, Yerington Nevada; U.S. EPA Region IX; CERCLA Docket No. 09-2009-0010.

The Site is located adjacent to the City of Yerington, in western Nevada (Figure 1-1). As shown in Figure 1-2, the ponds consist of five Finger Evaporation Ponds (FEPs; the largest FEP is also known as the Calcine Tailings Pond or Thumb Pond; the term Thumb Pond is carried forward in this RAC DSR), a Lined Evaporation Pond and an Unlined Evaporation Pond. In addition to the Ponds, OU-4 includes sulfide tailings, evaporation ponds associated with the pumpback wells, and the Weed Heights sewage lagoons (Figure 1-2). The Ponds are located on private and public property, the latter managed by the U.S. Bureau of Land Management (BLM).

1.1 Site Location and Physical Setting

The Site is located about one-half mile west and northwest of the City of Yerington in Lyon County, Nevada (Figure 1-1), within the Mason Valley and the Walker River watershed. Agriculture is the principal economic activity in Mason Valley, typically hay and grain farming, onion production and some beef and dairy cattle ranches. The Walker River flows northerly and northeasterly between the Site and the City of Yerington (the river is within a quarter-mile of the southern portion of the Site). The Paiute Tribe Indian Reservation is located approximately 2.5 miles north of the Site (Figure 1-1). The updated conceptual site model (CSM; Revision 3; Brown and Caldwell and Integral Consulting, 2009) provides information on the physical setting and Site conditions in addition to the brief summary contained in the following paragraphs.

The physical setting of the Site is within the Basin-and-Range physiographic province, which is part of the Great Basin sagebrush-steppe ecosystem. Mason Valley occupies a structural graben (i.e., down-dropped faulted basin) typical of basin-and-range topography. The Singatse Range, located immediately south and west of the Site, is an uplifted mountain block that has been subjected to extensive hydrothermal alteration and metals mineralization in the geologic past. Mining and ore processing activities at the Site have resulted in modifications to the natural, pre-mining topography including a large open pit (occupied by a pit lake), waste rock and leached ore piles, and evaporation and tailings ponds. Pond areas described in this RAC DSR are shown in Figure 1-2 and include the four finger evaporation ponds (FEPs), another FEP also referred to as the Thumb Pond, the lined evaporation pond (LEP) and the unlined evaporation pond (UEP).

The Site is located in a high desert environment characterized by an arid climate. Monthly average temperatures range from 33.3° F in December to 73.7° F in July. Annual average rainfall for the City of Yerington is only 5.3 inches per year, with lowest rainfall occurring between July and September (WRCC, 2007). Wind speed and direction at the Site are variable as a result of natural conditions and variable topographic features created by surface mining operations. Meteorological data collected since 2002 indicate that the dominant wind directions are to the north and the northeast (Brown and Caldwell, 2008a).

1.2 Document Organization

The remaining sections of this RAC Work Plan are described below. Section 2.0 provides background information on the construction and operational history of the Anaconda evaporation ponds included in the scope of this Work Plan, and describes the sample collection methods used and analysis performed for soil and groundwater samples as well as the surface radiological survey. Sections 3.0 and 4.0, respectively, summarize the chemical results from collected solids (Pond sediments, VLT and soils) and groundwater samples. Section 5.0 presents the chemical results of leach testing of soils from selected locations using the meteoric water mobility procedure (MWMP). Section 6.0 provides a summary of data quality for the geochemical results. Supplemental information on these sections is provided in Appendices A through F. Appendix G presents information and data for previous sampling and leachate testing of VLT, proposed as fill and cap materials for the Ponds removal action.

Geotechnical laboratory results from solid materials, including selected tests to support vadose zone modeling of pond materials and underlying soils, and a brief summary of vadose modeling activities results are presented in Section 7.0. Geotechnical laboratory reports are presented in Appendix H, and Appendix I provides a more detailed summary of vadose zone modeling activities and results. The results of the radiometric survey performed on the surface of the evaporation ponds are described in Section 8.0. Appendix J presents a grain size distribution curve for one sample of VLT materials from the existing cap on the Thumb Pond.

An updated conceptual model of the evaporation ponds is presented in Section 9.0. Recommendations for the removal action for the Ponds are described in Section 10.0. Section 10.0 also includes generalized recommendations for additional characterization activities to be conducted as part of a future Evaporation Ponds and Sulfide Tailings (OU-4) Remedial Investigation Work Plan. References cited in this RAC DSR are presented in Section 11.0.

SECTION 2.0
CHARACTERIZATION ACTIVITIES

Evaporation Pond characterization activities conducted by ARC were implemented to satisfy the data quality objectives (DQOs) for the Ponds presented in the RAC Work Plan, including the following general problem statement:

> "*Chemical and physical characteristics of the inactive Anaconda Evaporation Ponds are currently unknown, and the nature and extent of environmental impacts from these ponds are also currently unknown. Past operations of the Unlined Evaporation Ponds, Lined Evaporation Ponds and Finger Ponds may have resulted in the seepage of process waters with elevated chemical concentrations to alluvial soils and groundwater underlying these facilities. Incident precipitation on sediments and evaporative residues within the inactive ponds may have subsequently mobilized chemicals from the remaining solids to the underlying soils and groundwater. The potential also exists for continued mobilization of chemicals from these facilities via the migration of meteoric water through the vadose zone*."

The field sampling and analysis plan (FSAP) implemented in October 2008 to support decisions regarding the short-term removal action to be implemented in 2009 for the Ponds was consistent with the then-current Quality Assurance Project Plan (QAPP, Revision 5; Environmental Standards, Inc. and Brown and Caldwell, 2009), and included the following major elements:

- Characterization of the physical conditions and chemical compositions of the Ponds solids and underlying alluvium to identify potentially hazardous materials resulting from historic operations and any potential for continued mobilization of chemicals of concern via the infiltration of meteoric water through these materials.
- Establish the framework of groundwater chemical concentrations beneath the area of the Ponds, in the context of the existing monitor well network, to determine the potential need for, and locations of, additional groundwater monitor wells.
- Characterization of radiological activity associated with the pond sediments in anticipation of a Final Status Survey (FSS), as defined in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; EPA, 2000).

The following FSAP activities, as presented in the RAC Work Plan, were implemented:

- Drilling of 17 boreholes, using direct push Geoprobe and hollow-stem auger drilling methods, for the collection and laboratory analysis of shallow and deep vadose zone soil samples and groundwater grab samples;
- Collection of 16 groundwater grab samples for laboratory analysis from hydropunch or temporary well screen using a hand bailer;
- Collection of soil samples from each of the 17 boreholes for geochemical analysis from shallow soils beneath overlying pond sediments and from deep soils immediately above the groundwater table;
- Collection of soil samples from 8 of the 17 boreholes for geotechnical soil characterization from shallow and deep intervals within the vadose zone;
- Collection of shallow soil samples from 8 of the 17 boreholes for leachate testing using the Meteoric Water Mobility Leaching Procedure (MWMP) to determine the potential for metals and contaminants to leach from the underlying soils;
- Collection of pond sediment and shallow sub-surface soil samples beneath the pond sediments from 43 locations using a hand coring system and geochemical analysis of those materials; and
- Completion of a tightly spaced, 100 percent-coverage, MARSSIM level gamma radiological survey on the surface of the FEPs, LEP and UEP.

Three laboratories were used to complete the geochemical and geotechnical analyses of the soil and water samples collected during this activity. Geochemical analysis was done by approved project labs including TestAmerica Irvine (Irvine, CA) for all metals and water chemistry analytes and TestAmerica Richland (Richland, WA) for all radiochemical and radioisotope analysis. Daniel B. Stephens Laboratory (DBS; Albuquerque, NM) completed all the geotechnical testing on select soil samples. A fourth lab, Sierra Environmental Monitoring Laboratory, Inc. (SEM; Sparks, NV), conducted the MWMP. The resulting MWMP leachate was subsequently shipped under chain-of-custody to the TestAmerica labs for chemical analyses. Between the October field sampling event and the submittal of this RAC DSR, the QAPP has been updated to Revision 5 (ESI and Brown and Caldwell, 2009).

A description of the Ponds and the field activities are summarized in this section of the RAC DSR. Copies of field notes and field forms resulting from the field activities are provided as Appendix A. Groundwater chemical data, Pond solids and soil chemical data, and soil geotechnical data are presented in subsequent sections of this RAC DSR.

2.1 Pond Descriptions

Historical photos of the mine site have been used to help reconstruct the history of operations and use of the evaporation ponds. Aerial photos of the north end of the mine site provided for this RAC DSR include: 1) a 1938 aerial photo prior to the construction of any of the mine units, which shows the current mine boundary for reference (Figure 2-1); 2) a 1954 aerial photo taken shortly after mine operations started (Figure 2-2); 3) a 1965 aerial photo that shows the active UEP and Thumb Pond (Figure 2-3); 4) a 1977 aerial photo taken shortly before active operations were shut down by ARC (Figure 2-4); and 5) a recent oblique aerial photo of the LEP taken in 2002 (Figure 2-5). Finger Pond 5 is also referred to as the Thumb Pond, which is carried through the remainder of this RAC DSR. In addition to the historic photos, visual observations during the period of field investigation activities are included in the following descriptions.

Unlined Evaporation Pond (UEP)

The UEP consists of a large northern section (98 acres) and a much smaller southern section (4.1 acres), with about half of the northern section and all of the southern section located on BLM property. Initially, from approximately 1954 to 1961, the entire area of the Sulfide Tailings and the UEP were used as one large area for the evaporation of spent process solutions discharged from the copper oxide (vat) leaching operation. In 1961, the area was reduced to its current size and continued to operate in the same capacity until operations ended in 1978. The estimated volume of pond sediments contained in the UEP is approximately 270,230 cubic yards based on an average thickness measured during 2008 sampling activities of approximately 1.5 feet in the large northern section and about five feet in the small southern section.

The UEP was constructed on alluvial soils without a liner, and is surrounded by berms constructed of VLT, which generally consist of half to three-quarter inch size fractions with finer grained sand-, silt- and clay-size materials. The pond bottom was not excavated into the alluvial fan slope and, therefore, becomes deeper toward the northeast with the general slope of the underlying terrain. An elevated north-south berm through the center of the UEP may mark the route of the old Copper Belt railway.

No specific information has been found describing the chemical makeup or pH of the waste water disposed in these ponds, although it is known to have originated from the oxide leaching plant. The leaching and cementation process used large quantities of sulfuric acid, much of which was consumed by the ore and scrap iron (i.e., the discharged process water was likely to have been moderately acidic). The cementation step used scrap iron to precipitate the copper through ion exchange resulting in high iron concentrations, evidenced by the dark red color of the pond solutions in historic photos (Anaconda, 1954). The discharged process solutions likely contained elevated concentrations of other acid-soluble metals, including copper. Metals and other constituents precipitated as sulfate salts (e.g., jarosite, an iron sulfate mineral, and selenite gypsum, a calcium sulfate mineral) as the water evaporated. Evaporation of the solutions resulted in the yellow-tinted residue currently visible in the UEP.

Visual observation of the pond sediments during the October sampling event identified the materials as fine-grained yellow silty materials, which appeared to be generally homogeneous throughout the area of the UEP. A thin layer (approximately 0.5 inch thick of red silt was observed above the pond sediments along the northwest margin of the northern section of the UEP, which is interpreted to be a windblown deposit of the red calcine sediment from the Thumb Pond. Additionally, a 2-foot thick layer of red sediment was observed to occur beneath the yellow sediments in the western central portion of the northern section of the UEP, which is interpreted to be an accumulation of waste materials that originated from a different source and may have a different chemical composition. The red and yellow sediments in this area of the UEP were sampled and analyzed separately.

In all areas of the UEP, the sediments were observed to be slightly moist beneath the surface down to the soil contact with no areas of wet and saturated sediments. Surface sediments to approximately three inches below ground surface (bgs) were dry and showed evidence of wind erosion in areas. A thin weak (salt crystal) crust has developed on the surface as a result of moisture evaporation and salt precipitation. This crust provides minimal protection from wind erosion, but is easily broken by foot and vehicle traffic.

Lined Evaporation Pond (LEP)

The LEP was also used to store and evaporate excess process solutions from the oxide ore beneficiation process during the period from approximately 1974 through 1978 and, therefore, the pond sediments in the LEP should be similar (chemical and physical characteristics) to those in the UEP. The LEP includes three sections (North, Middle and South), which were lined with a relatively thin (approximate 0.5 to 1 inch thick) asphalt liner consisting of a mixture of asphalt tar and crushed gravel, similar to road paving. The asphalt liner was placed on a sub-base consisting of 1 to 2.5 feet of VLT materials. The LEP is mostly located on BLM property, with a small portion on the west side located on private property. The LEP, excluding the Weed Heights sewage lagoons, has a total combined area of approximately 101 acres (the total area of the three sections, the Weed Heights sewage lagoons and the interior berms is approximately 122 acres). The thickness of the pond sediments averages 3 to 6 inches, with a maximum measured thickness of approximately 12 inches in select areas within the central topographically lower portion of the LEP (a current topographic map of the LEP is provided as Figure 2-6. The volume of pond sediments contained in the LEP is approximately 65,800 cubic yards.

The LEP appears to have been constructed as one single lined surface, which was subsequently subdivided into three sections by the construction of two embankments (gravel roads constructed of VLT materials) across the pond liner. This conclusion is supported by the absence of liner material on the sides of the embankments and the presence of the asphalt liner encountered in boreholes drilled through the embankments. The northern embankment is used as an access road for the northern set of pumpback wells, which are drilled through the road and the pond liner to extract groundwater from the underlying shallow hydrostratigraphic zone of the alluvial aquifer.

The asphalt liner has deteriorated (i.e., cracking and peeling) in areas where exposed, and the underlying VLT sub-base is locally exposed). However, the liner appears to be intact in areas covered with thicker sediments. In the area of seasonal standing water, the VLT base material and underlying soils were locally observed to be close to saturation. This condition indicated that meteoric water was able to move through the Pond sediments and liner materials. In other areas, the VLT base material and underlying soils exhibited varying degrees of moisture content.

Although the LEP was used to evaporate the same process solutions as the UEP, the asphalt liner in the LEP restricted the downward percolation of meteoric water after the LEP became inactive. This condition, along with the topography of the LEP, allows meteoric water to accumulate on the surface, which has resulted in a greater accumulation of evaporative salt deposits on the surface of the Pond sediments (i.e., sulfate crystals caused by the remobilization of soluble sulfates from the pond sediments) during the dry months of the year. The sulfate salt crystals have resulted in the seasonal formation of a hardened salt crust on the LEP surface with a softer white crystalline salt of varying thickness (up to three inches) immediately beneath the crust and lying on top of the yellow Pond sediments. The hard and soft salt crusts occur in the area of seasonal standing water (i.e., within the central low-lying area), as depicted in Figures 2-5 and 2-6, but do not occur in the peripheral, topographically higher, portions of the LEP.

The salt encrustations appear to limit wind erosion of the underlying residual materials. The Pond sediments underlying the salt crusts in all three LEP sections exhibit a near-saturated condition throughout much of the year, whereas the Pond sediments in areas with no salt crust exhibit variable degrees of moisture content. Standing water above, and pore water within, the near-saturated sediments is very acidic, with pH values of less than 1.0 standard units (s.u.). The area of saturated sediments follows a general north-northwest orientation (Figure 2-5). This orientation is consistent with the presence of the well-preserved liner and salt crusts, and a pre-mining topographic low evidenced by the salt accumulations resulting from the use of agricultural water in this area (see the 1938 aerial photo mosaic in Figure 2-1).

<u>Finger Evaporation Ponds (FEPs)</u>

The four western-most FEPs (FEPs 1-4; Figure 1-2) were constructed by Anaconda in approximately 1974, at about the same time as the LEP. The specific source of process solutions placed in the four FEPs was not documented (or, at least, not available from the Site historic files maintained by EPA). However, the same solutions from the oxide leaching process that were conveyed to the UEP were also likely conveyed to FEPs 1-4, based on the similarity in appearance of the pond sediments.

FEPs 1-4 are constructed with a minimal cut and fill technique to create a flat bottom, which was subsequently lined with asphalt similar in construction and characteristics to the LEP asphalt liner. However, these ponds do not appear to have any VLT as a base for the liner, as the liner appears to lie directly on the underlying soils. These ponds currently exhibit yellow crystallized precipitate solids and sulfate salts (e.g., jarosite and selenite), approximately 2 to 6 inches thick with a hardened surface crust very similar to the crystals observed in the LEP, although generally not as well developed. Because the FEP sediments are thin, they can dry to a powder consistency and be subject to wind erosion when the surface crust is disturbed.

Each of these four ponds was originally 2,500 to 3,000 feet long and approximately 100 to 200 feet wide (Figure 2-4). The southern half of these ponds was covered by the Arimetco Phase IV VLT Heap Leach Pad in 1995. The surface area of these ponds is approximately 17.8 acres and the estimated volume of materials contained within the ponds is 5,838 cubic yards based on an average observed thickness of four inches. These ponds are completely on private property. The current condition of the asphalt liner is significantly deteriorated due to exposure to sun and weather. In addition, physical damage to the south end of these ponds likely occurred as a result of the use of heavy equipment during the construction of the leach pad.

<u>Thumb Pond</u>

The Thumb Pond is the largest and oldest of the Finger Ponds. It was used from approximately 1955 to 1977 to contain the red calcine tails and other dust precipitates created during the roasting of sulfur ore in the production of sulfuric acid at the Acid Plant. Waste water discharged to this pond was likely acidic and also likely to be elevated in various metals. The red-colored sediments in this pond were observed to consist of homogeneous, very fine-grained silt. The thickness of sediment encountered in this pond was highly variable, from 1 inch thick to a maximum thickness of 11.5 feet, with an estimated average thickness of approximately 3.5 feet.

In areas of thicker accumulations of pond sediment, a zone of saturated red pond sediment was encountered immediately above the alluvial soils, and the underlying soils appeared to consistently have limited moisture content.

The unlined Thumb Pond has elevated embankments along the north and east (downhill) sides, but no apparent cut on the uphill side. The pond was approximately 4,500 feet long by 600 to 1,000 feet wide as originally constructed, but the southern two-thirds was also covered by the Arimetco Phase IV VLT Heap Leach Pad and adjacent VLT fill. The exposed portion of this pond covers about 69 acres and has been capped with VLT materials (approximately 8 to 12 inches thick; areas with limited cap thickness can be scraped to reveal the red sediments).

As described above, the red sediments in the Thumb Pond are locally visible on nearby soils and other pond sediments. The estimated volume of materials contained within this pond, including only the remaining exposed portion and not including VLT capping material, is 95,000 cubic yards based on an average observed thickness of 3.5 feet of sediment. Soils underlying all of the FEPs are generally well graded silty sands with localized gravels and minor clays. This alluvial fan material type is consistent with the fan deposits located immediately to the west of the FEPs (i.e., background soils reference sub-area A-1, as depicted in Figure 2-7). These soils are classified as U.S. Soil Conservation Service (SCS; 1984) types Patna Fine Sand (511) and Rawe Gravelly Loam (551). Descriptions of these material types are provided in the updated *Background Soils Data Summary Report* (Revision 1; Brown and Caldwell, 2009a).

2.2 Sample Collection and Analysis

This section of the RAC DSR summarizes FSAP activities that were presented in Section 4.0 of the RAC Work Plan and implemented in the field in October 2008.

2.2.1 Borehole Drilling

Seventeen boreholes were drilled for the purpose of collecting 1) shallow and deep soil samples for geochemical analysis; 2) shallow and deep soil samples for geotechnical analysis; 3) shallow soil samples for the MWMP; and 4) shallow aquifer groundwater grab samples for geochemical analysis. MWMP and geotechnical samples were collected from 8 of the 17 boreholes. Borehole locations are shown in Figure 2-8. A summary of borehole samples is presented in Table 2-1.

Borehole locations were selected to be spatially representative of up-gradient and down-gradient locations within each of the Ponds, based on groundwater flow direction in this area of the Site, which varies from southeast to northwest and from east to west. Per EPA's suggestion, several boreholes were re-positioned during field implementation to be within the boundaries of the Ponds. Once the track-mounted direct-push drill rig arrived on the Site, the accessibility of the re-positioned locations was determined to be feasible (i.e., limited risk of the rig becoming stuck in the fine-grained, loose and potentially muddy sediments within the Ponds).

Two drilling methods were utilized based on borehole location and estimated depth to groundwater. A Geoprobe 7730 DT track-mounted rig was operated by WDC Exploration and Wells for locations within the Ponds and with an estimated depth-to-water of 50 or less. A second drill rig was mobilized to complete four boreholes associated with the FEPs because of the increased depth to groundwater and the hardened, gravelly nature of the soils in this portion of the Ponds area. Cascade Drilling used an 8-inch diameter CME hollow-stem auger drill rig to drill four boreholes (OU4-FEP-14, -15, -16 and -17). Due to the very hard soils encountered in the OU4-FEP-17 borehole, the auger rig was not able to reach groundwater. As a result, no groundwater or deep soil samples were collected at the OU4-FEP-17 location.

Soil Geochemical Sample Collection

Soil geochemical samples were collected from each borehole from both shallow and deep intervals for the analysis of the parameters listed in Table 2-2. Samples were collected from discrete intervals, from 1.5 to 4 feet in length depending on the type of rig used. The geoprobe rig collected undisturbed continuous soil core samples in 1.8-inch diameter, 5-foot long, single-use polyethylene terepthalate glycol (PETG) copolyester core sleeves. Soil samples obtained using the hollow-stem auger drill rig were retrieved in three 2-inch diameter, 6-inch long stainless steel core sleeves driven through the hollow-stem.

Table 2-1. Borehole Samples

Location	Sample Name	Sample Date	Duplicate	Begin Depth (ft bgs)	End Depth (ft bgs)	Matrix	Analysis Type
Lined Evaporation Pond (LEP)							
OU4-LEP-01	OU4-LEP-01A-SC	05-Oct-08		1.5	7	Soil (shallow)	Soil geochem
	OU4-LEP-01A-SG	05-Oct-08		7	10	Soil (shallow)	Geotechnical
	OU4-LEP-01A-MW	05-Oct-08		1.5	15	Soil (shallow)	MWMP
	OU4-LEP-01B-SC	05-Oct-08		15	18	Soil (deep)	Soil geochem
	OU4-LEP-01B-SG	05-Oct-08		18	20	Soil (deep)	Geotechnical
	OU4-LEP-01-GW	05-Oct-08		26	30	Groundwater	Water geochem
OU4-LEP-02	OU4-LEP-02A-SC	06-Oct-08		20	25	Soil (shallow)	Soil geochem
	OU4-LEP-02B-SC	06-Oct-08		29	32	Soil (deep)	Soil geochem
	OU4-LEP-02-GW	06-Oct-08		35	39	Groundwater	Water geochem
OU4-LEP-03	OU4-LEP-03A-SC	06-Oct-08		5	8	Soil (shallow)	Soil geochem
	OU4-LEP-03A-SG	06-Oct-08		8	10	Soil (shallow)	Geotechnical
	OU4-LEP-03A-MW	06-Oct-08		5	15	Soil (shallow)	MWMP
	OU4-LEP-03B-SC	06-Oct-08		15	18	Soil (deep)	Soil geochem
	OU4-LEP-03B-SG	06-Oct-08		18	20	Soil (deep)	Geotechnical
	OU4-LEP-03-GW	06-Oct-08		22	26	Groundwater	Water geochem
OU4-LEP-04	OU4-LEP-04A-SC	07-Oct-08		3	8	Soil (shallow)	Soil geochem
	OU4-LEP-04A-SC-FD	07-Oct-08	Dup	3	8	Soil (shallow)	Soil geochem
	OU4-LEP-04B-SC	07-Oct-08		11	16	Soil (deep)	Soil geochem
	OU4-LEP-04B-SC-FD	07-Oct-08	Dup	11	16	Soil (deep)	Soil geochem
	OU4-LEP-04-GW	07-Oct-08		21	25	Groundwater	Water geochem
	OU4-LEP-04-GW-FD	07-Oct-08	Dup	21	25	Groundwater	Water geochem
OU4-LEP-05	OU4-LEP-05A-SC	07-Oct-08		3	7	Soil (shallow)	Soil geochem
	OU4-LEP-05A-SG	07-Oct-08		8	10	Soil (shallow)	Geotechnical
	OU4-LEP-05A-MW	07-Oct-08		3	15	Soil (shallow)	MWMP
	OU4-LEP-05B-SC	07-Oct-08		12	15	Soil (deep)	Soil geochem
	OU4-LEP-05B-SG	07-Oct-08		15	17	Soil (deep)	Geotechnical
	OU4-LEP-05-GW	07-Oct-08		21	25	Groundwater	Water geochem
Unlined Evaporation Pond (UEP)							
OU4-UEP-06	OU4-UEP-06A-SC	14-Oct-08		15.5	20	Soil (shallow)	Soil geochem
	OU4-UEP-06B-SC	14-Oct-08		30	35	Soil (deep)	Soil geochem
	OU4-UEP-06-GW	14-Oct-08		36	40	Groundwater	Water geochem
OU4-UEP-07	OU4-UEP-07A-SC	08-Oct-08		5	8	Soil (shallow)	Soil geochem
	OU4-UEP-07A-SG	08-Oct-08		8	10	Soil (shallow)	Geotechnical
	OU4-UEP-07A-MW	08-Oct-08		5	15	Soil (shallow)	MWMP
	OU4-UEP-07B-SC	08-Oct-08		17	20	Soil (deep)	Soil geochem
	OU4-UEP-07B-SG	08-Oct-08		20	22	Soil (deep)	Geotechnical
	OU4-UEP-07-GW	08-Oct-08		26	30	Groundwater	Water geochem
OU4-UEP-08	OU4-UEP-08A-SC	08-Oct-08		3	6	Soil (shallow)	Soil geochem
	OU4-UEP-08A-SC-FD	08-Oct-08	Dup	3	6	Soil (shallow)	Soil geochem
	OU4-UEP-08A-SG	08-Oct-08		8	10	Soil (shallow)	Geotechnical
	OU4-UEP-08A-MW	08-Oct-08		3	15	Soil (shallow)	MWMP
	OU4-UEP-08B-SC	08-Oct-08		10	13	Soil (deep)	Soil geochem
	OU4-UEP-08B-SC-FD	08-Oct-08	Dup	10	13	Soil (deep)	Soil geochem
	OU4-UEP-08B-SG	08-Oct-08		13	15	Soil (deep)	Geotechnical
	OU4-UEP-08-GW	08-Oct-08		17	20	Groundwater	Water geochem

Table 2-1. Borehole Samples

Location	Sample Name	Sample Date	Duplicate	Begin Depth (ft bgs)	End Depth (ft bgs)	Matrix	Analysis Type
Unlined Evaporation Pond (UEP) - Continued							
OU4-UEP-09	OU4-UEP-09A-SC	14-Oct-08		4	7	Soil (shallow)	Soil geochem
	OU4-UEP-09B-SC	14-Oct-08		16	20	Soil (deep)	Soil geochem
	OU4-UEP-09-GW	14-Oct-08		23	26	Groundwater	Water geochem
OU4-UEP-10	OU4-UEP-10A-SC	12-Oct-08		3	5	Soil (shallow)	Soil geochem
	OU4-UEP-10A-SG	12-Oct-08		7	9	Soil (shallow)	Geotechnical
	OU4-UEP-10A-MW	12-Oct-08		3	15	Soil (shallow)	MWMP
	OU4-UEP-10B-SG	12-Oct-08		15	17	Soil (deep)	Geotechnical
	OU4-UEP-10B-SC	12-Oct-08		17	20	Soil (deep)	Soil geochem
	OU4-UEP-10-GW	12-Oct-08		23	25	Groundwater	Water geochem
	OU4-UEP-10-GW-FD	12-Oct-08	Dup	23	25	Groundwater	Water geochem
OU4-UEP-11	OU4-UEP-11A-SC	09-Oct-08		15	20	Soil (shallow)	Soil geochem
	OU4-UEP-11B-SC	09-Oct-08		31	35	Soil (deep)	Soil geochem
	OU4-UEP-11-GW	14-Oct-08		41	45	Groundwater	Water geochem
Finger Evaporation Ponds (FEPs)							
OU4-FEP-12	OU4-FEP-12A-SC	13-Oct-08		11	15	Soil (shallow)	Soil geochem
	OU4-FEP-12B-SC	13-Oct-08		41	45	Soil (deep)	Soil geochem
	OU4-FEP-12-GW	13-Oct-08		48	52	Groundwater	Water geochem
OU4-FEP-13	OU4-FEP-13A-SC	12-Oct-08		6	8	Soil (shallow)	Soil geochem
	OU4-FEP-13A-SG	12-Oct-08		8	10	Soil (shallow)	Geotechnical
	OU4-FEP-13A-MW	12-Oct-08		3	15	Soil (shallow)	MWMP
	OU4-FEP-13B-SC	12-Oct-08		40	43	Soil (deep)	Soil geochem
	OU4-FEP-13B-SG	12-Oct-08		43	45	Soil (deep)	Geotechnical
	OU4-FEP-13-GW	13-Oct-08		50	53	Groundwater	Water geochem
OU4-FEP-14	OU4-FEP-14A-SC	29-Oct-08		2	3.5	Soil (shallow)	Soil geochem
	OU4-FEP-14B-SC	29-Oct-08		5	6.5	Soil (shallow)	Soil geochem
	OU4-FEP-14C-SC	29-Oct-08		45	46.5	Soil (deep)	Soil geochem
	OU4-FEP-14-GW	29-Oct-08		70	75	Groundwater	Water geochem
OU4-FEP-15	OU4-FEP-15A-SC	29-Oct-08		2	3.5	Soil (shallow)	Soil geochem
	OU4-FEP-15A-SG	29-Oct-08		3.5	5	Soil (shallow)	Geotechnical
	OU4-FEP-15A-MW	29-Oct-08		2	15	Soil (shallow)	MWMP
	OU4-FEP-15I-SG	29-Oct-08		35	35.5	Soil (intermediate)	Geotechnical
	OU4-FEP-15B-SC	29-Oct-08		50	51.5	Soil (deep)	Soil geochem
	OU4-FEP-15B-SG	29-Oct-08		51.5	53	Soil (deep)	Geotechnical
	OU4-FEP-15-GW	30-Oct-08		65	70	Groundwater	Water geochem
	OU4-FEP-15-GW-FD	30-Oct-08	Dup	65	70	Groundwater	Water geochem
OU4-FEP-16	OU4-FEP-16A-SC	28-Oct-08		2	3.5	Soil (shallow)	Soil geochem
	OU4-FEP-16B-SC	28-Oct-08		65	66.5	Soil (deep)	Soil geochem
	OU4-FEP-16-GW	28-Oct-08		85	90	Groundwater	Water geochem
OU4-FEP-17	OU4-FEP-17A-SC	28-Oct-08		2	3.5	Soil (shallow)	Soil geochem

Because up to two liters of soil volume were required for the geochemical analyses, the sample intervals were adjusted to achieve the required volume. In order to provide homogenized samples to the two project laboratories as separate aliquots, the soils were removed from the original core sleeves and placed in a 1-gallon ziplock bag for blending (i.e., turning the bag end over end or, in the case of soils with high clay or silt content the sample was hand kneaded). A small volume of the homogenized sample was then placed in a 10-ounce glass jar for shipment to the TestAmerica Irvine laboratory for metals analysis. The remaining sample was left in the ziplock bag for shipment to the TestAmerica Richland laboratory for radiochemical analysis.

The depth intervals from which the soil samples were collected were dependent on the thickness of the overlying pond sediment, or road base, as well as the depth to groundwater. An isopach map of Pond sediment thickness is provided in Figure 2-9. Shallow soil samples were collected starting approximately 6 to 12 inches below the contact with the pond sediment, liner or VLT sub-base to ensure limited direct contamination from the pond sediments. Deep soil samples were collected starting approximately 4 to 10 feet above the first observed saturated soils to target the area just above the current static water level. At locations where geotechnical samples were also collected, the geochemical samples were collected immediately above the geotechnical samples and the deep sample intervals were adjusted upward to accommodate the geotechnical samples.

All soil samples were analyzed for a suite of 27 metals and two radiochemicals, as presented in Table 2-2. Soil screening levels presented in the recently updated QAPP (Revision 5) and revised background concentration limits (Brown and Caldwell, 2009a) are also provided in Table 2-2. Samples results are reported on a dry weight basis and percent moisture was determined by the TestAmerica Richland laboratory and applied to the results reported by the TestAmerica Irvine lab, which were initially analyzed wet and subsequently adjusted. Moisture content of soils ranged from 3.0 to 26.0 percent with an average of 14.2 percent. Moisture content of Pond sediments ranged from 2.9 to 46.9 percent with and average of 16.1. All moisture content values reported from TestAmerica are gravimetric moisture values (see Table 3-1).

Table 2-2. Solids Geochemical Analysis							
Analyte	Analytical Method[1]	Unit	Reporting Limit[1]	Screening Levels			
				Background Concentration Limits	Residential RSL[2]	Industrial RSL[2]	Ecological SLV[3]
Metals:							
Aluminum	6010B	mg/kg	10	16,455	77,000	990,000	NA
Antimony	6020	mg/kg	0.1	0.94	31	410	0.27
Arsenic	6020	mg/kg	0.5	13	0.39	1.6	9.79
Barium	6020	mg/kg	0.5	171	15,000	190,000	330
Beryllium	6020	mg/kg	0.3	1	160	2,000	21
Boron	6010B	mg/kg	5.0	24	16,000	200,000	0.5
Cadmium	6020	mg/kg	0.06	0.32	70	810	0.36
Calcium	6010B	mg/kg	15	22,614	NA	NA	NA
Chromium	6020	mg/kg	1.0	11	230	1,400	26
Cobalt	6020	mg/kg	0.5	12	23	300	13
Copper	6020	mg/kg	1.0	58	3,100	41,000	28
Iron	6010B	mg/kg	5.0	19,502	55,000	720,000	NA
Lead	6020	mg/kg	0.5	11	400	800	11
Magnesium	6010B	mg/kg	10	6,314	NA	NA	NA
Manganese	6020	mg/kg	0.5	526	1,800	23,000	220
Mercury	7471A	mg/kg	0.001	0.031	23	310	0.01
Molybdenum	6020	mg/kg	1.0	1.7	390	5,100	2
Nickel	6020	mg/kg	1.0	12	1,600	20,000	22.7
Potassium	6010B	mg/kg	50	3,365	NA	NA	NA
Selenium	6020	mg/kg	0.00015	0.8	390	5,100	0.52
Silver	6020	mg/kg	0.5	0.54	390	5,100	4.2
Sodium	6010B	mg/kg	50	2,093	NA	NA	NA
Thallium	6020	mg/kg	0.5	0.61	5.1	66	1
Thorium (total)	6020	mg/kg	0.5	15	NA	NA	NA
Uranium (total)	6020	mg/kg	0.5	2.9	230	3,100	NA
Vanadium	6020	mg/kg	1.0	57	390	5,200	7.8
Zinc	6020	mg/kg	10	61	23,000	310,000	46
Radiochemicals:							
Radium-226	EPA 903.0	pCi/g	1.0	2.04	0.193[4]	3.70[4]	50.6
Radium-228	EPA 904.0	pCi/g	1.0	2.24	0.260[4]	8.40[4]	43.9

Notes: [1] EPA laboratory analytical methods and reporting limits are consistent with the updated QAPP (Revision.5).
[2] EPA Regional Screening Levels for Chemical Contaminants (EPA, 2008).
[3] Ecological screening level represents the lowest SLV are consistent with the updated QAPP (Revision 5).
[4] EPA Preliminary Remediation Goals for Radionuclides; http://epa-prgs.ornl.gov/radionuclides/.
NA - Not Applicable, no published screening level available.

Boreholes drilled with the geoprobe rig had continuous cores that were logged for soil lithology by the field geologist (see Section 4.1). Boreholes drilled by the auger rig were also logged, although the lithologic information obtained from auger drilling was not as detailed because the auger rig did not produce continuous cores. Remaining core sections not shipped to the various analytical laboratories have been stored at the Site.

Soil Geotechnical Sample Collection

Soil samples for geotechnical analysis were collected using the same methods as described above. Pursuant to the RAC Work Plan, the geotechnical samples were only collected from eight of the 17 borehole locations (Figure 2-8). Geotechnical samples were collected from the soil core immediately below that used for the geochemical analysis, unless there was not sufficient length of undisturbed core (i.e., two feet of intact core) to meet geotechnical sample requirements. At locations where the subjacent intact core interval was needed for the collection of geotechnical samples, observed differences in sample lithology were recorded in the field logs.

As shown in Figure 2-8, the three LEP boreholes were generally located along the axis of the 'wet' areas that correspond to the topographically low portion of the LEP. Because the 'wet' areas would not support the weight of a drill rig, the boreholes were either located on a berm between cells or at an adjacent location that would support the rig. As a result, samples collected from these boreholes are likely more representative of 'wet' area soils than 'dry' area soils. Soils underlying the LEP 'dry' areas are anticipated to exhibit a gradation in subsurface hydraulic properties from the 'wet' areas towards the UEP and/or FEP 5 (i.e., less saturated soils).

Prior to shipment, geotechnical samples from the geoprobe rig were cut to lengths of approximately 18 to 24 inches, and the plastic sleeve ends were covered with Teflon film and sealed with a plastic cap wrapped with duct tape to preserve soil moisture (gaps were packed with Teflon film to minimize possible shifting and breaking of the soil core during transport). Samples collected by the hollow-stem auger drilling method were collected in three individual six-inch long stainless steel core sleeves (total length of 18 inches). The individual steel core sleeves were packaged in the same manner as the plastic sleeves for shipment to the lab.

Soil samples were collected from shallow and deep intervals from the eight borehole locations shown in Figure 2-8 for the geotechnical characterization of hydraulic properties, particle size, plasticity, and ASTM soil classification. Samples collected for geotechnical tests were submitted to the DBS Laboratory in their original core sleeves as an undisturbed, intact core. The geotechnical tests completed on select soil samples are summarized in Table 2-3. Moisture content values reported by the DBS Laboratory are volumetric values. The relationship between gravimetric and volumetric moisture content is discussed in Section 7.0.

Table 2-3. Soil Geotechnical Tests

Test	Analytical Method
Hydraulic Properties/Soil Water Characteristic Curve:	
Saturated hydraulic conductivity (rigid-wall)	ASTM D2434
Initial volumetric and gravimetric water content (soil moisture)	ASTM D2216/D6836
Dry bulk density	ASTM D2937/D6836
Calculated total porosity	ASTM D6836
Moisture characteristics (5-7 points)	ASTM D6836/D2325
Calculated unsaturated hydraulic conductivity	ASTM D6836
Particle Size Analysis:	
Standard sieves with wash and hydrometer	ASTM D422
Atterberg Limits:	
Liquid limit, plastic limit, plasticity index	ASTM D4318
Soil Classification for Engineering Purposes	
ASTM soil classification	ASTM D2487

Soil MWMP Sample Collection

Shallow soil samples to a depth of 15 feet bgs, were collected from eight borehole locations (Figure 2-8) for leach testing using the MWMP, which required a volume of up to three gallons of soil and a longer sample interval than required for geochemical analysis. To obtain the soil volume necessary for analysis, samples collected by geoprobe required up to three parallel boreholes within 12 inches of each other (the three sample cores were independent of cores used for geochemical and geotechnical samples over the same interval). Soils were placed in a 3-gallon bucket, lined with a plastic garbage bag, and mixed by a gloved hand (dense clay and silty soils were manually broken into smaller, 1-inch sized pieces).

One of the sample locations (OU4-FEP-15) was drilled using a hollow-stem auger, which only required one borehole. This sample was collected from cuttings that accumulated around the borehole (cuttings that included Pond sediments were cleared before sample collection, and care was taken to not include cuttings that contacted Pond sediments).

MWMP Samples were hand delivered to the SEM Laboratory in Sparks, Nevada, where the 24-hour leaching procedure was completed. SEM Lab then returned the collected leachate to Brown and Caldwell. The leachate was then submitted to the TestAmerica project labs for geochemical analysis for metals and radiochemicals (Table 2-4).

Groundwater Grab Sample Collection

Boreholes were drilled to a total depth of approximately 10 to 15 feet below the top of the shallow aquifer, which varied between 16 and 80 feet bgs depending on location. A 5-foot long, 2-inch diameter PVC screen (0.01-inch slot size) was then placed at the target sample depth (about 5 to 10 feet below the water table), either as a hydropunch tip attached to the end of the geoprobe casing or as a temporary 2-inch well, connected to the surface with 10-foot PVC sections. As needed, to provide the best sample possible from groundwater with high turbidity, a coarse sand filter pack was positioned around the screen in the temporary wells.

Groundwater grab samples were collected from 16 of the 17 boreholes. As stated previously, the borehole at sample location OU4-FEP-17 encountered a zone of very hard material at 70 feet bgs, which could not be penetrated. Drilling at this location was suspended and the borehole was not re-located because similar hard layers were encountered in nearby boreholes and was expected in a proximal re-drill location. No water was used during drilling, and all down-hole drilling equipment was decontaminated between each borehole location.

Table 2-4. Soil Leaching Analysis

Leaching Test:

Nevada Meteoric Water Mobility Procedure	Nevada MWMP/ ASTM E2242

Geochemical Analysis of Leachate:

Parameter or Analyte	Analytical Method	Units	Reporting Limit	Screening Levels: EPA RSL Tapwater	Screening Levels: Drinking Water MCL
Aluminum	EPA 200.7	mg/L	0.05	37	NA
Antimony	EPA 200.8	mg/L	0.002	0.015	0.006
Arsenic	EPA 200.8	mg/L	0.001	0.000045	0.01
Barium	EPA 200.8	mg/L	0.001	7.3	2
Beryllium	EPA 200.8	mg/L	0.0005	0.073	0.004
Boron	EPA 200.7	mg/L	0.05	7.3	NA
Cadmium	EPA 200.8	mg/L	0.001	0.018	0.005
Calcium	EPA 200.7	mg/L	0.1	NA	NA
Chromium	EPA 200.8	mg/L	0.002	55	0.1
Cobalt	EPA 200.8	mg/L	0.001	0.011	NA
Copper	EPA 200.8	mg/L	0.001	1.5	1.3
Iron	EPA 200.7	mg/L	0.04	26	NA
Lead	EPA 200.8	mg/L	0.001	NA	0.015
Lithium	EPA 200.7	mg/L	0.0005	0.073	NA
Magnesium	EPA 200.7	mg/L	0.02	NA	NA
Manganese	EPA 200.8	mg/L	0.001	0.88	NA
Mercury	EPA 245.1	mg/L	0.0002	0.011	0.002
Molybdenum	EPA 200.8	mg/L	0.002	0.18	NA
Nickel	EPA 200.8	mg/L	0.002	0.73	NA
Phosphorus	EPA 200.7	mg/L	0.5	NA	NA
Potassium	EPA 200.7	mg/L	0.5	NA	NA
Selenium	EPA 200.8	mg/L	0.002	0.18	0.05
Silica	EPA 200.7	mg/L	0.05	NA	NA
Silver	EPA 200.8	mg/L	0.0001	0.18	NA
Sodium	EPA 200.7	mg/L	0.5	NA	NA
Strontium	EPA 200.7	mg/L	0.02	22	NA
Thallium	EPA 200.8	mg/L	0.0002	0.0024	0.002
Tin	EPA 200.7	mg/L	0.012	22	NA
Titanium	EPA 200.7	mg/L	0.001	150	NA
Uranium, Total	EPA 200.8	mg/L	0.001	0.11	0.03
Vanadium	EPA 200.8	mg/L	0.002	0.18	NA
Zinc	EPA 200.8	mg/L	0.01	11	NA
Gross Alpha	EPA 900.0	pCi/L	1.0	NA	15
Gross Beta	EPA 900.0	pCi/L	1.0	NA	NA
Radium-226	EPA 903.0	pCi/L	1.0	0.0008	5.0
Radium-228	EPA 904.0	pCi/L	1.0	0.0458	
Thorium-228	EPA 907.0	pCi/L	1.0	0.445	NA
Thorium-230	EPA 907.0	pCi/L	1.0	0.523	NA

Groundwater samples were collected using a hand bailing method or peristaltic pump, depending on borehole conditions. Bailed samples were collected using a 3-foot long, 1.5-inch diameter bailer constructed of either stainless steel or plastic. The stainless steel bailer was decontaminated with Alconox soap and a high pressure washer between each location, and the plastic bailers were disposed of after each sample. Groundwater retrieved from the bailer was commonly very high in fine sediment content. Samples were collected using a peristaltic pump at two locations (OU4-UEP-08 and OU4-UEP-09) where the screened interval had not sufficiently penetrated the aquifer, and the volume of water in the screen was either too shallow to adequately fill the bailer or the recharge rate was too slow. Disposable silicone tubing was used for the collection of samples with the peristaltic pump.

Because of the very low recharge rate into the screen interval, and the high volume of water that was required for sample analysis (8.5 liters), no purging of water from the borehole was done prior to sample collection. In order to collect sufficient volume to obtain 8.5 liters of filtered sample, ten or more 1-liter bottles of unfiltered water were collected. The typical procedure was to fill a new 1-liter unpreserved bottle, allow the sediments to settle for up to 10 minutes, decant the water off the top into a second new 1-liter unpreserved bottle, and discard the settled sediments. The sample bottles were taken to the on-Site field office where they were filtered and preserved in the laboratory-provided containers, as required by the Work Plan. This procedure could take up to four hours after sample collection, depending on sample turbidity.

One sample container required for total organic carbon (TOC) analysis needed to be collected as an unfiltered sample with zero-headspace and therefore the bottle was filled at the borehole location from the decanted portion of a 1-liter bottle. However, the high sediment content of the water reacted with the hydrochloric acid preservative in the sample container creating bubbles within the bottle. The project laboratory advised the field staff to discard the preservative prior to filling the bottle and the lab would add the preservative upon receipt. This procedure was followed and documented on the chain of custody (COC) forms as well as on the sample labels.

Samples that required filtration (e.g. dissolved metals) were filtered using a peristaltic pump with silicone tubing and an in-line 0.45 µm single-use filter. As needed, 1 µm and 5 µm pre-filters were used to reduce the sediment load on the primary filter. The sample was homogenized by pumping a roughly equal portion from each unfiltered bottle into a single filtered bottle. Groundwater grab samples were submitted to project laboratories for the same analytical suite used for quarterly groundwater monitoring from Site monitor wells, as summarized in Table 2-5.

Table 2-5. Groundwater Geochemical Analysis

Parameter or Analyte	Total/ Dissolv.(1)	Analytical Method(2)	Units	Reporting Limit(2)	Screening Levels		
					EPA RSL Tapwater(3)	Drinking Water MCL(4)	Ecological SLV(5)
Field Method Parameters							
pH		EPA 150.1	pH Units	0.1	NA	NA	NA
Specific Conductance		EPA 150.1	µS/cm	1	NA	NA	NA
Temperature		SM 212	°C	0.1	NA	NA	NA
Laboratory Physical Parameters and Major Anions/Cations							
Alkalinity	T	SM 2320B	mg/L	2.0	NA	NA	NA
Bicarbonate	T	SM 2320B	mg/L	2.0	NA	NA	NA
Carbonate	T	SM 2320B	mg/L	2.0	NA	NA	NA
Chloride	T	EPA 300.0	mg/L	0.5	NA	NA	NA
Fluoride	T	EPA 300.0	mg/L	0.5	NA	NA	NA
Nitrate-Nitrite, Total	T	EPA 300.0	mg/L	0.15	NA	NA	NA
Nitrate	T	EPA 300.0	mg/L	0.15	58	10	NA
Nitrite	T	EPA 300.0	mg/L	0.15	3.7	1	NA
Sulfate	T	EPA 300.0	mg/L	0.5	NA	NA	NA
pH	T	SM 4500 B/H	pH Units	0.01	NA	NA	NA
Total Dissolved Solids (TDS)	T	SM 2540C	mg/L	10	NA	NA	NA
Total Organic Carbon (TOC)	T	SM 5310B	mg/L	1.0	NA	NA	NA
Metals							
Aluminum	D	EPA 200.7	mg/L	0.05	37	NA	0.087
Antimony	D	EPA 200.8	mg/L	0.002	0.015	0.006	0.03
Arsenic	D	EPA 200.8	mg/L	0.001	0.000045	0.01	0.15
Barium	D	EPA 200.8	mg/L	0.001	7.3	2	0.004
Beryllium	D	EPA 200.8	mg/L	0.0005	0.073	0.004	0.0066
Boron	D	EPA 200.7	mg/L	0.05	7.3	NA	0.0016
Cadmium	D	EPA 200.8	mg/L	0.001	0.018	0.005	0.00025
Calcium	D	EPA 200.7	mg/L	0.1	NA	NA	NA
Chromium	D	EPA 200.8	mg/L	0.002	55(6)	0.1	0.074
Cobalt	D	EPA 200.8	mg/L	0.001	0.011	NA	0.023
Copper	D	EPA 200.8	mg/L	0.001	1.5	1.3	0.009
Iron	D	EPA 200.7	mg/L	0.04	26	NA	1

Table 2-5. Groundwater Geochemical Analysis

Parameter or Analyte	Total/ Dissolv.[1]	Analytical Method[2]	Units	Reporting Limit[2]	Screening Levels		
					EPA RSL Tapwater[3]	Drinking Water MCL[4]	Ecological SLV[5]
Metals - Continued							
Lead	D	EPA 200.8	mg/L	0.001	NA	0.015	0.0025
Lithium	D	EPA 200.7	mg/L	0.0005	0.073	NA	0.014
Magnesium	D	EPA 200.7	mg/L	0.02	NA	NA	na
Manganese	D	EPA 200.8	mg/L	0.001	0.88	NA	0.014
Mercury	D	EPA 245.1	mg/L	0.0002	0.011[7]	0.002	0.00077
Molybdenum	D	EPA 200.8	mg/L	0.002	0.18	NA	0.073
Nickel	D	EPA 200.8	mg/L	0.002	0.73	NA	0.052
Phosphorus	D	EPA 200.7	mg/L	0.5	NA	NA	NA
Potassium	D	EPA 200.7	mg/L	0.5	NA	NA	NA
Selenium	D	EPA 200.8	mg/L	0.002	0.18	0.05	0.005
Silica	D	EPA 200.7	mg/L	0.05	NA	NA	NA
Silver	D	EPA 200.8	mg/L	0.0001	0.18	NA	0.0001
Sodium	D	EPA 200.7	mg/L	0.5	NA	NA	NA
Strontium	D	EPA 200.7	mg/L	0.02	22	NA	1.5
Thallium	D	EPA 200.8	mg/L	0.0002	0.0024	0.002	0.0008
Tin	D	EPA 200.7	mg/L	0.012	22	NA	0.073
Titanium	D	EPA 200.7	mg/L	0.001	150[8]	NA	NA
Uranium, Total	D	EPA 200.8	mg/L	0.001	0.11	0.03	0.0026
Vanadium	D	EPA 200.8	mg/L	0.002	0.18	NA	0.02
Zinc	D	EPA 200.8	mg/L	0.01	11	NA	0.12
Radiochemicals							
Gross Alpha	D	EPA 900.0	pCi/L	1.0	NA	15	NA
Gross Beta	D	EPA 900.0	pCi/L	1.0	NA	NA	NA
Radium-226	D	EPA 903.0	pCi/L	1.0	0.0008	5.0[9]	4.08
Radium-228	D	EPA 904.0	pCi/L	1.0	0.0458		3.4
Thorium-228	D	EPA 907.0	pCi/L	1.0	0.445	NA	374
Thorium-230	D	EPA 907.0	pCi/L	1.0	0.523	NA	2570

Notes: (1) Dissolved constituents are field filtered with a disposable 0.45 micron filter.
(2) Laboratory analytical methods and reporting limits are consistent with the updated QAPP (Revision 5).
(3) EPA Regional Screening Level for Tap Water (EPA, Sept. 12, 2008)
(4) EPA Safety Primary Drinking Water Standards, Maximum Contaminant Level.
(5) Ecological screening level represents the lowest SLV as documented in the updated QAPP (Revision 5).
(6) Chromium, Total (1:6 ratio Cr VI:Cr III)
(7) Mercury, inorganic salts
(8) EPA Region 9 PRG Table (2004)
(9) Ra-226/-228 combined
NA - Not Applicable, no published screening level available.

The quality of the groundwater grab samples collected using the methods described above is not expected to be of the same quality as samples collected from completed and developed monitor wells. For example, specific analytes may be affected by the aeration caused by the agitation of the sample during bailing and certain field parameters such as oxidation-reduction potential (ORP) and dissolved oxygen (DO) that are typically measured during low-flow sampling of monitor wells were not measured. Also, turbidity was not measured because it was typically at such high levels that it was beyond the range of the field instrument. As described in the RAC Work Plan, the data can be used in a qualitative manner to determine general concentration levels of chemicals in groundwater beneath the Ponds, and to guide the locations for future monitor wells to be installed as part of a future RI Work Plan (Site-Wide Groundwater OU and/or Evaporation Ponds/Sulfide Tailings OU).

2.2.2 Hand Core Sampling

Hand-core sampling was used to collect Pond sediments, and shallow soils up to two feet below the Pond sediments. A total of 43 locations were randomly selected using the Visual Sample Plan (VSP) method, as shown in Figure 2-8. Table 2-6 summarizes depths and material types for the collected samples. Samples of VLT were collected from the Thumb Pond cap and from below the LEP liner (not all locations where VLT was encountered were sampled given the homogeneity of this material).

Sediment and soil samples were collected by a hand-core sampling method using a 3-foot long, 1.5-inch outer-diameter stainless steel core barrel with a 1.2-inch diameter single-use PETG plastic liner. The core barrel, equipped with a beveled stainless steel cutting tip on the end, was decontaminated and cleaned between each location and the sample was only in contact with the disposable plastic liner rather than the inside of the core barrel. The core barrel was driven into the soil using an electric impact hammer powered by a portable gasoline generator. At a limited number of sample locations, where Pond sediments were thicker than average, a three-foot extension rod was added to allow sample collection to a depth of six feet bgs (generally, samples were collected to a maximum depth of three feet bgs). The core barrel was then extracted using a foot-operated jack stand and the core sleeve was pushed out of the barrel using a wooden dowel.

Table 2-6. Hand Core Samples

Location	Sample Name	Sample Date	Duplicate	Begin Depth (ft bgs)	End Depth (ft bgs)	Matrix	Analysis Type
Lined Evaporation Pond (LEP)							
OU4-LEP-18	OU4-LEP-18A-SC	18-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-18B-SC	18-Oct-08		1.5	3	Soil	Solids geochem
OU4-LEP-19	OU4-LEP-19A-SC	15-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-LEP-19B-SC	15-Oct-08		1.7	3	Soil	Solids geochem
OU4-LEP-20	OU4-LEP-20A-SC	19-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-20B-SC	15-Oct-08		1	3	Soil	Solids geochem
OU4-LEP-21	OU4-LEP-21A-SC	19-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-21B-SC	19-Oct-08		1.5	3	Soil	Solids geochem
OU4-LEP-22	OU4-LEP-22A-SC	18-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-22B-SC	18-Oct-08		1.5	2.5	Soil	Solids geochem
OU4-LEP-23	OU4-LEP-23A-SC	18-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-23B-SC	18-Oct-08		2	3	Soil	Solids geochem
OU4-LEP-24	OU4-LEP-24A-SC	19-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-24B-SC	30-Oct-08		1.5	3	Soil	Solids geochem
OU4-LEP-25	OU4-LEP-25A-SC	19-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-25B-SC	19-Oct-08		1.5	3	Soil	Solids geochem
OU4-LEP-26	OU4-LEP-26A-SC	15-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-26B-SC	15-Oct-08		1	3	Soil	Solids geochem
OU4-LEP-27	OU4-LEP-27A-SC	18-Oct-08		0	0.33	Pond Sediment	Solids geochem
	OU4-LEP-27B-SC	18-Oct-08		2	3	Soil	Solids geochem
OU4-LEP-28	OU4-LEP-28A-SC	18-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-LEP-28B-SC	18-Oct-08		1	3	Soil	Solids geochem
OU4-LEP-29	OU4-LEP-29A-SC	17-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-29B-SC	17-Oct-08		0.5	2	VLT gravel	Solids geochem
	OU4-LEP-29C-SC	17-Oct-08		2	5	Soil	Solids geochem
OU4-LEP-30	OU4-LEP-30A-SC	17-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-30A-SC-FD	17-Oct-08	Dup	0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-30B-SC	17-Oct-08		0.5	2.5	VLT gravel	Solids geochem
	OU4-LEP-30B-SC-FD	17-Oct-08	Dup	0.5	2.5	VLT gravel	Solids geochem
	OU4-LEP-30C-SC	17-Oct-08		2.5	6	Soil	Solids geochem
	OU4-LEP-30C-SC-FD	17-Oct-08	Dup	2.5	6	Soil	Solids geochem
OU4-LEP-31	OU4-LEP-31A-SC	17-Oct-08		0	0.33	Pond Sediment	Solids geochem
	OU4-LEP-31B-SC	17-Oct-08		0.33	2.5	VLT gravel	Solids geochem
	OU4-LEP-31C-SC	17-Oct-08		2.5	6	Soil	Solids geochem
OU4-LEP-32	OU4-LEP-32A-SC	17-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-LEP-32B-SC	17-Oct-08		0.5	3	VLT gravel	Solids geochem
	OU4-LEP-32C-SC	17-Oct-08		3	6	Soil	Solids geochem
Unlined Evaporation Pond (UEP)							
OU4-UEP-33	OU4-UEP-33A-SC	18-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-UEP-33B-SC	18-Oct-08		0.5	3	Soil	Solids geochem
OU4-UEP-34	OU4-UEP-34A-SC	17-Oct-08		0	2	Pond Sediment	Solids geochem
	OU4-UEP-34B-SC	17-Oct-08		2	3	Soil	Solids geochem
OU4-UEP-35	OU4-UEP-35A-SC	16-Oct-08		0	1.5	Pond Sediment	Solids geochem
	OU4-UEP-35B-SC	16-Oct-08		1.5	3	Soil	Solids geochem
OU4-UEP-36	OU4-UEP-36A-SC	15-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-UEP-36B-SC	15-Oct-08		1	3	Soil	Solids geochem
OU4-UEP-37	OU4-UEP-37A-SC	15-Oct-08		0	1.5	Pond Sediment	Solids geochem
	OU4-UEP-37B-SC	15-Oct-08		1.5	3	Soil	Solids geochem

Table 2-6. Hand Core Samples

Location	Sample Name	Sample Date	Duplicate	Begin Depth (ft bgs)	End Depth (ft bgs)	Matrix	Analysis Type
Unlined Evaporation Pond (UEP) - Continued							
OU4-UEP-38	OU4-UEP-38A-SC	16-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-UEP-38A-SC-FD	16-Oct-08	Dup	0	0.5	Pond Sediment	Solids geochem
	OU4-UEP-38B-SC	16-Oct-08		0.5	3	Soil	Solids geochem
	OU4-UEP-38B-SC-FD	16-Oct-08	Dup	0.5	3	Soil	Solids geochem
OU4-UEP-39	OU4-UEP-39A-SC	16-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-UEP-39B-SC	16-Oct-08		1	3	Soil	Solids geochem
OU4-UEP-40	OU4-UEP-40A-SC	16-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-UEP-40B-SC	16-Oct-08		1	3	Soil	Solids geochem
OU4-UEP-41	OU4-UEP-41A-SC	16-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-UEP-41B-SC	16-Oct-08		0.5	2	Pond Sediment	Solids geochem
	OU4-UEP-41C-SC	16-Oct-08		2	3	Soil	Solids geochem
OU4-UEP-42	OU4-UEP-42A-SC	16-Oct-08		0	0.33	Pond Sediment	Solids geochem
	OU4-UEP-42B-SC	16-Oct-08		0.33	2.5	Pond Sediment	Solids geochem
	OU4-UEP-42C-SC	16-Oct-08		2.5	6	Soil	Solids geochem
OU4-UEP-43	OU4-UEP-43A-SC	16-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-UEP-43B-SC	16-Oct-08		1	3	Soil	Solids geochem
OU4-UEP-44	OU4-UEP-44A-SC	16-Oct-08		0	0.33	Pond Sediment	Solids geochem
	OU4-UEP-44A-SC-FD	16-Oct-08	Dup	0	0.33	Pond Sediment	Solids geochem
	OU4-UEP-44B-SC	16-Oct-08		0.33	3	Soil	Solids geochem
	OU4-UEP-44B-SC-FD	16-Oct-08	Dup	0.33	3	Soil	Solids geochem
OU4-UEP-45	OU4-UEP-45A-SC	16-Oct-08		0	1	Pond Sediment	Solids geochem
	OU4-UEP-45B-SC	16-Oct-08		1	3	Soil	Solids geochem
OU4-UEP-46	OU4-UEP-46A-SC	16-Oct-08		0	1.5	Pond Sediment	Solids geochem
	OU4-UEP-46B-SC	16-Oct-08		1.5	3	Soil	Solids geochem
OU4-UEP-47	OU4-UEP-47A-SC	16-Oct-08		0	3	Pond Sediment	Solids geochem
	OU4-UEP-47A-SC-FD	16-Oct-08	Dup	0	3	Pond Sediment	Solids geochem
	OU4-UEP-47B-SC	16-Oct-08		3	6	Pond Sediment	Solids geochem
	OU4-UEP-47B-SC-FD	16-Oct-08	Dup	3	6	Pond Sediment	Solids geochem
	OU4-UEP-47C-SC	16-Oct-08		6	9	Soil	Solids geochem
	OU4-UEP-47C-SC-FD	16-Oct-08	Dup	6	9	Soil	Solids geochem
Finger Evaporation Ponds (FEPs)							
OU4-FEP-48	OU4-FEP-48A-SC	9-Oct-08		0	0.5	VLT gravel	Solids geochem
	OU4-FEP-48B-SC	9-Oct-08		0.5	5	Pond Sediment	Solids geochem
	OU4-FEP-48C-SC	9-Oct-08		9	12	Pond Sediment	Solids geochem
	OU4-FEP-48D-SC	9-Oct-08		12	15	Soil	Solids geochem
OU4-FEP-49	OU4-FEP-49A-SC	9-Oct-08		0	0.5	VLT gravel	Solids geochem
	OU4-FEP-49B-SC	9-Oct-08		0.5	4	Pond Sediment	Solids geochem
	OU4-FEP-49C-SC	9-Oct-08		5	8	Soil	Solids geochem
OU4-FEP-50	OU4-FEP-50A-SC	9-Oct-08		0	0.5	VLT gravel	Solids geochem
	OU4-FEP-50B-SC	9-Oct-08		0.5	2	Pond Sediment	Solids geochem
	OU4-FEP-50C-SC	9-Oct-08		2	5	Soil	Solids geochem
OU4-FEP-51	OU4-FEP-51A-SC	9-Oct-08		0	0.5	VLT gravel	Solids geochem
	OU4-FEP-51B-SC	9-Oct-08		1	5	Soil	Solids geochem
OU4-FEP-52	OU4-FEP-52A-SC	9-Oct-08		0	0.5	VLT gravel	Solids geochem
	OU4-FEP-52B-SC	9-Oct-08		0.5	4	Pond Sediment	Solids geochem
	OU4-FEP-52C-SC	9-Oct-08		5	8	Soil	Solids geochem
OU4-FEP-53	OU4-FEP-53A-SC	18-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-FEP-53B-SC	18-Oct-08		0.5	3	Soil	Solids geochem

Table 2-6. Hand Core Samples

Location	Sample Name	Sample Date	Duplicate	Begin Depth (ft bgs)	End Depth (ft bgs)	Matrix	Analysis Type
Finger Evaporation Ponds (FEPs) - Continued							
OU4-FEP-54	OU4-FEP-54A-SC	18-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-FEP-54B-SC	18-Oct-08		0.25	3	Soil	Solids geochem
OU4-FEP-55	OU4-FEP-55A-SC	18-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-FEP-55B-SC	18-Oct-08		0.5	3	Soil	Solids geochem
OU4-FEP-56	OU4-FEP-56A-SC	18-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-FEP-56B-SC	18-Oct-08		0.25	1	Soil	Solids geochem
OU4-FEP-57	OU4-FEP-57A-SC	17-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-FEP-57B-SC	17-Oct-08		0.25	3	Soil	Solids geochem
OU4-FEP-58	OU4-FEP-58A-SC	17-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-FEP-58B-SC	17-Oct-08		0.5	3	Soil	Solids geochem
OU4-FEP-59	OU4-FEP-59A-SC	17-Oct-08		0	0.5	Pond Sediment	Solids geochem
	OU4-FEP-59B-SC	17-Oct-08		1	3	Soil	Solids geochem
OU4-FEP-60	OU4-FEP-60A-SC	17-Oct-08		0	0.25	Pond Sediment	Solids geochem
	OU4-FEP-60B-SC	17-Oct-08		0.25	3	Soil	Solids geochem
OU4-UEP-61 (next to UEP-08)	OU4-UEP-61-SED	16-Jan-09		0	1	Pond Sediment	Geotechnical
OU4-UEP-62 (next to UEP-07)	OU4-UEP-62-SED	16-Jan-09		0	1	Pond Sediment	Geotechnical
OU4-LEP-63 (next to LEP-03)	OU4-LEP-63-SED	16-Jan-09		0	0.5	Pond Sediment	Geotechnical
OU4-LEP-64 (near LEP-03)	OU4-LEP-64-SED	16-Jan-09		0	0.5	Pond Sediment	Geotechnical
OU4-FEP-65 (next to FEP-12)	OU4-FEP-65-SED	16-Jan-09		10”	16”	Pond Sediment	Geotechnical

Once removed from the core barrel, the plastic core sleeve was cut open, the thickness of the encountered material was estimated and described, and the sample intervals were selected. Samples were transferred from the core sleeve into a plastic ziplock bag, taking care to minimize cross-contamination from the different media (e.g. Pond sediments, VLT, and soils). An unavoidable, but limited, smearing effect within the core sleeve occurred for saturated Pond sediment intervals as the sediments were pushed through the sleeve, which resulted in a visible yellow staining on the outside of the underlying soil core intervals. Where possible, the potentially affected soil material was either excluded from the sample or the outer portions of the core were scraped with a spatula to remove as much stained material as possible. It was not possible to collect a completely unstained soil sample from eight locations, primarily in the LEP.

Twelve sample locations in the LEP and eight sample locations in the four FEPs did not contain a sufficient thickness of Pond sediment to collect an adequate sample volume from the core sleeve (i.e., where the sediment thickness was less than six inches). These samples were supplemented with material collected by disposable plastic trowel, which was used to widen the area around the original core hole so that the required volume of sample could be collected. Photos of the hand core sample collection method are presented in Appendix B.

Collected samples were transported to the on-Site field office for preparation and shipment to the project laboratories for the same solids geochemical analysis used in borehole sampling (Table 2-2). Samples were blended in 1-gallon ziplock bag to homogenize the materials collected from the designated sample intervals. This process included breaking any large clumps by hand using disposable gloves and tumbling the bag end-over-end for at least one minute. Materials with high silt or clay content required mixing or kneading by hand, which generally resulted in a less homogenized sample. A blended sample aliquot was placed in a 10-ounce glass jar for submittal to the TestAmerica Irvine lab for metals analysis. The material remaining in the original ziplock bag was submitted to the TestAmerica Richland lab for radiochemical analysis. Duplicate samples were collected at 10 percent of the locations as parallel core samples. Prepared samples for metals analysis were stored in a refrigerator at a controlled location (the Site field office) until they were packaged for shipment to the lab in a sample cooler refrigerated using wet ice.

Five locations in the Thumb Pond (OU4-FEP-48, -49, -50, -51 and -52) were anticipated to have moderately thick accumulations of Pond sediments in addition to the VLT cap. Samples from these locations were collected using the geoprobe rig rather than the hand core method. The sample collection and handling procedures were the same as described above for the hand core method. An approximate 12-foot thickness of Pond sediments was observed at sample location OU4-FEP-48. Therefore, two intervals were collected to represent shallow and deep Pond sediments at location OU4-FEP-48. Conversely, no sample was collected at location OU4-FEP-51 because of the 0.5-inch thickness of Pond sediments encountered at this location.

Five additional Pond sediment samples (Figure 2-8) were collected in January 2009 at select locations adjacent to previously sampled locations (OU4-UEP-61, UEP-62, LEP-63, LEP-64, and FEP-65) to provide additional geotechnical data not previously collected for the sediments.

These data were determined to be necessary for vadose zone modeling to supplement data from the shallow and deep soil samples. The additional sediment samples were collected by pushing a 6-inch brass core sleeve into the Pond sediments at intervals of 0 to 6 inches and 6 to 12 inches bgs. The core sleeves were sealed with plastic caps and hand delivered to AMEC Laboratory in Sparks, Nevada for particle size distribution and saturated hydraulic conductivity tests.

2.3 Radiological Survey

Pursuant to the RAC Work Plan, a radiological (gamma) survey was conducted on the exposed surface areas of the Ponds during the period October 14 through 18, 2008. Radiological survey equipment consisted of Ludlum model 2241-3 series survey meters with Ludlum model 44-20 3"x3" NaI radiation detectors. Transect mapping was performed using Trimble GeoXT global positioning system (GPS) units. Transect alignments are shown in Figures 8-1 and 8-2. The survey and mapping equipment was mounted to two infant jogger strollers and pushed by hand. The detectors were mounted along the main axle of the strollers so that the detector face was six inches from the ground. The strollers were pushed at approximately 1 meter per second (m/s) along transects spaced approximately 10 meters apart.

Due to difficult access, some sections of the LEP (saturated areas with or without crust) and the UEP (most notably the southernmost area) could not be surveyed, which resulted in deviations from the planned transects. In addition, large mine equipment tires and other scrap materials were encountered in the UEP, resulting in deviations from the 10-meter transect spacing. The inaccessible areas, or deviations to the transect spacing, did not adversely affect the radiological survey results presented in Section 8.0 of this RAC DSR.

Because the FEPs did not have definitive edges, survey transects were conducted up the berms and to the margins of undisturbed, vegetated alluvial areas. The three westernmost FEPs contained a variety of trash and debris (e.g., boards with nails, scrap iron, and broken glass), which resulted in minor damage to the survey equipment. FEP-4, located immediately west of the large capped Thumb Pond, had sufficiently rough terrain to damage the detection equipment and the strollers. In order to survey this pond, a four wheel drive vehicle was driven into some areas in order to leave smoother paths for the strollers to follow. The VLT cap on the Thumb Pond did not affect the radiological survey.

2.4 EPA Oversight

EPA provided oversight of sampling activities during implementation of the work activities by having contracted personnel from both CH2M Hill and TetraTech on Site for five days. Ms. Ilke Dinkleman of CH2M Hill observed geoprobe drilling, and soil and groundwater sampling activities on October 8 and 9. She provided a written summary of observations and concerns in a Technical Memorandum to Mr. David Seter (EPA) dated October 20, 2008.

Brown and Caldwell provided responses to those concerns in a follow-up Technical Memorandum No. 1 to Ms. Nadia Hollan Burke dated October 23, 2008. Copies of both communications are provided in Appendix C.

Mr. Doug Herlocker and Mr. Jerry Fauchaux of TetraTech observed drilling and hand core sampling procedures during the period October 13-15, and collected duplicate samples of Pond sediments, shallow and deep soils, and groundwater for analysis by an independent laboratory. Duplicate samples were collected by EPA's contractors from the following locations:

- OU4-UEP-06
- OU4-UEP-36
- OU4-UEP-40
- OU4-LEP-26
- OU4-UEP-09
- OU4-UEP-37
- OU4-LEP-19

EPA's analytical results have not been made available to ARC for inclusion in this RAC DSR to allow for the two data sets to be compared.

SECTION 3.0
POND SOLIDS AND SOIL GEOCHEMICAL DATA

This section of the RAC DSR presents the results of the field and laboratory activities associated with the sampling and analysis of Pond solids (sediment and VLT) and underlying alluvial soils, as described in Section 2.2.

3.1 Borehole Lithology

During drilling activities, soils were visually inspected and described by the field geologist and recorded in the field log books (Appendix A). Field descriptions included general soil classification, color observations, and approximate degree of moisture content. Detailed lithologic logs for the 17 boreholes are provided as Appendix D, including soil and groundwater sample identifications and intervals in addition to soil descriptions. Soil cores that were not submitted for laboratory analysis or otherwise used are preserved on Site in the core storage area of the Truck Shop building in the Process Areas. In addition to the visual field descriptions, select soil and pond sediment intervals were submitted to the DBS and AMEC Laboratories for geotechnical characterization including particle size analysis and ASTM soil classification. Further discussion of geotechnical results and soil classifications are presented in Section 7.0.

Generalized Pond Material and Soil Profiles

Generalized material profiles, including soil lithology, for each of the Ponds are shown in Figure 3-1. These profiles are intended to combine field observations with physical data obtained from lab analyses, and provide the basis for the preliminary vadose zone modeling results described in Section 7.0. The generalized profiles for each Pond are discussed below.

Lined Evaporation Pond – In terms of physical properties and observed hydraulic conditions, the LEP is represented by two end-member ‘sub-areas’: 1) areas of seasonal standing water (’wet’ areas); and 2) peripheral ‘dry’ areas. Transitional sediment and soil moisture conditions likely occur between the two ‘sub-areas’. The differences between the ‘wet’ and ‘dry’ areas, as observed in the field, include Pond sediment characteristics (i.e., the presence of a surface crust of evaporite crystals) and the higher degree of saturation of Pond sediments and underlying VLT liner sub-base and alluvial soils in the 'wet' areas. The single profile for the LEP shown in Figure 3-1 represents proximal 'wet' area Pond sediment and soil conditions, including laboratory results from the two characterization boreholes drilled in the LEP, as previously described in Section 2.2.

Throughout the LEP, a layer of yellow silty Pond sediments (similar to the UEP sediments) ranging from three to 12 inches thick (Figure 2-9) and averaging six-inches was observed in October 2008 to be dry to slightly moist in the 'dry' areas and completely saturated in the 'wet' areas. Given their proximity, Pond sediment and underlying soil hydraulic properties in the southern portion of the LEP are anticipated to be similar to the characteristics of the sediments and soils associated with the UEP during the 'dry' season (mid-to-late summer through October). Potentially, other peripheral 'dry' portions of the LEP may also be similar to the sediments and underlying soils associated with the UEP during the 'dry' season.

Within the LEP 'wet' areas, a cap (1- to 3-inch thickness) of soft white crystals overlain by a hardened 1-inch thick layer of crystals with a greenish color and a wrinkled texture was also observed in the 'wet' areas (this surface crust could support the weight of an adult although the underlying material was fairly soft). Although its chemical composition has not been determined, the crystalline material is interpreted to be an evaporite salt (most likely a sulfate salt because of the high sulfate concentrations present in the spent process solutions). Pore water contained in these saturated Pond sediments was acidic (pH values commonly less than 1.0).

Underlying the LEP sediments is a thin asphalt liner situated on top of an 8 to 18 inch thick base of VLT. The asphalt liner is significantly degraded with cracking and crumbling of the material when exposed at the surface or where it underlies areas of thin Pond sediments. In areas where the liner has been protected by a thicker layer of sediments, it appears to be in fairly good condition (as observed at locations where samples were collected). The VLT sub-base materials and shallow soils were observed to be saturated in the boreholes proximal to the 'wet' areas, indicating hydraulic communication between the saturated Pond sediments and the VLT/shallow alluvial soils. Shallow soils under the LEP are generally characterized as silty materials with clays and sands associated with the distal alluvial fan depositional and transitional settings. Locally, within the 'wet' areas of the LEP, shallow soils exhibited clays with a dense, plastic characteristic. The occurrence of the dense clay material may result from: 1) natural conditions associated with the deposition of lake bed sediments in Pleistocene Lake Lahontan; 2) clay formation as a result of pre-mining agricultural practices in this area; and/or 3) the leaching of shallow soils by the percolation of acidic process solutions during the period of Pond operations.

Although the Pond sediments in the 'dry' areas of the LEP and the UEP (described below) appear to be generally similar, these two Pond sediment types likely exhibit different hydraulic responses to direct precipitation. For example, lateral flow of meteoric water towards the central 'wet' areas of the LEP (as surface run-off and/or sub-flow along the sediment-liner contact) appears to occur because of the presence of the liner (assumes sufficient liner integrity). In addition, direct precipitation is not anticipated to result in the same degree of saturation in the UEP sediments during the 'wet' season due to the absence of the asphalt liner.

Unlined Evaporation Pond - The UEP consists of a top layer of yellow fine-grained Pond sediment, predominantly silt with up to ten percent clay and only minor sand. In the north-central and northwestern areas of the UEP, a layer of red sediment up to 12 inches thick occurs beneath the yellow sediment, and likely represents the evaporative residue from process solutions that accumulated during an early operational phase prior to the segregation of waste types into separate Pond areas. The measured thickness of Pond sediments ranges from 6 to 72 inches (Figure 2-9), with an average thickness of approximately 18 inches (the greatest thickness is observed at the southern tip of the UEP).

In October 2008, the top three inches of Pond sediments were observed to be dry. Below the top three inches, moisture content of the sediments was estimated as slightly moist. Very moist to near saturated conditions were not observed in these Pond sediments. The Pond sediments directly overlie the alluvial soils (i.e., no liner material between the sediments and soils). While the contact with the soil was generally well defined, color variations were locally observed in the top six inches of soil, indicating some intermixing with Pond sediments. Shallow soils (distal alluvial fan materials and other soil types) were classified as predominantly silty sands (4 to 10 feet thick) with deeper soils consisting of interbedded layers of sand, silt and clay.

Finger Evaporation Ponds - The four FEPs were constructed in a similar manner as the LEP, with yellow silty Pond sediments overlying an asphalt liner. However, very limited or no VLT base material was observed beneath the asphalt liners in the FEPs. Pond sediments were observed to be only 3 to 6 inches thick, and were very dry at the time of sampling in October 2008. Some areas exhibited a hardened crust of evaporite salt crystals, although not as well developed as in the LEP, and no areas of soft saturated sediments were present underneath the crust. Shallow soils under the liner are classified as silty sands with gravel (coarser grained than the soils under the LEP or UEP, consistent with their location higher up on the alluvial fan).

Thumb Pond - The Thumb Pond as a longer operational history than the other FEPs (from approximately 1955 to 1977), and received calcine tails and other dust precipitates from sulfur ore roasting to produce sulfuric acid (the other FEPs received spent process solutions from the vat leaching process). Red-colored sediments were observed to consist of homogeneous, very fine-grained silt with physical characteristics similar to the yellow sediments described above. The Thumb Pond area was capped with VLT materials, from 6 to 18 inches in thickness.

The red silty sediments ranged in thickness from one inch to 11.5 feet, with an approximate average thickness of four feet. During the October 2008 sampling event, the sediments were observed to be slightly moist throughout most of the profile. In areas of Pond sediment thickness greater than four feet, the base of the sediment profile (a 2- to 6-inch zone just above its contact with underlying soils) was observed to be saturated (i.e., the cored material would drip pore water when retrieved, partly a result of the core being slightly compressed during sampling). The contact with the underlying soil was well defined, with localized ‘bleeding’ of red sediment into the top several inches of soil. The soils were observed to be dry, and similar to the alluvial fan materials under FEPs 1-4 (silty sands and minor gravels).

3.2 Gravimetric Moisture Content of Geochemical Samples

Gravimetric moisture contents were determined for all Pond samples (analytical results are reported on a dry weight basis). Gravimetric water content is defined as the mass of water in a soil divided by the mass of the soil. Table 3-1 summarizes gravimetric soil moisture values from TestAmerica for each geochemical sample interval. Section 7.0 summarizes gravimetric and volumetric soil moisture data for geotechnical samples analyzed by DBS.

Table 3-1. Gravimetric Moisture Content for Pond Samples

Location Name	Date	VLT Cap	Pond Sediments	Pond Sediments (deep)	VLT Base	Soil (shallow)	Soil (deep)
		% Moisture[(1)]	% Moisture	% Moisture	% Moisture	% Moisture	% Moisture
Lined Evaporation Pond (LEP)							
OU4-LEP-01	05-Oct-08					13.0	11.0
OU4-LEP-02	06-Oct-08					12.4	11.2
OU4-LEP-03	06-Oct-08					17.7	13.9
OU4-LEP-04	07-Oct-08					7.6	9.3
OU4-LEP-05	07-Oct-08					18.6	15.2
OU4-LEP-18	18-Oct-08		4.9			16.9	
OU4-LEP-19	15-Oct-08		19.3			19.0	
OU4-LEP-20	15-Oct-08		21.5			20.9	
OU4-LEP-21	19-Oct-08		13.4			19.9	
OU4-LEP-22	18-Oct-08		34.1			18.1	
OU4-LEP-23	18-Oct-08		28.3			17.6	
OU4-LEP-24	30-Oct-08		27.2			19.4	
OU4-LEP-25	19-Oct-08		20.8			15.4	
OU4-LEP-26	15-Oct-08		7.3			15.1	
OU4-LEP-27	18-Oct-08		38.0			19.2	
OU4-LEP-28	18-Oct-08		4.5			11.0	
OU4-LEP-29	17-Oct-08		8.6		5.3	16.2	
OU4-LEP-30	17-Oct-08		11.3		6.8	20.7	
OU4-LEP-31	17-Oct-08		6.4		5.4	9.2	
OU4-LEP-32	17-Oct-08		18.4		5.3	11.3	
	Minimum		**4.5**		**5.3**	**7.6**	**9.3**
	Median		**18.4**		**5.4**	**17.3**	**11.2**
	Average		**17.6**		**5.7**	**16.0**	**12.1**
	Maximum		**38.0**		**6.8**	**20.9**	**15.2**

Table 3-1. Gravimetric Moisture Content for Pond Samples

Location Name	Date	VLT Cap	Pond Sediments	Pond Sediments (deep)	VLT Base	Soil (shallow)	Soil (deep)
		% Moisture(1)	% Moisture	% Moisture	% Moisture	% Moisture	% Moisture
Unlined Evaporation Pond (UEP)							
OU4-UEP-06	14-Oct-08					15.7	14.6
OU4-UEP-07	08-Oct-08					10.6	13.6
OU4-UEP-08	08-Oct-08					3.0	5.6
OU4-UEP-09	14-Oct-08					24.7	14.3
OU4-UEP-10	12-Oct-08					20.0	14.3
OU4-UEP-11	09-Oct-08					7.4	7.2
OU4-UEP-33	18-Oct-08		6.1			7.2	
OU4-UEP-34	17-Oct-08		10.8			11.1	
OU4-UEP-35	16-Oct-08		21.5			21.4	
OU4-UEP-36	15-Oct-08		22.3			21.1	
OU4-UEP-37	15-Oct-08		7.9			25.7	
OU4-UEP-38	16-Oct-08		19.8			20.6	
OU4-UEP-39	16-Oct-08		18.2			20.6	
OU4-UEP-40	16-Oct-08		20.4			25.2	
OU4-UEP-41	16-Oct-08		19.3	35.8		26.0	
OU4-UEP-42	16-Oct-08		11.0	20.6		16.6	
OU4-UEP-43	16-Oct-08		18.5			12.9	
OU4-UEP-44	16-Oct-08		4.5			18.7	
OU4-UEP-45	16-Oct-08		19.1			22.6	
OU4-UEP-46	16-Oct-08		23.4			18.4	
OU4-UEP-47	16-Oct-08		3.8	14.8		16.7	
	Minimum		**3.8**	**14.8**		**3.0**	**5.6**
	Median		**18.5**	**20.6**		**18.7**	**14.0**
	Average		**15.1**	**23.7**		**17.4**	**11.6**
	Maximum		**23.4**	**35.8**		**26.0**	**14.6**
Finger Evaporation Ponds (FEPs)							
OU4-FEP-12	13-Oct-08					7.4	10.7
OU4-FEP-13	12-Oct-08					7.5	12.0
OU4-FEP-48	09-Oct-08	0.7	15.6	38.2		8.6	
OU4-FEP-49	09-Oct-08	1.0	19.7			7.2	
OU4-FEP-50	09-Oct-08	1.0	40.6			4.3	
OU4-FEP-51	09-Oct-08	1.0				5.2	
OU4-FEP-52	09-Oct-08	1.5	46.9			4.1	
OU4-FEP-14	29-Oct-08					14.0	8.0
OU4-FEP-15	29-Oct-08					13.1	12.3
OU4-FEP-16	28-Oct-08					7.4	5.3
OU4-FEP-17	28-Oct-08					7.8	
OU4-FEP-53	18-Oct-08		8.7			9.2	
OU4-FEP-54	18-Oct-08		17.2			10.3	
OU4-FEP-55	18-Oct-08		17.1			12.8	

Table 3-1. Gravimetric Moisture Content for Pond Samples

Location Name	Date	VLT Cap	Pond Sediments	Pond Sediments (deep)	VLT Base	Soil (shallow)	Soil (deep)
		% Moisture[(1)]	% Moisture	% Moisture	% Moisture	% Moisture	% Moisture
Finger Evaporation Ponds (FEPs) - Continued							
OU4-FEP-56	18-Oct-08		2.9			11.0	
OU4-FEP-57	17-Oct-08		5.8			8.6	
OU4-FEP-58	17-Oct-08		2.9			12.2	
OU4-FEP-59	17-Oct-08		6.0			10.4	
OU4-FEP-60	17-Oct-08		4.2			7.3	
	Minimum	**0.7**	**2.9**	**38.2**		**4.1**	**5.3**
	Median	**1.0**	**12.2**	**38.2**		**8.6**	**10.7**
	Average	**1.0**	**15.6**	**38.2**		**8.9**	**9.7**
	Maximum	**1.5**	**46.9**	**38.2**		**14.0**	**12.3**
	Overall Minimum	**0.7**	**2.9**	**14.8**	**5.3**	**3.0**	**5.3**
	Overall Median	**1.0**	**17.2**	**28.2**	**5.4**	**13.6**	**11.6**
	Overall Average	**1.0**	**16.1**	**27.4**	**5.7**	**14.2**	**11.2**
	Overall Maximum	**1.5**	**46.9**	**38.2**	**6.8**	**26.0**	**15.2**

The data presented in Table 3-1 indicate the following general conditions for the Pond solids:

- The average gravimetric moisture content for LEP sediments (17.6 percent) is greater than that of the VLT base (5.7 percent) and the underlying soils (16.0 percent). The five shallow and deep soil sample pairs beneath the LEP indicate that, on average, shallow soils contain about 30 percent more moisture than deep soils (16.0 vs. 12.1 percent). Shallow soils underlying areas of seasonal standing water (OU-4-LEP-01, -02, -03, -05, 19, -20, -21, -24, -27 and -30) exhibit about 30 percent greater moisture content than soils beneath other portions of the LEP (averages of 18.1 vs. 13.8 percent).
- The average gravimetric moisture content of shallow UEP sediments (15.1 percent) is less than that of the underlying shallow soils (17.4 percent), a different condition than observed for the LEP. Three deep UEP sediment samples in areas with sufficient sediment thickness average 23.7 percent. Although four of six shallow and deep soil sample pairs beneath the UEP exhibit greater moisture contents in the shallow sample, no clear conclusion regarding shallow vs. deep soil moisture content can be reached.
- The average gravimetric moisture content (15.6 percent) of the sediments in the FEPs, including the Thumb Pond, was about 75 percent greater than the value (8.9 percent) for subjacent shallow soils. A deep sediment sample from OU-4-FEP-2 in the Thumb Pond yielded a gravimetric moisture content of 38.2 percent. Although three of five soil sample pairs beneath the UEP exhibit greater moisture contents in the shallow sample, no clear conclusion regarding shallow vs. deep soil moisture content can be reached.

As explained in Section 7.0, the gravimetric moisture data provided by TestAmerica for the Pond solids samples, specifically the soil samples, cannot be directly correlated to the soil gravimetric moisture values generated by the DBS Laboratory as a result of sample handling differences. In addition to the moisture content values presented in Figure 3-1, the Pond profiles include percent saturation values (the volume of water present in the material relative to the volume of the pores in the material). For example, if a soil has a porosity of 35 percent, and the volumetric water content is 35 percent, then the soil is 100 percent saturated. Clay-rich soils can exhibit saturation values in excess of 100 percent because these soils swell upon wetting, and the relative volume of water at saturation exceeds the soil porosity.

3.3 Pond Solids and Soil Geochemical Results

Table 3-2 summarizes analytical results from all Pond materials and soils sampled in boreholes and hand-cores, grouped by Pond area. All data presented in Table 3-2 have been reviewed for quality control using Level II (verification) and Level IV (validation) data review, as required by the QAPP (Revision 5). All original laboratory reports are provided in Appendix E and copies of data validation and verification reports are included in Appendix F. The following Qualifier flags have been assigned to denote the level of confidence and usability of the data (Section 6.0 presents more information regarding QA/QC issues for the solid material samples):

- U Analyte not detected above laboratory detection limit (< reported value).
- J Reported value is an estimated concentration.
- UJ Analyte not detected at an estimated concentration (< reported value).
- R The data is rejected and shall not be used for any purpose.

The same data presented in Table 3-2 are also summarized in Table 3-3 by solids media type (e.g. Pond sediment, soil and VLT) and Pond area. Table 3-3 also provides: 1) the minimum, median, average, and maximum concentrations of each analyte for each media type and Pond area; and 2) EPA regional screening levels (RSLs; EPA, 2008) presented in the most recently updated QAPP (Revision 5) and the updated *Background Soils Data Summary Report* dated March 9, 2009 (Background Soils DSR, Revision 1; Brown and Caldwell, 2009a).

Background concentration limits for soils presented in Table 3-3, and in Section 9.0 of this RAC DSR, were derived from the soils data for the northern of the two reference areas (sub-Area A-1). The proximity of background soils sub-Area A-1 to the FEPs (Figure 2-7) indicates that the alluvial fan material types underlying the FEPs are represented by the sub-Area A-1 soils data and associated background concentration limits. As indicated in Figure 2-7, it is not likely that the other Pond areas (LEP and UEP) were constructed on sub-Area A-1 soil types.

Distribution of Select Analytes in Solid Materials

Chemical concentration data for a number of analytes sampled from VLT materials, Pond sediments and subjacent soils are discussed below. The spatial distribution of these analytes (arsenic, copper, iron, mercury, molybdenum, nickel, selenium, thallium, uranium, zinc, radium-226, radium-/228, and radium-226/228 combined) are shown in Figures 3-2 through 3-14.

VLT

Analytical results for VLT materials are generally consistent, as would be expected for this chemically homogeneous spent ore that was used as a cap and as a sub-grade material in the Pond areas. One analyte that showed a noticeable difference between the two uses for the VLT in the Pond areas is sodium, which was found to be approximately 4 to 10 times greater in the VLT base material underlying the LEP than, for example, the cap on the Thumb Pond.

Pond Sediments

Some geochemical variability was observed between the sediments sampled in the different Ponds, most notably a difference between the red sediments collected from the Thumb Pond in relation to the yellow sediments found in the other Ponds. In addition, two samples were collected in the UEP from a deep layer of red sediments (OU4-UEP-41B and -42B), which were observed to be physically and geochemically similar to sediments in the Thumb Pond. This similarity indicates that calcine tailings were initially conveyed to the UEP during an early operational period before being restricted to the Thumb Pond.

The red sediments sampled in the Thumb Pond exhibit: 1) lower sodium and calcium concentrations than the yellow sediments found in the other Ponds; and 2) elevated concentrations of the following analytes compared to the yellow sediments found in the other Ponds:

Antimony	Chromium	Selenium	Zinc
Arsenic	Lead	Thallium	Radium-226
Barium	Mercury	Thorium	Radium-228
Cadmium	Nickel	Uranium	

Of these analytes, the concentrations of antimony, arsenic, barium, chromium, lead, mercury, nickel, selenium, uranium, and zinc are at least 10 times higher in the red sediments than in the yellow sediments.

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lined Evaporation Pond																					
OU4-LEP-01	OU4-LEP-01A-SC	Soil 1	1.5	7	05-Oct-08		12,000	0.29 J	4.5	70	0.55	2.4 U	0.11 J	3,900	14	13	330 J	21,000	5.0	6,000	300
	OU4-LEP-01B-SC	Soil 2	15	18	05-Oct-08		8,800	0.32 J	5.3	71	0.46	2.3 U	0.072 J	3,800	9.3	7.2	110 J	16,000	4.5	4,400	250
OU4-LEP-02	OU4-LEP-02A-SC	Soil 1	20	25	06-Oct-08		11,000	0.38 J	24	77	1.8	17	0.069 J	5,100	11	6.7	38 J	18,000	6.0	5,200	280
	OU4-LEP-02B-SC	Soil 2	29	32	06-Oct-08		9,500	1.1 J	5.4	70	0.32 J	2.4 U	0.067 U	3,700	11	5.2	560 J	16,000	4.8	5,800	200
OU4-LEP-03	OU4-LEP-03A-SC	Soil 1	5	8	06-Oct-08		24,000	0.49 J	15	89	1.0	21	0.25 J	4,400	21	18	420 J	25,000	8.5	9,900	490
	OU4-LEP-03B-SC	Soil 2	15	18	06-Oct-08		13,000	0.57 J	10	110	0.44	7.5	0.076 J	17,000	13	7.3	26 J	20,000	6.2	6,500	330
OU4-LEP-04	OU4-LEP-04A-SC	Soil 1	3	8	07-Oct-08		8,000	0.39 J	7.0	61	0.31 J	2.3 U	0.065 U	3,800	10	4.2	99 J	19,000	4.8	3,200	140
	OU4-LEP-04A-SC-FD	Soil 1	3	8	07-Oct-08	Dup	7,000	0.46 J	6.0	54	0.23 J	2.3 U	0.065 U	3,400	8.4	3.9	91 J	18,000	4.1	3,200	130
	OU4-LEP-04B-SC	Soil 2	11	16	07-Oct-08		8,000	0.33 J	6.7	99	0.36	2.3 U	0.075 J	9,300	9.5	6.6	36 J	17,000	4.5	4,400	350
	OU4-LEP-04B-SC-FD	Soil 2	11	16	07-Oct-08	Dup	7,600	0.33 J	6.7	88	0.32 J	2.3 U	0.097 J	11,000	10	7.0	33 J	16,000	5.8	4,200	390
OU4-LEP-05	OU4-LEP-05A-SC	Soil 1	3	7	07-Oct-08		27,000	0.42 J	35 J	140	1.1 J	140	0.53 J	9,600	16	25	150 J	30,000	12	12,000	1,600
	OU4-LEP-05B-SC	Soil 2	12	15	07-Oct-08		11,000	0.59 J	11 J	140	0.42 J	2.5 U	0.12 J	20,000	13	11	25 J	21,000	7.2	6,000	660
OU4-LEP-18	OU4-LEP-18A-SC	Sed	0	0.25	18-Oct-08		1,800	0.53 UJ	3.3	9.9	0.53 U	22 U	0.32 U	31,000	2.7 J	4.4	130	180,000	2.0 J	1,000	68
	OU4-LEP-18B-SC	Soil 1	1.5	3	18-Oct-08		8,400	0.20 J	7.6	52	0.60 U	27	0.36 U	2,700	7.5	8.5	170	43,000	5.5	2,800	140
OU4-LEP-19	OU4-LEP-19A-SC	Sed	0	1	15-Oct-08		12,000 J	0.62 UJ	2.5 J	22 J	0.79 J	-- R	0.37 U	32,000 J	9.8 J	88 J	2,800	96,000 J	1.7 J	12,000 J	800 J
	OU4-LEP-19B-SC	Soil 1	1.7	3	15-Oct-08		37,000 J	0.46 J	14 J	89 J	1.3 J	34 J	0.26 J	8,300 J	25 J	29 J	1,000	42,000 J	9.8	14,000 J	710 J
OU4-LEP-20	OU4-LEP-20A-SC	Sed	0	0.25	19-Oct-08		14,000	0.64 UJ	2.2 UJ	16 J	0.65 J	27 UJ	0.38 U	50,000 J	7.3	66	1,800	150,000	1.4 J	11,000	800
	OU4-LEP-20B-SC	Soil 1	1	3	19-Oct-08		30,000	0.53 J	24 J	120 J	1.5 J	27 UJ	0.38 U	10,000 J	31	27	640	43,000	11	15,000	670
OU4-LEP-21	OU4-LEP-21A-SC	Sed	0	0.5	19-Oct-08		1,500	0.80 J	2.0 UJ	5.7 J	0.57 U	24 UJ	0.34 U	39,000 J	2.8 J	3.7	130	190,000	1.2 J	1,000	66
	OU4-LEP-21B-SC	Soil 1	1.5	3	19-Oct-08		10,000	0.34 J	17 J	92 J	0.62 U	26 UJ	0.37 U	7,500 J	14	6.1	200	60,000	5.6	3,800	170
OU4-LEP-22	OU4-LEP-22A-SC	Sed	0	0.5	18-Oct-08		18,000	0.25 J	2.7 U	19	1.1 J	13 U	0.46 U	20,000	12	65	1,400	120,000	3.4 J	13,000	860
	OU4-LEP-22B-SC	Soil 1	1.5	2.5	18-Oct-08		17,000	0.42 J	37	90	1.0 J	11	0.37 U	4,500	21	16	310	21,000	6.7	7,200	340
OU4-LEP-23	OU4-LEP-23A-SC	Sed	0	0.25	18-Oct-08		23,000	0.28 J	2.5 J	14	1.9 J	13 J	0.70 J	34,000	15	84	2,100	92,000	3.0 J	17,000	1,100
	OU4-LEP-23B-SC	Soil 1	2	3	18-Oct-08		23,000	0.51 J	39 J	77 J	1.2 J	22 J	0.36 U	4,700 J	21	21	520	29,000	8.1	10,000	510
OU4-LEP-24	OU4-LEP-24A-SC	Sed	0	0.5	19-Oct-08		15,000	0.69 UJ	3.5 J	8.5 J	1.2 J	29 UJ	0.41 U	34,000 J	14	52	1,100	170,000	2.1 J	12,000	1,000
	OU4-LEP-24B-SC	Soil 1	1.5	3	30-Oct-08		28,000	2.0 J	40	110	2.3	31	0.58 J	5,300	26	25	710	30,000	9.6	12,000	730
OU4-LEP-25	OU4-LEP-25A-SC	Sed	0	0.25	19-Oct-08		12,000	0.63 UJ	2.6 J	8.3 J	0.81 J	27 UJ	0.38 U	63,000 J	6.5	24	820	140,000	2.1 J	8,200	580
	OU4-LEP-25B-SC	Soil 1	1.5	3	19-Oct-08		18,000	0.43 J	15 J	90 J	0.90 J	26 J	0.35 U	5,000 J	13	15	320	20,000	6.7	7,400	430
OU4-LEP-26	OU4-LEP-26A-SC	Sed	0	0.25	15-Oct-08		4,800 J	0.54 UJ	3.5 J	12 J	0.54 UJ	57 J	0.32 U	47,000 J	3.8 J	7.8 J	160	160,000 J	3.2	4,300 J	310 J
	OU4-LEP-26B-SC	Soil 1	1	3	15-Oct-08		16,000 J	0.40 J	7.0 J	91 J	0.30 J	12 J	0.071 U	6,500 J	13 J	5.3 J	74	36,000 J	7.1	4,700 J	190 J
OU4-LEP-27	OU4-LEP-27A-SC	Sed	0	0.33	18-Oct-08		14,000	1.4 J	2.8 UJ	24 J	0.81 U	34 UJ	0.48 U	41,000 J	11	32	570	220,000	5.1	8,300	630
	OU4-LEP-27B-SC	Soil 1	2	3	18-Oct-08		26,000	0.52 J	49 J	72 J	1.3 J	110 J	0.37 U	12,000 J	16	17	550	34,000	9.2	9,600	1,000
OU4-LEP-28	OU4-LEP-28A-SC	Sed	0	0.25	18-Oct-08		860	0.52 UJ	4.2 J	11 J	0.52 U	22 UJ	0.31 U	53,000 J	2.5 J	0.42 U	32	170,000	3.1	140	8.4 U
	OU4-LEP-28B-SC	Soil 1	1	3	18-Oct-08		8,900	0.33 J	7.1 J	62 J	0.56 U	2.4 UJ	0.34 U	2,400 J	6.7	4.3	92	19,000	5.8	3,000	120
OU4-LEP-29	OU4-LEP-29A-SC	Sed	0	0.5	17-Oct-08		2,300	0.55 U	1.9 U	5.5	0.55 UJ	23 UJ	0.33 U	72,000	1.9 UJ	4.2 J	200	190,000	2.4 J	2,100	150
	OU4-LEP-29B-SC	VLT	0.5	2	17-Oct-08		4,700	1.8 J	4.6	40	0.53 UJ	2.2 UJ	0.32 U	2,500	8.4 J	2.2 J	220	11,000	2.5 J	4,800	43
	OU4-LEP-29C-SC	Soil 1	2	5	17-Oct-08		16,000	0.31 J	17	83	0.60 UJ	23 J	0.36 U	9,200	10 J	5.6 J	190	39,000	7.3	5,600	250
OU4-LEP-30	OU4-LEP-30A-SC	Sed	0	0.5	17-Oct-08		4,400	0.58 J	2.0 U	6.1	0.56 UJ	93 J	0.34 U	57,000	2.0 UJ	13 J	940	130,000	2.0 J	5,500	940
	OU4-LEP-30A-SC-FD	Sed	0	0.5	17-Oct-08	Dup	4,800	0.54 U	1.9 J	7.8	0.54 UJ	63 J	0.32 U	61,000	2.3 J	14 J	1,100	160,000	2.3 J	5,600	870
	OU4-LEP-30B-SC	VLT	0.5	2.5	17-Oct-08		4,700	0.64 J	2.8	28	0.54 UJ	7.7 J	0.32 U	3,200	1.9 UJ	2.8 J	380	11,000	2.7	4,100	79
	OU4-LEP-30B-SC-FD	VLT	0.5	2.5	17-Oct-08	Dup	5,300	0.54 U	4.3	32	0.54 UJ	7.9 J	0.32 U	3,400	3.3 J	3.8 J	450	12,000	3.1	4,800	86
	OU4-LEP-30C-SC	Soil 1	2.5	6	17-Oct-08		17,000	0.63 U	41 J	100	1.2 J	50 J	0.38 U	7,100 J	12 J	25 J	130 J	25,000	11	8,600	1,900
	OU4-LEP-30C-SC-FD	Soil 1	2.5	6	17-Oct-08	Dup	19,000	0.44 J	110 J	130	1.1 J	66 J	0.38 U	3,100 J	11 J	27 J	55 J	26,000	13	9,800	1,300
OU4-LEP-31	OU4-LEP-31A-SC	Sed	0	0.33	17-Oct-08		1,000	0.53 U	2.8	5.4	0.53 UJ	22 UJ	0.32 U	60,000	1.9 J	2.4 J	110	170,000	2.8	900	55
	OU4-LEP-31B-SC	VLT	0.33	2.5	17-Oct-08		4,400	0.67 J	3.2	26	0.52 UJ	2.2 UJ	0.31 U	2,000	3.9 J	3.3 J	370	13,000	2.4 J	4,200	44
	OU4-LEP-31C-SC	Soil 1	2.5	6	17-Oct-08		5,200	0.55 U	5.7	54	0.55 UJ	2.3 UJ	0.33 U	3,000	5.8 J	3.4 J	52	19,000	3.3	2,400	120
OU4-LEP-32	OU4-LEP-32A-SC	Sed	0	0.5	17-Oct-08		7,500	0.61 U	3.0 J	6.2	0.98 J	45 J	0.47 J	69,000	3.1 J	20 J	2,300	150,000	3.2	8,900	810
	OU4-LEP-32B-SC	VLT	0.5	3	17-Oct-08		4,800	1.6 J	4.6	35	0.53 UJ	2.2 UJ	0.32 U	3,000	3.9 J	2.9 J	440	13,000	3.6	4,800	62
	OU4-LEP-32C-SC	Soil 1	3	6	17-Oct-08		18,000	0.41 J	19	98	0.92 J	43 J	0.34 U	12,000	11 J	15 J	420	25,000	9.4	7,000	1,100

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Unlined Evaporation Pond																					
OU4-UEP-06	OU4-UEP-06A-SC	Soil 1	15.5	20	14-Oct-08		28,000	0.43 J	11 J	160 J	0.79	25 J	0.37 J	7,800	15	12	110 J	37,000	12	9,700	710 J
	OU4-UEP-06B-SC	Soil 2	30	35	14-Oct-08		5,600	0.27 J	7.0 J	57 J	0.23 J	2.5 UJ	0.071 U	2,100	8.3	4.1	42 J	12,000	3.3	2,400	140 J
OU4-UEP-07	OU4-UEP-07A-SC	Soil 1	5	8	08-Oct-08		12,000	0.30 J	17 J	68	0.62 J	5.8	0.085 J	12,000	14	6.1	210 J	28,000	6.1	3,400	160
	OU4-UEP-07B-SC	Soil 2	17	20	08-Oct-08		16,000	0.37 J	10 J	110	0.43 J	2.4 U	0.10 J	3,500	12	7.7	52 J	25,000	7.3	5,900	320
OU4-UEP-08	OU4-UEP-08A-SC	Soil 1	3	6	08-Oct-08		2,100	0.25 J	17	42	0.10 U	4.3 U	0.062 U	2,400	3.9 J	1.9	20	10,000	2.5 J	1,000	61 J
	OU4-UEP-08A-SC-FD	Soil 1	3	6	08-Oct-08	Dup	3,000	0.26 J	18	49	0.10 U	4.3 U	0.062 U	2,900	6.2 J	2.1	21	13,000	4.0 J	1,100	70 J
	OU4-UEP-08B-SC	Soil 2	10	13	08-Oct-08		4,300	0.26 J	27	62	0.11 J	4.4 U	0.064 U	3,900	6.7	2.9	35	13,000	3.8	2,000	110 J
	OU4-UEP-08B-SC-FD	Soil 2	10	13	08-Oct-08	Dup	5,300	0.29 J	31	77	0.13 J	4.4 U	0.064 U	4,200	7.9	3.4	40	15,000	4.0	2,300	120 J
OU4-UEP-09	OU4-UEP-09A-SC	Soil 1	4	7	14-Oct-08		21,000	0.52 J	35 J	190 J	0.37 J	9.7 J	0.08 U	10,000	24	7.6	100 J	40,000	12	7,400	240 J
	OU4-UEP-09B-SC	Soil 2	16	20	14-Oct-08		9,200	0.36 J	8.0 J	100 J	0.34 J	2.5 UJ	0.07 U	3,900	11	5.0	31 J	15,000	4.2	3,700	230 J
OU4-UEP-10	OU4-UEP-10A-SC	Soil 1	3	5	12-Oct-08		24,000	0.56 J	71 J	170 J	0.42	13 J	0.09 J	4,500	25	6.9	100 J	36,000	11	7,400	240 J
	OU4-UEP-10B-SC	Soil 2	17	20	12-Oct-08		8,500	0.47 J	11 J	81 J	0.36	2.5 UJ	0.11 J	40,000	8.0	6.0	14 J	12,000	3.6	3,600	420 J
OU4-UEP-11	OU4-UEP-11A-SC	Soil 1	15	20	09-Oct-08		12,000	0.32 J	13	81	0.39	13	0.065 U	7,400	5.8	3.9	22	12,000	5.8	3,700	350 J
	OU4-UEP-11B-SC	Soil 2	31	35	09-Oct-08		12,000	0.38 J	6.3	100	0.37	4.5 U	0.065 U	3,200	8.0	6.3	30	18,000	6.6	5,800	540 J
OU4-UEP-33	OU4-UEP-33A-SC	Sed	0	0.5	18-Oct-08		3,400	0.90 J	23	26	0.53 U	38 J	0.32 U	33,000	8.7	8.7	430	170,000	23	2,500	200
	OU4-UEP-33B-SC	Soil 1	0.5	3	18-Oct-08		4,000	0.23 J	9.0	47	0.54 U	10	0.32 U	5,500	3.3 J	1.8 J	51	19,000	4.5	1,300	63
OU4-UEP-34	OU4-UEP-34A-SC	Sed	0	2	17-Oct-08		10,000	1.1 J	75	35	0.56 UJ	31 J	0.34 U	73,000	23 J	12 J	950	190,000	22	7,000	540
	OU4-UEP-34B-SC	Soil 1	2	3	17-Oct-08		6,600	0.30 J	37	62	0.56 UJ	11 J	0.34 U	8,200	5.7 J	2.7 J	120	32,000	5.4	2,300	95
OU4-UEP-35	OU4-UEP-35A-SC	Sed	0	1.5	16-Oct-08		2,500	0.64 U	80 J	48	0.64 UJ	13 U	0.38 UJ	41,000	8.2 J	5.9 J	270 J	180,000	32	1,500	130 J
	OU4-UEP-35B-SC	Soil 1	1.5	3	16-Oct-08		14,000	0.45 J	92 J	140	0.64 UJ	27	0.38 UJ	7,100	16 J	7.2 J	230 J	34,000	9.1	5,300	230 J
OU4-UEP-36	OU4-UEP-36A-SC	Sed	0	1	15-Oct-08		3,400 J	1.0 J	120 J	68 J	0.64 UJ	20 J	0.39 U	46,000 J	13 J	7.3 J	360	180,000 J	50	1,700 J	130 J
	OU4-UEP-36B-SC	Soil 1	1	3	15-Oct-08		19,000 J	0.46 J	49 J	120 J	0.35 J	66 J	0.092 J	11,000 J	12 J	6.3 J	280	42,000 J	9.8	5,300 J	250 J
OU4-UEP-37	OU4-UEP-37A-SC	Sed	0	1.5	15-Oct-08		4,600 J	0.77 J	23 J	39 J	0.54 UJ	13 J	0.33 U	36,000 J	4.7 J	13 J	720	120,000 J	17	3,700 J	290 J
	OU4-UEP-37B-SC	Soil 1	1.5	3	15-Oct-08		22,000 J	0.66 J	120 J	150 J	0.36 J	52 J	0.12 J	12,000 J	19 J	9.2 J	380	51,000 J	15	7,200 J	350 J
OU4-UEP-38	OU4-UEP-38A-SC	Sed	0	0.5	16-Oct-08		4,300 J	0.70 J	23 J	42 J	0.62 UJ	16 J	0.37 U	48,000 J	5.9 J	6.9 J	540	130,000 J	12 J	2,300 J	150 J
	OU4-UEP-38A-SC-FD	Sed	0	0.5	16-Oct-08	Dup	3,900 J	0.65 J	43 J	51 J	0.63 UJ	22 J	0.38 U	38,000 J	7.1 J	7.4 J	540	190,000 J	25 J	2,200 J	170 J
	OU4-UEP-38B-SC	Soil 1	0.5	3	16-Oct-08		25,000 J	0.45 J	67 J	130 J	0.38 J	36 J	0.086 J	9,700 J	18 J	7.7 J	320	63,000 J	11	7,800 J	300 J
	OU4-UEP-38B-SC-FD	Soil 1	0.5	3	16-Oct-08	Dup	24,000 J	0.44 J	70 J	150 J	0.64 UJ	40 J	0.38 U	13,000 J	23 J	9.7 J	390	62,000 J	13	7,300 J	280 J
OU4-UEP-39	OU4-UEP-39A-SC	Sed	0	1	16-Oct-08		7,600 J	0.61 UJ	65 J	50 J	0.61 UJ	43 J	0.37 U	31,000 J	8.6 J	4.8 J	330	190,000 J	14	2,400 J	150 J
	OU4-UEP-39B-SC	Soil 1	1	3	16-Oct-08		23,000 J	0.39 J	46 J	110 J	0.30 J	58 J	0.076 U	12,000 J	12 J	5.0 J	210	60,000 J	10	6,100 J	230 J
OU4-UEP-40	OU4-UEP-40A-SC	Sed	0	1	16-Oct-08		2,300 J	0.89 J	80 J	60 J	0.63 UJ	-- R	0.38 U	38,000 J	8.0 J	7.5 J	320	240,000 J	44	1,400 J	130 J
	OU4-UEP-40B-SC	Soil 1	1	3	16-Oct-08		26,000 J	0.53 J	110 J	130 J	0.38 J	56 J	0.083 J	13,000 J	17 U	6.1 J	240	58,000 J	14	7,200 J	280 J
OU4-UEP-41	OU4-UEP-41A-SC	Sed	0	0.5	16-Oct-08		8,200	0.62 U	83 J	32	0.77 J	13 U	0.47 J	50,000	28 J	14 J	500 J	140,000	21	3,900	470 J
	OU4-UEP-41B-SC	Sed	0.5	2	16-Oct-08		11,000	7.8	790 J	300	0.78 UJ	16 U	0.89 J	12,000	91 J	69 J	280 J	130,000	160	3,100	260 J
	OU4-UEP-41C-SC	Soil 1	2	3	16-Oct-08		27,000	0.55 J	52 J	150	1.1 J	12	0.41 UJ	12,000	34 J	16 J	430 J	37,000	15	10,000	470 J
OU4-UEP-42	OU4-UEP-42A-SC	Sed	0	0.33	16-Oct-08		7,500	0.56 U	130 J	14	0.66 J	17 J	0.53 J	41,000	14 J	13 J	260 J	160,000	12	3,900	510 J
	OU4-UEP-42B-SC	Sed	0.33	2.5	16-Oct-08		4,300	9.6	540 J	360	0.63 UJ	13 U	0.82 J	4,000	62 J	77 J	150 J	99,000	170	1,000	110 J
	OU4-UEP-42C-SC	Soil 1	2.5	6	16-Oct-08		18,000	0.60 U	25 J	100	0.80 J	26	0.36 UJ	10,000	14 J	8.9 J	130 J	27,000	8.8	6,800	390 J
OU4-UEP-43	OU4-UEP-43A-SC	Sed	0	1	16-Oct-08		3,000 J	0.75 J	71 J	55 J	0.61 UJ	23 J	0.37 U	41,000 J	9.8 J	6.0 J	230	200,000 J	46	1,800 J	120 J
	OU4-UEP-43B-SC	Soil 1	1	3	16-Oct-08		7,700 J	0.36 J	68 J	60 J	0.16 J	7.3 J	0.069 U	3,600 J	10 J	3.5 J	60	19,000 J	4.8	2,500 J	120 J
OU4-UEP-44	OU4-UEP-44A-SC	Sed	0	0.33	16-Oct-08		1,700 J	0.57 J	81 J	45 J	0.52 UJ	41 J	0.31 U	28,000 J	9.1 J	2.4 J	160	210,000 J	32	1,000 J	66 J
	OU4-UEP-44A-SC-FD	Sed	0	0.33	16-Oct-08	Dup	1,500	0.97 J	70 J	32	0.52 UJ	34 J	0.31 UJ	27,000	7.8 J	2.5 J	150 J	190,000	32	1,200	79 J
	OU4-UEP-44B-SC	Soil 1	0.33	3	16-Oct-08		23,000 J	0.56 J	120 J	130 J	0.32 J	31 J	0.074 U	9,400 J	20 J	5.5 J	87	47,000 J	12	7,100 J	220 J
	OU4-UEP-44B-SC-FD	Soil 1	0.33	3	16-Oct-08	Dup	16,000	0.61 J	130 J	120	0.31 J	20	0.074 UJ	11,000	17 J	4.9 J	80 J	41,000	12	6,200	200 J
OU4-UEP-45	OU4-UEP-45A-SC	Sed	0	1	16-Oct-08		6,000	0.63 J	31 J	39	0.62 UJ	13 U	0.37 UJ	26,000	7.2 J	7.6 J	240 J	120,000	9.7	5,900	190 J
	OU4-UEP-45B-SC	Soil 1	1	3	16-Oct-08		16,000	0.83 J	58 J	110	0.40 J	6.6 J	0.091 J	9,900	16 J	6.5 J	120 J	42,000	14	6,000	250 J
OU4-UEP-46	OU4-UEP-46A-SC	Sed	0	1.5	16-Oct-08		8,400	1.4 J	100 J	65	0.65 UJ	5.5 U	0.39 UJ	10,000	25 J	11 J	1,700 J	73,000	28	6,600	97 J
	OU4-UEP-46B-SC	Soil 1	1.5	3	16-Oct-08		14,000	0.63 J	42 J	100	0.51 J	10 J	0.098 J	13,000	10 J	5.2 J	160 J	49,000	16	4,400	200 J

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
OU4-UEP-47	OU4-UEP-47A-SC	Sed	0	3	16-Oct-08		4,000	0.60 J	1.8 UJ	22	0.52 UJ	2.2 U	0.31 UJ	3,500	4.2 J	2.8 J	470 J	12,000	1.6 J	4,600	54 J
	OU4-UEP-47A-SC-FD	Sed	0	3	16-Oct-08	Dup	4,000	0.34 J	1.8 UJ	21	0.51 UJ	2.2 U	0.31 UJ	3,600	4.3 J	3.0 J	490 J	12,000	1.5 J	4,700	56 J
	OU4-UEP-47B-SC	Sed	3	6	16-Oct-08		4,900	0.47 J	7.6 J	36	0.58 UJ	2.5 U	0.35 UJ	3,600	7.4 J	6.5 J	790 J	19,000	4.3	5,000	110 J
	OU4-UEP-47B-SC-FD	Sed	3	6	16-Oct-08	Dup	4,700	0.59 U	32 J	39	0.59 UJ	2.4 U	0.35 UJ	3,100	18 J	8.1 J	900 J	27,000	6.1	4,600	130 J
	OU4-UEP-47C-SC	Soil 1	6	9	16-Oct-08		15,000	0.40 J	41 J	95	0.89 J	7.4	0.36 UJ	8,200 J	9.7 J	13 J	230 J	27,000	7.9	4,500	540 J
	OU4-UEP-47C-SC-FD	Soil 1	6	9	16-Oct-08	Dup	15,000	0.34 J	22 J	80	0.97 J	3.7 J	0.35 UJ	16,000 J	7.5 J	9.8 J	260 J	18,000	6.5	4,100	280 J
Finger Evaporation Pond																					
OU4-FEP-12	OU4-FEP-12A-SC	Soil 1	11	15	13-Oct-08		8,700	0.38 J	150 J	110 J	0.26 J	2.3 UJ	0.065 U	2,500	26	2.3	58 J	17,000	6.5	1,900	75 J
	OU4-FEP-12B-SC	Soil 2	41	45	13-Oct-08		11,000	0.31 J	15 J	89 J	0.37	2.3 UJ	0.067 U	5,600	12	3.6	30 J	13,000	4.9	2,800	120 J
OU4-FEP-13	OU4-FEP-13A-SC	Soil 1	6	8	12-Oct-08		7,600	0.68 J	86 J	95 J	0.22 J	2.3 UJ	0.065 U	1,300	18	2.6	160 J	18,000	6.0	2,400	79 J
	OU4-FEP-13B-SC	Soil 2	40	43	12-Oct-08		9,800	0.42 J	22 J	91 J	0.44	3.2 J	0.069 U	8,100	13	3.9	78 J	12,000	8.4	2,800	150 J
OU4-FEP-14	OU4-FEP-14A-SC	Soil 1	2	3.5	29-Oct-08		9,500	1.2 J	14	90	0.58 U	24 U	0.35 U	9,300	13	7.1	44	51,000	6.9	2,800	130
	OU4-FEP-14B-SC	Soil 1	5	6.5	29-Oct-08		7,100	0.58 UJ	12	65	0.56 U	23 U	0.33 U	6,700	11	6.1	31	30,000	5.5	3,000	140
	OU4-FEP-14C-SC	Soil 2	45	46.5	29-Oct-08		6,200	0.54 U	6.5	85	0.54 U	23 U	0.33 U	7,000	9.5	3.3	40	11,000	5.1	2,500	130
OU4-FEP-15	OU4-FEP-15A-SC	Soil 1	2	3.5	29-Oct-08		8,800	0.67 UJ	9.9	76	0.58 U	24 U	0.35 U	5,200	12	7.8	54	30,000	4.9	2,900	140
	OU4-FEP-15B-SC	Soil 2	50	51.5	29-Oct-08		12,000	0.57 U	6.1	100	0.79 J	24 U	0.34 U	16,000	10	6.3	61	20,000	6.8	3,800	250
OU4-FEP-16	OU4-FEP-16A-SC	Soil 1	2	3.5	28-Oct-08		5,500	0.54 U	6.3	76	0.54 U	23 U	0.32 U	5,100	7.2	2.9	39	17,000	4.9	2,100	99
	OU4-FEP-16B-SC	Soil 2	65	66.5	28-Oct-08		9,800	0.70 UJ	7.0	97	0.53 U	22 U	0.32 U	11,000	56	4.7	20	18,000	7.2	3,800	420
OU4-FEP-17	OU4-FEP-17A-SC	Soil 1	2	3.5	28-Oct-08		5,000	0.54 U	9.1	87	0.54 U	23 U	0.33 U	5,300	9.3	2.5 J	34	21,000	4.9	1,700	90
OU4-FEP-48	OU4-FEP-48A-SC	VLT	0	0.5	09-Oct-08		6,400	2.4 J	6.3	52	0.16 J	4.2 U	0.06 U	3,800	3.7	4	1,800	12,000	4.8	5,000	44 J
	OU4-FEP-48B-SC	Sed	0.5	5	09-Oct-08		6,500	9.2 J	210	720	0.15 J	12 U	2.4	670	46	56	300	100,000	500	1,600	53 J
	OU4-FEP-48C-SC	Sed	9	12	09-Oct-08		9,500	12 J	1,400	1,100	0.31 J	17 U	2.2	500	180	66	450	150,000	200	280	30 J
	OU4-FEP-48D-SC	Soil 2	12	15	09-Oct-08		11,000	0.35 J	55	120	0.47	4.6 U	0.066 U	3,200	22	2.5	44	13,000	5.3	2,600	97 J
OU4-FEP-49	OU4-FEP-49A-SC	VLT	0	0.5	09-Oct-08		5,800	1.5 J	3.8	38	0.11 J	4.2 U	0.061 U	2,000	3.3	2.6	500	9,800	4.2	4,500	44 J
	OU4-FEP-49B-SC	Sed	0.5	4	09-Oct-08		6,400	9.1 J	420	760	0.25 U	10 U	1.8	1,300	89	71	430	98,000	400	780	39 J
	OU4-FEP-49C-SC	Soil 1	5	8	09-Oct-08		5,600	0.33 J	190	100	0.16 J	4.5 U	0.065 U	1,500	21	1.5	18	28,000	6.6	1,200	50 J
OU4-FEP-50	OU4-FEP-50A-SC	VLT	0	0.5	09-Oct-08		8,200	2.1 J	8.5	59	0.16 J	4.2 U	0.061 U	3,800	6.7	4.2	950	16,000	7.6	6,200	49 J
	OU4-FEP-50B-SC	Sed	0.5	2	09-Oct-08		11,000	8.4 J	630	340	0.42 J	14 U	1.9	790	100	37	570	150,000	1100	640	32 J
	OU4-FEP-50C-SC	Soil 1	2	5	09-Oct-08		7,900	0.28 J	200	110	0.19 J	4.4 U	0.063 U	1,500	24	1.6	26	36,000	6.9	1,500	64 J
OU4-FEP-51	OU4-FEP-51A-SC	VLT	0	0.5	09-Oct-08		5,800	2.1 J	6.1	36	0.14 J	4.2 U	0.061 U	2,500	4.2	2.8	740	10,000	3.1	4,700	38 J
	OU4-FEP-51B-SC	Soil 1	1	5	09-Oct-08		5,200	0.30 J	54 J	64	0.18 J	2.2 U	0.063 U	4,100	11	1.2	51 J	17,000	7.4	1,100	50
OU4-FEP-52	OU4-FEP-52A-SC	VLT	0	0.5	09-Oct-08		4,900	1.9 J	5.4	42	0.16 J	4.3 U	0.061 U	4,200	3.1	2.3	860	11,000	4.3	4,100	28 J
	OU4-FEP-52B-SC	Sed	0.5	4	09-Oct-08		9,200	9.4 J	740	520	0.53 J	16 U	2.7	1,500	130	44	490	140,000	800	820	42 J
	OU4-FEP-52C-SC	Soil 1	5	8	09-Oct-08		6,400	0.25 J	160	68	0.20 J	4.4 U	0.063 U	1,300	23	1.5	16	20,000	4.7	1,300	55 J
OU4-FEP-53	OU4-FEP-53A-SC	Sed	0	0.5	18-Oct-08		1,400	0.55 UJ	1.9 U	7.4	0.55 U	23 U	0.33 U	18,000	1.9 U	6.1	35	250,000	4.8	720	42
	OU4-FEP-53B-SC	Soil 1	0.5	3	18-Oct-08		5,000	0.23 J	3.6	100	0.55 U	14	0.33 U	12,000	1.9 U	6.7	41	42,000	5.8	1,500	63
OU4-FEP-54	OU4-FEP-54A-SC	Sed	0	0.25	18-Oct-08		2,600	0.84 J	2.5 J	29	0.60 U	13 U	0.36 U	49,000	2.3 J	6.6	64	170,000	16	990	61
	OU4-FEP-54B-SC	Soil 1	0.25	3	18-Oct-08		1,000	0.22 J	7.0	76	0.56 U	2.4 J	0.33 U	1,100	4.4 J	3.6	33	6,200	5.3	240	11
OU4-FEP-55	OU4-FEP-55A-SC	Sed	0	0.5	18-Oct-08		2,200	0.92 J	3.2	28	0.60 U	13 U	0.36 U	41,000	3.9 J	6.2	55	150,000	17	910	56
	OU4-FEP-55B-SC	Soil 1	0.5	3	18-Oct-08		4,700	0.25 J	4.0	100	0.57 U	15	0.34 U	7,400	2.9 J	3.7	41	32,000	5.6	1,200	57
OU4-FEP-56	OU4-FEP-56A-SC	Sed	0	0.25	18-Oct-08		2,000	1.0 J	0.36 U	11	0.10 U	8.7 U	0.062 U	42,000	1.7	3.6	23	60,000	7.9	820	55
	OU4-FEP-56B-SC	Soil 1	0.25	1	18-Oct-08		7,100	0.32 J	8.1	98	0.56 U	15	0.34 U	7,900	6.5	6.6	45	33,000	11	2,100	110
OU4-FEP-57	OU4-FEP-57A-SC	Sed	0	0.25	17-Oct-08		2,600	0.53 U	4.1	8.6	0.53 UJ	22 UJ	0.32 U	160,000	3.9 J	1.2 J	42	170,000	4.5	900	60
	OU4-FEP-57B-SC	Soil 1	0.25	3	17-Oct-08		5,100	0.19 J	5.3	71	0.55 UJ	4.0 J	0.33 U	4,500	2.8 J	2.0 J	41	26,000	5.0	1,500	70
OU4-FEP-58	OU4-FEP-58A-SC	Sed	0	0.25	17-Oct-08		24,000	0.57 J	7.4	150	1.4 J	14 J	0.31 U	22,000	11 J	19 J	500	36,000	15	11,000	930
	OU4-FEP-58B-SC	Soil 1	0.5	3	17-Oct-08		5,700	0.27 J	5.4	70	0.57 U	21	0.34 U	5,400	4.9 J	2.2 J	43	26,000	5.6	1,700	75
OU4-FEP-59	OU4-FEP-59A-SC	Sed	0	0.5	17-Oct-08		26,000	0.90 J	6.9	150	1.6	15	0.41 J	15,000	12	38	640	35,000	15	13,000	980
	OU4-FEP-59B-SC	Soil 1	1	3	17-Oct-08		6,000	0.21 J	5.1	81	0.56 U	5.4 J	0.33 U	4,600	5.6	5.7	70	27,000	5.2	2,300	140
OU4-FEP-60	OU4-FEP-60A-SC	Sed	0	0.25	17-Oct-08		1,500	0.52 UJ	4.4	18	0.52 U	11 U	0.31 U	42,000	1.9 J	1.4 J	31	120,000	3.4	580	40
	OU4-FEP-60B-SC	Soil 1	0.25	3	17-Oct-08		5,700	0.29 J	7.9	83	0.54 U	6.0	0.32 U	6,400	4.3 J	3.1	45	20,000	5.3	2,000	97

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
Lined Evaporation Pond																					
OU4-LEP-01	OU4-LEP-01A-SC	Soil 1	1.5	7	05-Oct-08		0.059 UJ	1.7	13	1,900 J	0.46 J	340	0.17 U	490 J	0.15 J	10.8	15.3	50	49	1.06	1.19
	OU4-LEP-01B-SC	Soil 2	15	18	05-Oct-08		0.031 UJ	1.2	8.3	1,300 J	0.27 J	320	0.17 U	1,500 J	0.15 J	11.7	10.2	37	35	0.958 J	1.17 U
OU4-LEP-02	OU4-LEP-02A-SC	Soil 1	20	25	06-Oct-08		0.039 UJ	3.4	8.4	2,200 J	0.45 J	230	0.17 J	3,800 J	0.21 J	9.48	3.87	54	39	1.08	1.20
	OU4-LEP-02B-SC	Soil 2	29	32	06-Oct-08		0.11 UJ	5.1	8.2	1,800 J	1.1	250	0.17 U	2,900 J	0.13 J	9.40	3.36	44	30	1.5	1.26
OU4-LEP-03	OU4-LEP-03A-SC	Soil 1	5	8	06-Oct-08		0.045 UJ	1.7	20	3,900 J	0.57 J	260	0.18 U	1,600 J	0.22 J	10.1	23.4	91	71	1.45	1.64
	OU4-LEP-03B-SC	Soil 2	15	18	06-Oct-08		0.055 UJ	0.59 UJ	8.5	1,800 J	0.30 J	240	0.18 U	5,000 J	0.20 J	8.93	2.31	72	42	1.39	1.56
OU4-LEP-04	OU4-LEP-04A-SC	Soil 1	3	8	07-Oct-08		0.091 UJ	2.7	5.8	1,800 J	0.62 J	250	0.16 U	1,200 J	0.38 J	13.5	7.60	42	25	1.14	1.26
	OU4-LEP-04A-SC-FD	Soil 1	3	8	07-Oct-08	Dup	0.051 UJ	2.4	5.3	1,600 J	0.41 J	280	0.16 U	1,400 J	0.23 J	NA	NA	41	22	NA	NA
	OU4-LEP-04B-SC	Soil 2	11	16	07-Oct-08		0.043 UJ	1.6	7.0	1,200 J	0.25 J	260	0.16 U	1,300 J	0.22 J	7.73	2.64	42	32	0.824 J	0.972 J
	OU4-LEP-04B-SC-FD	Soil 2	11	16	07-Oct-08	Dup	0.044 UJ	1.5	6.8	1,100 J	0.29 J	250	0.16 U	1,200 J	0.17 J	NA	NA	41	31	NA	NA
OU4-LEP-05	OU4-LEP-05A-SC	Soil 1	3	7	07-Oct-08		0.019 UJ	32	25	5,700	0.50 J	140 J	0.19 J	8,300	0.37 J	9.95	13.3	75	84 J	1.38	1.45
	OU4-LEP-05B-SC	Soil 2	12	15	07-Oct-08		0.051 UJ	5.1	8.9	1,600	0.29 J	86 J	0.18 U	4,200	0.21 J	8.91	2.43	77	41 J	1.27	1.61
OU4-LEP-18	OU4-LEP-18A-SC	Sed	0	0.25	18-Oct-08		0.025	4.7 J	2.8 J	3,700	1.3 J	450 J	0.79 U	21,000	4.3	16.7	2.61	9.3	7.6 J	0.686 J	2.17
	OU4-LEP-18B-SC	Soil 1	1.5	3	18-Oct-08		0.014 U	0.86 J	9.1	2,600	0.90 U	320 J	0.90 U	3,900	0.60 U	13.6	7.49	18	25 J	0.918 J	1.56
OU4-LEP-19	OU4-LEP-19A-SC	Sed	0	1	15-Oct-08		0.065 J	0.62 UJ	46 J	1,200	1.3 J	370 J	0.93 U	11,000	0.62 UJ	8.01	26.4	28 J	120 J	0.916 J	1.35
	OU4-LEP-19B-SC	Soil 1	1.7	3	15-Oct-08		0.032 J	1.5 J	26 J	6,200	0.48 J	42 J	0.24 J	900	0.26 J	11.7	17.9	160 J	89 J	1.18	1.31
OU4-LEP-20	OU4-LEP-20A-SC	Sed	0	0.25	19-Oct-08		0.056	1.1 J	33	1,300	1.6 J	410 J	0.96 U	16,000	1.1 J	12.5	23.3	27 J	94 J	0.849 J	1.50
	OU4-LEP-20B-SC	Soil 1	1	3	19-Oct-08		0.055	2.9 J	32	3,900	1.2 J	490 J	0.95 U	850	0.63 U	14.8	31.3	100 J	110 J	1.53	1.70
OU4-LEP-21	OU4-LEP-21A-SC	Sed	0	0.5	19-Oct-08		0.042	0.94 J	2.6 U	860	1.4 J	560 J	0.86 U	25,000	0.57 U	23.1	9.15	4.4 J	7.5 UJ	1.18	1.66
	OU4-LEP-21B-SC	Soil 1	1.5	3	19-Oct-08		0.024 J	1.2 J	7.4	3,500	1.3 J	320 J	0.94 U	4,600	0.62 U	9.50	2.96	45 J	29 J	0.651 J	1.52
OU4-LEP-22	OU4-LEP-22A-SC	Sed	0	0.5	18-Oct-08		0.083	1.7 J	43	1,500	2.8 J	510 J	1.1 U	14,000	1.1 J	11.8	39.7	28	110 J	0.682 J	1.89
	OU4-LEP-22B-SC	Soil 1	1.5	2.5	18-Oct-08		0.015 U	0.91 J	20	2,100	0.92 U	250 J	0.92 U	540	0.61 U	12.5	30.9	64	71 J	0.917 U	0.986 J
OU4-LEP-23	OU4-LEP-23A-SC	Sed	0	0.25	18-Oct-08		0.082	1.6 J	57	1,400	2.8 J	460 J	1.0 U	11,000	1.1 J	12.4	60.5	44	140 J	0.353 J	1.55
	OU4-LEP-23B-SC	Soil 1	2	3	18-Oct-08		0.032	17 J	29	2,600	1.1 J	450 J	0.91 U	2,400	0.61 U	14.2	31.1	69 J	81 J	0.897 U	1.80
OU4-LEP-24	OU4-LEP-24A-SC	Sed	0	0.5	19-Oct-08		0.047	5.3 J	35	4,200	2.1 J	300 J	1.0 U	22,000	2.0 J	29.5	42.4	39 J	100 J	0.508 J	2.56
	OU4-LEP-24B-SC	Soil 1	1.5	3	30-Oct-08		1.0	3.9 J	32	3,900	1.1 J	520 J	0.97 U	1,900	1.3 J	10.6	46.6	150	110 J	1.26	1.48
OU4-LEP-25	OU4-LEP-25A-SC	Sed	0	0.25	19-Oct-08		0.051	4.7 J	19	4,000	2.0 J	420 J	0.95 U	17,000	2.3 J	9.72	1.87	17 J	56 J	1.14	1.14
	OU4-LEP-25B-SC	Soil 1	1.5	3	19-Oct-08		0.035	7.4 J	20	3,100	0.89 U	360 J	0.89 U	3,500	0.59 U	19.7	21.9	55 J	66 J	0.54 U	2.20
OU4-LEP-26	OU4-LEP-26A-SC	Sed	0	0.25	15-Oct-08		0.081 J	11 J	11 J	9,100	1.5 J	210 J	0.81 U	21,000	6.5 J	34.3	4.43	26 J	11 J	0.705 U	3.92
	OU4-LEP-26B-SC	Soil 1	1	3	15-Oct-08		0.040 J	1.6 J	8.6 J	3,900	0.51 J	36 J	0.18 U	2,000	0.23 J	11.8	4.63	40 J	33 J	1.27	1.43
OU4-LEP-27	OU4-LEP-27A-SC	Sed	0	0.33	18-Oct-08		0.14	2.6 J	21	2,800	4.2 J	750 J	1.2 U	29,000	1.2 J	16.0	29.8	24 J	60 J	0.716 J	3.68
	OU4-LEP-27B-SC	Soil 1	2	3	18-Oct-08		0.018 J	36 J	29	5,100	1.1 J	460 J	0.93 U	7,200	1.2 J	13.0	27.6	78 J	74 J	0.991 J	1.70
OU4-LEP-28	OU4-LEP-28A-SC	Sed	0	0.25	18-Oct-08		0.063 U	6.6 J	2.4 U	6,900	0.97 J	200 J	0.79 U	18,000	5.7	22.9	3.33	13 J	6.8 UJ	0.735 J	4.71
	OU4-LEP-28B-SC	Soil 1	1	3	18-Oct-08		0.013 U	4.0 J	6.3	2,000	0.84 U	360 J	0.84 U	730	0.56 U	10.9	6.08	25 J	27 J	1.09	1.21
OU4-LEP-29	OU4-LEP-29A-SC	Sed	0	0.5	17-Oct-08		0.053	10	3.9 J	7,300	1.5 J	810 J	0.82 U	21,000	6.6	34.1	3.16	10 J	11 J	0.572 J	4.60 U
	OU4-LEP-29B-SC	VLT	0.5	2	17-Oct-08		0.4	2.6 J	8.5 J	1,300	3.1 J	270 J	0.79 U	620	0.53 U	9.14	1.73	16 J	7.3 J	3.32	0.601 J
	OU4-LEP-29C-SC	Soil 1	2	5	17-Oct-08		0.014 U	3.1 J	11 J	4,100	0.89 UJ	410 J	0.89 U	2,000	0.60 U	15.0	8.32	38 J	42 J	0.809 J	1.54
OU4-LEP-30	OU4-LEP-30A-SC	Sed	0	0.5	17-Oct-08		0.051	8.6	11 J	5,800	1.5 J	370 J	0.85 U	29,000	5.1	42.0	14.0 J	9.2 J	26 J	0.524 J	3.65
	OU4-LEP-30A-SC-FD	Sed	0	0.5	17-Oct-08	Dup	0.040	8.5	12 J	6,900	1.4 J	770 J	0.81 U	28,000	5.3	32.2	8.18 J	8.7 J	25 J	0.598 J	3.73
	OU4-LEP-30B-SC	VLT	0.5	2.5	17-Oct-08		0.15 J	4.9 J	4.7 J	770	1.9 J	330 J	0.8 U	1500	0.54 U	9.57	3.99	13 J	7.6 J	2.65	1.24
	OU4-LEP-30B-SC-FD	VLT	0.5	2.5	17-Oct-08	Dup	0.052 J	3.3 J	7.1 J	1,100	2.7 J	350 J	0.8 U	1400	0.54 U	8.92	3.82	16 J	10 J	2.45	0.905 J
	OU4-LEP-30C-SC	Soil 1	2.5	6	17-Oct-08		0.029	11	26 J	4,200 J	0.95 UJ	380 J	0.95 U	6,200	0.63 U	8.81	5.12	40 J	64 J	0.855 J	0.897 J
	OU4-LEP-30C-SC-FD	Soil 1	2.5	6	17-Oct-08	Dup	0.015 U	17	29 J	6,700 J	0.94 UJ	410 J	0.94 U	6,300	0.63 U	9.52	6.42	31 J	61 J	1.01	1.08
OU4-LEP-31	OU4-LEP-31A-SC	Sed	0	0.33	17-Oct-08		0.027	8.9	2.9 J	6,500	1.2 J	280 J	0.80 U	18,000	5.4	33.9	2.40	14 J	6.9 UJ	0.524 U	4.47
	OU4-LEP-31B-SC	VLT	0.33	2.5	17-Oct-08		0.17	1.3 J	6.7 J	1,300	1.4 J	200 J	0.78 U	480 J	0.52 U	9.37	3.17	18 J	8.7 J	2.67	1.16
	OU4-LEP-31C-SC	Soil 1	2.5	6	17-Oct-08		0.013 U	3.3 J	5.2 J	1,300	0.82 UJ	310 J	0.82 U	830	0.55 U	21.5	6.57	27 J	20 J	0.916 J	1.45
OU4-LEP-32	OU4-LEP-32A-SC	Sed	0	0.5	17-Oct-08		0.043	10	16 J	8,700	1.9 J	390 J	0.92 U	30,000	5.0	11.7	11.4	18 J	49 J	1.21	1.42
	OU4-LEP-32B-SC	VLT	0.5	3	17-Oct-08		0.32	2.8 J	7.2 J	1,500	5.4 J	320 J	0.79 U	900	0.53 U	7.36	2.84	16 J	11 J	1.9	1.01 U
	OU4-LEP-32C-SC	Soil 1	3	6	17-Oct-08		0.014 J	12	15 J	4,000	0.85 UJ	380 J	0.85 U	4,900	0.56 U	26.2	16.1	45 J	52 J	0.591 J	3.17

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
Unlined Evaporation Pond																					
OU4-UEP-06	OU4-UEP-06A-SC	Soil 1	15.5	20	14-Oct-08		0.089	13	15	5,100	0.47 J	96 J	0.19 J	1,500	0.36 J	14.0 J	5.33	49	70	0.981 J	1.10
	OU4-UEP-06B-SC	Soil 2	30	35	14-Oct-08		0.031	2.6	4.8	730	0.18 UJ	73 J	0.18 U	560	0.12 J	10.6 J	4.99	38	24	1.13	1.17
OU4-UEP-07	OU4-UEP-07A-SC	Soil 1	5	8	08-Oct-08		0.098	2.5	8.8	1,800	1.2	72 J	0.17 U	1,500	1.4	30.7	14.4	61	36 J	1.31	2.68
	OU4-UEP-07B-SC	Soil 2	17	20	08-Oct-08		0.023 UJ	1.3	9.1	2,100	0.33 J	4.1 UJ	0.17 U	1,300	0.34 J	10.4	4.26	54	51 J	1.73	1.89
OU4-UEP-08	OU4-UEP-08A-SC	Soil 1	3	6	08-Oct-08		0.015 UJ	0.69 J	2.4	520 J	0.55 J	330 J	0.15 U	370 J	2.7	16.7	2.85	19	11	1.06	1.04
	OU4-UEP-08A-SC-FD	Soil 1	3	6	08-Oct-08	Dup	0.015 UJ	1.2	2.8	580 J	0.57 J	360 J	0.15 U	420 J	2.7	NA	NA	27	16	NA	NA
	OU4-UEP-08B-SC	Soil 2	10	13	08-Oct-08		0.020 UJ	1.1	3.6	750 J	0.31 J	360 J	0.16 U	570 J	1.7	6.64 J	2.07	31	17	1.04	1.28
	OU4-UEP-08B-SC-FD	Soil 2	10	13	08-Oct-08	Dup	0.018 UJ	1.4	4.0	870 J	0.42 J	390 J	0.16 U	660 J	2.0	NA	NA	37	19	NA	NA
OU4-UEP-09	OU4-UEP-09A-SC	Soil 1	4	7	14-Oct-08		0.12	2.7	12	3,400	0.54 J	110 J	0.20 J	1,100	0.38 J	14.6 J	7.87	61	49	1.99	2.20
	OU4-UEP-09B-SC	Soil 2	16	20	14-Oct-08		0.041	0.86 J	7.1	930	0.18 UJ	89 J	0.18 U	980	0.14 J	8.95 J	2.93	48	31	1.20	1.17
OU4-UEP-10	OU4-UEP-10A-SC	Soil 1	3	5	12-Oct-08		0.17	24	11	3,100	1.8 J	27 J	0.19 U	2,400	1.4	22.9 J	12.1	63	50	1.50	2.89
	OU4-UEP-10B-SC	Soil 2	17	20	12-Oct-08		0.048	1.9	5.6	830	0.20 J	55 J	0.17 U	1,700	0.17 J	9.32 J	3.00	38	26	1.24	1.26
OU4-UEP-11	OU4-UEP-11A-SC	Soil 1	15	20	09-Oct-08		0.037 UJ	0.76 J	5.7	2,100 J	0.34 J	460 J	0.16 U	3,700 J	0.16 J	7.86	3.48	46	26	1.05	1.28
	OU4-UEP-11B-SC	Soil 2	31	35	09-Oct-08		0.022 UJ	0.92 J	7.7	1,900 J	0.21 J	400 J	0.16 U	1,000 J	0.2 J	8.25	1.54	35	36	1.28	1.33
OU4-UEP-33	OU4-UEP-33A-SC	Sed	0	0.5	18-Oct-08		0.26	14	9.1	10,000	6.9	210 J	0.79 U	16,000	18	167	31.7	30	24 J	2.25	16.7
	OU4-UEP-33B-SC	Soil 1	0.5	3	18-Oct-08		0.013 U	1.6 J	2.7 J	1,500	0.81 U	290 J	0.81 U	1,300	0.54 U	12.3	2.01	16	32 J	0.933 U	1.27
OU4-UEP-34	OU4-UEP-34A-SC	Sed	0	2	17-Oct-08		0.19	23	12 J	10,000	11 J	660 J	0.84 U	13,000	15	189	34.0	44 J	37 J	3.24	24.3
	OU4-UEP-34B-SC	Soil 1	2	3	17-Oct-08		0.013 U	3.7 J	4.7 J	2,000	3.2 J	320 J	0.84 U	1,800	1.3 J	17.7	4.46	26 J	770 J	1.11	1.88
OU4-UEP-35	OU4-UEP-35A-SC	Sed	0	1.5	16-Oct-08		1.1	20 J	8.9 J	9,300	27 J	350 J	0.96 UJ	19,000	38	65.3	13.9	28	26 J	1.88	7.65
	OU4-UEP-35B-SC	Soil 1	1.5	3	16-Oct-08		0.13	15 J	11 J	3,200	4.5 J	450 J	0.95 UJ	2,200	5.8	17.0	12.3	46	46 J	1.16	1.88
OU4-UEP-36	OU4-UEP-36A-SC	Sed	0	1	15-Oct-08		1.4 J	32 J	9.4 J	12,000	76 J	690 J	0.97 U	22,000	48 J	88.5	16.6	58 J	19 J	2.01	12.1
	OU4-UEP-36B-SC	Soil 1	1	3	15-Oct-08		0.22 J	4.3 J	8.6 J	5,500	8.5 J	76 J	0.19 U	3,100	9.2 J	17.8	6.36	38 J	40 J	1.55	2.71
OU4-UEP-37	OU4-UEP-37A-SC	Sed	0	1.5	15-Oct-08		0.48 J	8.7 J	14 J	9,500	9.1 J	240 J	0.81 U	17,000	20 J	64.8	9.70	28 J	38 J	1.88	7.01
	OU4-UEP-37B-SC	Soil 1	1.5	3	15-Oct-08		0.81 J	20 J	12 J	5,200	8.7 J	52 J	0.20 U	4,300	13 J	31.8	11.3	78 J	46 J	1.47	3.68
OU4-UEP-38	OU4-UEP-38A-SC	Sed	0	0.5	16-Oct-08		0.39 J	6.1 J	6.9 J	7,900	6.6 J	280 J	0.94 U	16,000	14 J	48.2	5.57	44 J	140 J	1.59	5.09
	OU4-UEP-38A-SC-FD	Sed	0	0.5	16-Oct-08	Dup	0.62 J	9.0 J	8.7 J	9,700	12 J	220 J	0.94 U	21,000	24 J	45.0	5.01	45 J	24 J	1.61	5.29
	OU4-UEP-38B-SC	Soil 1	0.5	3	16-Oct-08		0.14 J	4.0 J	12 J	5,400	1.9 J	85 J	0.19 U	5,100	3.1 J	17.7	7.08	66 J	45 J	1.69 J	2.18
	OU4-UEP-38B-SC-FD	Soil 1	0.5	3	16-Oct-08	Dup	0.1 J	4.7 J	15 J	5,400	3.6 J	96 J	0.96 U	5,300	7.1 J	19.0	6.60	69 J	84 J	1.23 J	1.95
OU4-UEP-39	OU4-UEP-39A-SC	Sed	0	1	16-Oct-08		0.53 J	7.6 J	4.8 J	9,700	17 J	250 J	0.92 U	20,000	30 J	55.8	4.28	39 J	37 J	1.00	5.88
	OU4-UEP-39B-SC	Soil 1	1	3	16-Oct-08		0.15 J	1.8 J	8.7 J	5,800	1.8 J	82 J	0.19 U	4,300	3.7 J	15.7	4.32	47 J	36 J	1.70	2.27
OU4-UEP-40	OU4-UEP-40A-SC	Sed	0	1	16-Oct-08		1.3 J	15 J	12 J	9,000	25 J	440 J	0.94 U	28,000	45 J	42.6	4.96	33 J	21 J	1.27	5.72
	OU4-UEP-40B-SC	Soil 1	1	3	16-Oct-08		0.15 J	13 J	8.9 J	6,200	4.7 J	55 J	0.39 J	3,900	6.1 J	20.8	10.1	54 J	44 J	1.63	2.79
OU4-UEP-41	OU4-UEP-41A-SC	Sed	0	0.5	16-Oct-08		0.37	16 J	14 J	11,000	7.9 J	300 J	0.92 UJ	13,000	24	102	62.5	22	58 J	2.74	13.5
	OU4-UEP-41B-SC	Sed	0.5	2	16-Oct-08		7.8	19 J	150 J	4,200	45 J	580 J	1.2 UJ	8,200	38	151	104	44	77 J	4.08	19.4
	OU4-UEP-41C-SC	Soil 1	2	3	16-Oct-08		0.085	31 J	21 J	3,900	2.3 J	500 J	1.0 UJ	3,300	8.0	38.8	80.1	88	91 J	1.78	4.14
OU4-UEP-42	OU4-UEP-42A-SC	Sed	0	0.33	16-Oct-08		0.10	8.1 J	13 J	13,000	4.5 J	230 J	0.84 UJ	20,000	36	83.5	34.8	17	45 J	1.52	8.86
	OU4-UEP-42B-SC	Sed	0.33	2.5	16-Oct-08		2.9	10 J	180 J	1,700	20 J	230 J	0.94 UJ	6,100	42	62.8	21.4	58	74 J	2.71	10.3
	OU4-UEP-42C-SC	Soil 1	2.5	6	16-Oct-08		0.017 J	33 J	15 J	3,300	0.90 UJ	510 J	0.9 UJ	4,200	1.8 J	14.6	21.3	51	53 J	1.32	1.68
OU4-UEP-43	OU4-UEP-43A-SC	Sed	0	1	16-Oct-08		1.2 J	13 J	8.2 J	9,000	42 J	300 J	0.92 U	23,000	39 J	55.3	6.71	36 J	27 J	1.60	7.65
	OU4-UEP-43B-SC	Soil 1	1	3	16-Oct-08		0.067 J	0.94 J	5.7 J	1,600	2.4 J	130 J	0.17 U	940	5.1 J	23.5	11.6	33 J	22 J	1.14	1.63
OU4-UEP-44	OU4-UEP-44A-SC	Sed	0	0.33	16-Oct-08		0.95	12 J	3.4 J	14,000	39 J	190 J	0.79 U	26,000	57 J	60.5	6.73	39 J	10 J	1.10	6.35
	OU4-UEP-44A-SC-FD	Sed	0	0.33	16-Oct-08	Dup	0.84	11 J	3.6 J	9,900	41 J	210 J	0.79 UJ	23,000	46	59.6	6.84	29	8.6 J	1.06	6.36
	OU4-UEP-44B-SC	Soil 1	0.33	3	16-Oct-08		0.14	6.0 J	11 J	4,000	2.9 J	-- R	0.18 U	2,900	7.4 J	28.7	8.83	59 J	40 J	1.75	3.42
	OU4-UEP-44B-SC-FD	Soil 1	0.33	3	16-Oct-08	Dup	0.11	5.1 J	9.3 J	2,900	3.0 J	500 J	0.19 UJ	2,300	6.5	31.5	10.2	41	34 J	1.81	3.27
OU4-UEP-45	OU4-UEP-45A-SC	Sed	0	1	16-Oct-08		0.38	6 J	9.6 J	6,900	8.0 J	370 J	0.93 UJ	14,000	20	35.6	7.80	31 J	21 J	1.73	3.76
	OU4-UEP-45B-SC	Soil 1	1	3	16-Oct-08		0.83	33 J	9.6 J	3,300	6.0 J	580 J	0.19 UJ	2,700	8.7	45.5	22.1	52	36 J	1.70	4.24
OU4-UEP-46	OU4-UEP-46A-SC	Sed	0	1.5	16-Oct-08		0.58	6.2 J	14 J	5,200	6.0 J	460 J	0.98 UJ	4,300	14	40.4	17.2	39	45 J	2.50	4.61
	OU4-UEP-46B-SC	Soil 1	1.5	3	16-Oct-08		0.28	7.1 J	9.4 J	4,300	3.3 J	440 J	0.18 J	3,200	7.5	13.4	19.2	63	31 J	1.38	1.70

Table 3-2. Solids Geochemical Results

Location Name	Sample Name	Matrix	Begin Depth	End Depth	Sample Date	Duplicate	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
			ft bgs	ft bgs			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
OU4-UEP-47	OU4-UEP-47A-SC	Sed	0	3	16-Oct-08		0.053	1.7 J	6.0 J	1,000	1.2 J	250 J	0.78 UJ	38 J	0.52 U	8.10	1.43	15	8.5 J	0.817 J	0.845 J
	OU4-UEP-47A-SC-FD	Sed	0	3	16-Oct-08	Dup	0.048	1.5 J	6.7 J	1,000	1.2 J	270 J	0.77 UJ	49 J	0.51 U	9.30	1.64	15	9.9 J	0.793 J	0.934 J
	OU4-UEP-47B-SC	Sed	3	6	16-Oct-08		0.071	2.0 J	39 J	2,000	1.2 J	380 J	0.88 UJ	390	2.7 J	12.5	13.0	19	31 J	1.37	1.45
	OU4-UEP-47B-SC-FD	Sed	3	6	16-Oct-08	Dup	0.095	2.3 J	71 J	2,300	1.4 J	400 J	0.88 UJ	550	5.4	14.0	17.7	21	49 J	1.34	1.38
	OU4-UEP-47C-SC	Soil 1	6	9	16-Oct-08		0.025	4.9 J	30 J	2,200	0.90 UJ	560 J	0.90 UJ	720	0.60 U	11.6	19.8	80	100 J	1.32	1.41
	OU4-UEP-47C-SC-FD	Soil 1	6	9	16-Oct-08	Dup	0.038	3.0 J	29 J	1,900	0.89 UJ	520 J	0.89 UJ	730	0.59 U	10.5	23.0	59	84 J	1.14	1.49
Finger Evaporation Pond																					
OU4-FEP-12	OU4-FEP-12A-SC	Soil 1	11	15	13-Oct-08		0.26	2.4	3.4	2,100	27 J	170 J	0.16 U	230	17	15.7 J	30.4	25	19	1.28	1.38
	OU4-FEP-12B-SC	Soil 2	41	45	13-Oct-08		0.013 U	0.62 J	4.1	1,600	0.28 J	170 J	0.17 U	590	0.16 J	8.05 J	15.1	43	31	1.24	2.23
OU4-FEP-13	OU4-FEP-13A-SC	Soil 1	6	8	12-Oct-08		0.49	1.3	3.5	2,800	15 J	200 J	0.16 U	200	18	11.7 J	18.1	27	20	1.28	1.30
	OU4-FEP-13B-SC	Soil 2	40	43	12-Oct-08		0.14	1.6	5.7	1,500	1.7 J	340 J	0.17 U	390	0.91	13.0 J	11.6	45	34	1.51	2.03
OU4-FEP-14	OU4-FEP-14A-SC	Soil 1	2	3.5	29-Oct-08		0.014 U	1.8 J	4.8 J	3,000	0.87 U	220 J	0.87 U	1,600	0.73 J	84.6	7.78	27	27 J	1.54	5.90
	OU4-FEP-14B-SC	Soil 1	5	6.5	29-Oct-08		0.013 U	0.99 J	5.2 J	1,400	0.84 U	210 J	0.84 U	1,900	0.56 U	22.4	10.9	27	44 J	1.30	2.29
	OU4-FEP-14C-SC	Soil 2	45	46.5	29-Oct-08		0.013 U	0.96 J	5.1 J	1,100	0.82 U	200 J	0.82 U	740	0.54 U	10.0	8.76	21	28 J	1.37	1.51
OU4-FEP-15	OU4-FEP-15A-SC	Soil 1	2	3.5	29-Oct-08		0.014 U	0.79 J	5.9	2,400	0.86 U	300 J	0.86 U	1,300	0.58 U	33.8	11.5	25	58	1.01	2.54
	OU4-FEP-15B-SC	Soil 2	50	51.5	29-Oct-08		0.014 U	1.4 J	8.6	1,800	0.86 U	230 J	0.86 U	540 J	0.57 U	6.54	9.58	39	50 J	1.39	1.58
OU4-FEP-16	OU4-FEP-16A-SC	Soil 1	2	3.5	28-Oct-08		0.013 U	0.95 J	3.5 J	1,200	0.81 U	190 J	0.81 U	1,100	1.0 J	5.22	4.53	20	22 J	1.07	1.02
	OU4-FEP-16B-SC	Soil 2	65	66.5	28-Oct-08		0.013 U	4.5 J	12	2,000	0.79 U	250 J	0.79 U	1,500	0.53 U	7.32	2.47	27	42 J	1.46	1.78
OU4-FEP-17	OU4-FEP-17A-SC	Soil 1	2	3.5	28-Oct-08		0.013 U	1.7 J	3.9 J	1,200	0.81 U	280 J	0.81 U	1,800	0.54 U	7.68	2.06	16	15 J	0.93 J	1.22
OU4-FEP-48	OU4-FEP-48A-SC	VLT	0	0.5	09-Oct-08		0.5	3.3	6.2	1,000 J	3.4	340 J	0.15 U	160 J	0.26 J	10.1	6.28	16	11	3	1.19
	OU4-FEP-48B-SC	Sed	0.5	5	09-Oct-08		84 J	14	120	2,600 J	23	280 J	1.7	630 J	30	191	50.7	12	420	4.59	22.9
	OU4-FEP-48C-SC	Sed	9	12	09-Oct-08		17 J	19	160	1,400 J	130	350 J	1.0	280 J	75	226	276	18	99	5.84	29.0
	OU4-FEP-48D-SC	Soil 2	12	15	09-Oct-08		0.28	3.9	3.1	2,700 J	7.9	470 J	0.16 U	300 J	36	43.3	89.4	29	25	1.12	3.17
OU4-FEP-49	OU4-FEP-49A-SC	VLT	0	0.5	09-Oct-08		1 J	2.6	5.3	1,000 J	3.2	420 J	0.15 U	48 J	0.1 U	10	4.63	14	11	4.33	1.46
	OU4-FEP-49B-SC	Sed	0.5	4	09-Oct-08		14 J	15	170	2,100 J	49	360 J	1.5	340 J	48	191	102	20	230	4.79	24.7
	OU4-FEP-49C-SC	Soil 1	5	8	09-Oct-08		0.13 J	1.5	1.7	3,000 J	9.2	460 J	0.16 U	360 J	26	16.5	36.5	15	12	1.11	1.82
OU4-FEP-50	OU4-FEP-50A-SC	VLT	0	0.5	09-Oct-08		0.79	5	8.3	1,200 J	9.1	330 J	0.15 U	77 J	0.38 J	12.7	4.79	23	14	3.81	1.48
	OU4-FEP-50B-SC	Sed	0.5	2	09-Oct-08		49	37	80	2,200 J	180	580 J	2.9	330 J	97	630	337	9.4	310	9.88	78.8
	OU4-FEP-50C-SC	Soil 1	2	5	09-Oct-08		0.19	2.2	1.6	4,100 J	14	450 J	0.16 U	430 J	22	27.2	53.2	21	14	1.06	2.40
OU4-FEP-51	OU4-FEP-51A-SC	VLT	0	0.5	09-Oct-08		0.21	3	5.2	910 J	2.9	350 J	0.15 U	100 J	0.17 J	9.57	4.42	15	9.7 J	3.77	1.25
	OU4-FEP-51B-SC	Soil 1	1	5	09-Oct-08		0.030	1.9	1.5	1,900 J	2.6	490 J	0.16 U	240	11	55.8	18.2	14	11	1.14	4.32
OU4-FEP-52	OU4-FEP-52A-SC	VLT	0	0.5	09-Oct-08		0.86	3.8	4.5	720 J	4.1	300 J	0.15 U	52 J	0.22 J	8.66	3.2	14	7.3 J	3.75	1.19
	OU4-FEP-52B-SC	Sed	0.5	4	09-Oct-08		26	36	91	2,400 J	160	410 J	3.4	350 J	88	748	404	12	690	14.0	94.6
	OU4-FEP-52C-SC	Soil 1	5	8	09-Oct-08		0.30	0.87 J	1.7	2,200 J	7.7	490 J	0.16 U	210 J	13	13.4	35.9	17	14	0.822 J	1.39
OU4-FEP-53	OU4-FEP-53A-SC	Sed	0	0.5	18-Oct-08		0.036	0.94 J	2.5 U	710	0.82 U	270 J	0.82 U	1,400	0.55 U	6.73	0.859	1.9 U	12 J	0.764 J	1.22
	OU4-FEP-53B-SC	Soil 1	0.5	3	18-Oct-08		0.013 U	3.1 J	3.6 J	3,300	0.82 U	280 J	0.82 U	1,800	0.56 J	21.8	1.27	12	14 J	1.06	2.36
OU4-FEP-54	OU4-FEP-54A-SC	Sed	0	0.25	18-Oct-08		0.029	5.1 J	2.8 J	3,500	1.5 J	770 J	0.91 U	7,000	0.60 U	34.9	3.52	14	7.9 U	2.65	5.35
	OU4-FEP-54B-SC	Soil 1	0.25	3	18-Oct-08		0.022 J	2.6 J	3.1 J	440	0.84 U	58 J	0.84 U	220	0.56 U	36.8	4.30	15	13 J	1.01	3.14
OU4-FEP-55	OU4-FEP-55A-SC	Sed	0	0.5	18-Oct-08		0.11	5.9 J	3.3 J	3,600	1.7 J	490 J	0.90 U	7,400	0.68 J	42.2	2.74	15	22 J	3.04	6.57
	OU4-FEP-55B-SC	Soil 1	0.5	3	18-Oct-08		0.014 U	2.4 J	3.7 J	2,700	0.85 U	290 J	0.85 U	1,600	0.57 U	25.9	2.87	14	51 J	1.15	2.58
OU4-FEP-56	OU4-FEP-56A-SC	Sed	0	0.25	18-Oct-08		0.083	2.7	2.0	1,800	0.43 J	360 J	0.15 U	2,200	0.54	45.9	9.44	1.6	4.2 J	3.11	6.03
	OU4-FEP-56B-SC	Soil 1	0.25	1	18-Oct-08		0.013 U	5.1 J	6.9	3,200	0.84 U	350 J	0.84 U	1,400	0.79 J	36.0	7.78	20	21 J	1.36	3.60
OU4-FEP-57	OU4-FEP-57A-SC	Sed	0	0.25	17-Oct-08		0.023	13	2.4 UJ	9,900	1.1 J	530 J	0.80 U	16,000	10	57.1	6.09	19 J	6.9 UJ	0.618 J	6.47
	OU4-FEP-57B-SC	Soil 1	0.25	3	17-Oct-08		0.013 U	0.55 U	3.7 J	1,500	0.82 UJ	380 J	0.82 U	2,200	0.62 J	12.1	3.59	15 J	16 J	0.993 J	1.18
OU4-FEP-58	OU4-FEP-58A-SC	Sed	0	0.25	17-Oct-08		0.13	1.8 J	18 J	5,500	1.3 J	410 J	0.77 U	1,400	0.79 J	15.0	5.50	37 J	78 J	2.33	1.98
	OU4-FEP-58B-SC	Soil 1	0.5	3	17-Oct-08		0.014 U	0.57 U	4.1 J	1,600	0.85 U	350 J	0.85 U	2,400	1.2 J	9.95	3.33	18	16 J	0.914 J	0.989 J
OU4-FEP-59	OU4-FEP-59A-SC	Sed	0	0.5	17-Oct-08		0.11	1.7 J	29	5,300	1.5 J	340 J	0.80 U	1,800	0.75 J	14.6	6.69	39	100 J	2.29	1.97
	OU4-FEP-59B-SC	Soil 1	1	3	17-Oct-08		0.013 U	0.56 U	5.5 J	1,400	0.84 U	290 J	0.84 U	2,800	0.56 U	10.7	3.31	20	94 J	0.906 J	1.27
OU4-FEP-60	OU4-FEP-60A-SC	Sed	0	0.25	17-Oct-08		0.067	7.1	3.5 J	6,900	0.97 J	440 J	0.78 U	12,000	9.7	55.3	4.09	14	22 J	0.666 J	5.38
	OU4-FEP-60B-SC	Soil 1	0.25	3	17-Oct-08		0.013 U	0.54 U	4.7 J	1,500	0.81 U	280 J	0.81 U	1,500	0.54 U	10.6	3.18	18	23 J	0.971 J	1.16

U - Analyte not detected above laboratory detection limit (< reported value).
J - Reported value is an estimated concentration.
UJ - Analyte not detected at an estimated detection limit concentration (< reported value).
R - Rejected, not to be used for any purpose.
NA - Not analyzed

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	Background Limits (A1)				**16,445**	**0.94**	**13**	**171**	**1**	**24**	**0.32**	**22,614**	**11**	**12**	**58**	**19,502**	**11**	**6,314**	**526**
	Residential				**77,000**	**31**	**0.39**	**15,000**	**160**	**16,000**	**70**	**NA**	**280**	**23**	**3,100**	**55,000**	**400**	**NA**	**1,800**
	Industrial				**990,000**	**410**	**1.6**	**190,000**	**2,000**	**200,000**	**810**	**NA**	**1,400**	**300**	**41,000**	**720,000**	**800**	**NA**	**23,000**
	Ecological SLV				**NA**	**0.27**	**9.79**	**330**	**21**	**0.5**	**0.36**	**NA**	**26**	**13**	**28**	**NA**	**11**	**NA**	**220**
VLT Materials																			
LEP Base	OU4-LEP-29B-SC	0.5	2	17-Oct-08	4,700	1.8 J	4.6	40	0.53 UJ	2.2 UJ	0.32 U	2,500	8.4 J	2.2 J	220	11,000	2.5 J	4,800	43
LEP Base	OU4-LEP-30B-SC	0.5	2.5	17-Oct-08	4,700	0.64 J	2.8	28	0.54 UJ	7.7 J	0.32 U	3,200	1.9 UJ	2.8 J	380	11,000	2.7	4,100	79
LEP Base	OU4-LEP-31B-SC	0.33	2.5	17-Oct-08	4,400	0.67 J	3.2	26	0.52 UJ	2.2 UJ	0.31 U	2,000	3.9 J	3.3 J	370	13,000	2.4 J	4,200	44
LEP Base	OU4-LEP-32B-SC	0.5	3	17-Oct-08	4,800	1.6 J	4.6	35	0.53 UJ	2.2 UJ	0.32 U	3,000	3.9 J	2.9 J	440	13,000	3.6	4,800	62
FEP Cap	OU4-FEP-48A-SC	0	0.5	09-Oct-08	6,400	2.4 J	6.3	52	0.16 J	4.2 U	0.06 U	3,800	3.7	4.0	1,800	12,000	4.8	5,000	44 J
FEP Cap	OU4-FEP-49A-SC	0	0.5	09-Oct-08	5,800	1.5 J	3.8	38	0.11 J	4.2 U	0.061 U	2,000	3.3	2.6	500	9,800	4.2	4,500	44 J
FEP Cap	OU4-FEP-50A-SC	0	0.5	09-Oct-08	8,200	2.1 J	8.5	59	0.16 J	4.2 U	0.061 U	3,800	6.7	4.2	950	16,000	7.6	6,200	49 J
FEP Cap	OU4-FEP-51A-SC	0	0.5	09-Oct-08	5,800	2.1 J	6.1	36	0.14 J	4.2 U	0.061 U	2,500	4.2	2.8	740	10,000	3.1	4,700	38 J
FEP Cap	OU4-FEP-52A-SC	0	0.5	09-Oct-08	4,900	1.9 J	5.4	42	0.16 J	4.3 U	0.061 U	4,200	3.1	2.3	860	11,000	4.3	4,100	28 J
	Minimum				**4,400**	**0.64**	**2.8**	**26**	**ND**	**ND**	**ND**	**2,000**	**ND**	**2.2**	**220**	**9,800**	**2.4**	**4,100**	**28**
	Median				**4,900**	**1.8**	**4.6**	**38**	**0.16**	**ND**	**ND**	**3,000**	**3.9**	**2.8**	**500**	**11,000**	**3.6**	**4,700**	**44**
	Average				**5,522**	**1.6**	**5.0**	**40**	**0.32**	**3.9**	**ND**	**3,000**	**4.3**	**3.0**	**696**	**11,867**	**3.9**	**4,711**	**48**
	Maximum				**8,200**	**2.4**	**8.5**	**59**	**0.54**	**7.7**	**ND**	**4,200**	**8.4**	**4.2**	**1,800**	**16,000**	**7.6**	**6,200**	**79**
Pond Sediments																			
LEP	OU4-LEP-18A-SC	0	0.25	18-Oct-08	1,800	0.53 UJ	3.3	9.9	0.53 U	22 U	0.32 U	31,000	2.7 J	4.4	130	180,000	2.0 J	1,000	68
LEP	OU4-LEP-19A-SC	0	1	15-Oct-08	12,000 J	0.62 UJ	2.5 J	22 J	0.79 J	-- R	0.37 U	32,000 J	9.8 J	88 J	2,800	96,000 J	1.7 J	12,000 J	800 J
LEP	OU4-LEP-20A-SC	0	0.25	19-Oct-08	14,000	0.64 UJ	2.2 UJ	16 J	0.65 J	27 UJ	0.38 U	50,000 J	7.3	66	1,800	150,000	1.4 J	11,000	800
LEP	OU4-LEP-21A-SC	0	0.5	19-Oct-08	1,500	0.80 J	2.0 UJ	5.7 J	0.57 U	24 UJ	0.34 U	39,000 J	2.8 J	3.7	130	190,000	1.2 J	1,000	66
LEP	OU4-LEP-22A-SC	0	0.5	18-Oct-08	18,000	0.25 J	2.7 U	19	1.1 J	13 U	0.46 U	20,000	12	65	1,400	120,000	3.4 J	13,000	860
LEP	OU4-LEP-23A-SC	0	0.25	18-Oct-08	23,000	0.28 J	2.5 J	14	1.9 J	13 J	0.70 J	34,000	15	84	2,100	92,000	3.0 J	17,000	1,100
LEP	OU4-LEP-24A-SC	0	0.5	19-Oct-08	15,000	0.69 UJ	3.5 J	8.5 J	1.2 J	29 UJ	0.41 U	34,000 J	14	52	1,100	170,000	2.1 J	12,000	1,000
LEP	OU4-LEP-25A-SC	0	0.25	19-Oct-08	12,000	0.63 UJ	2.6 J	8.3 J	0.81 J	27 UJ	0.38 U	63,000 J	6.5	24	820	140,000	2.1 J	8,200	580
LEP	OU4-LEP-26A-SC	0	0.25	15-Oct-08	4,800 J	0.54 UJ	3.5 J	12 J	0.54 UJ	57 J	0.32 U	47,000 J	3.8 J	7.8 J	160	160,000 J	3.2	4,300 J	310 J
LEP	OU4-LEP-27A-SC	0	0.33	18-Oct-08	14,000	1.4 J	2.8 UJ	24 J	0.81 U	34 UJ	0.48 U	41,000 J	11	32	570	220,000	5.1	8,300	630
LEP	OU4-LEP-28A-SC	0	0.25	18-Oct-08	860	0.52 UJ	4.2 J	11 J	0.52 U	22 UJ	0.31 U	53,000 J	2.5 J	0.42 U	32	170,000	3.1	140	8.4 U
LEP	OU4-LEP-29A-SC	0	0.5	17-Oct-08	2,300	0.55 U	1.9 U	5.5	0.55 UJ	23 UJ	0.33 U	72,000	1.9 UJ	4.2 J	200	190,000	2.4 J	2,100	150
LEP	OU4-LEP-30A-SC	0	0.5	17-Oct-08	4,400	0.58 J	2.0 U	6.1	0.56 UJ	93 J	0.34 U	57,000	2.0 UJ	13 J	940	130,000	2.0 J	5,500	940
LEP	OU4-LEP-31A-SC	0	0.33	17-Oct-08	1,000	0.53 U	2.8	5.4	0.53 UJ	22 UJ	0.32 U	60,000	1.9 J	2.4 J	110	170,000	2.8	900	55
LEP	OU4-LEP-32A-SC	0	0.5	17-Oct-08	7,500	0.61 U	3.0 J	6.2	0.98 J	45 J	0.47 J	69,000	3.1 J	20 J	2,300	150,000	3.2	8,900	810
	Minimum				**860**	**ND**	**ND**	**5.4**	**ND**	**ND**	**ND**	**20,000**	**ND**	**ND**	**32**	**92,000**	**1.2**	**140**	**ND**
	Median				**7,500**	**ND**	**2.7**	**9.9**	**ND**	**ND**	**ND**	**47,000**	**3.8**	**20**	**820**	**160,000**	**2.4**	**8,200**	**630**
	Average				**8,811**	**0.61**	**2.8**	**12**	**0.80**	**32**	**0.40**	**46,800**	**6.4**	**31**	**973**	**155,200**	**2.6**	**7,023**	**545**
	Maximum				**23,000**	**1.4**	**4.2**	**24**	**1.9**	**93**	**0.7**	**72,000**	**15**	**88**	**2,800**	**220,000**	**5.1**	**17,000**	**1100**
UEP	OU4-UEP-33A-SC	0	0.5	18-Oct-08	3,400	0.90 J	23	26	0.53 U	38 J	0.32 U	33,000	8.7	8.7	430	170,000	23	2,500	200
UEP	OU4-UEP-34A-SC	0	2	17-Oct-08	10,000	1.1 J	75	35	0.56 UJ	31 J	0.34 U	73,000	23 J	12 J	950	190,000	22	7,000	540
UEP	OU4-UEP-35A-SC	0	1.5	16-Oct-08	2,500	0.64 U	80 J	48	0.64 UJ	13 U	0.38 UJ	41,000	8.2 J	5.9 J	270 J	180,000	32	1,500	130 J
UEP	OU4-UEP-36A-SC	0	1	15-Oct-08	3,400 J	1.0 J	120 J	68 J	0.64 UJ	20 J	0.39 U	46,000 J	13 J	7.3 J	360	180,000 J	50	1,700 J	130 J
UEP	OU4-UEP-37A-SC	0	1.5	15-Oct-08	4,600 J	0.77 J	23 J	39 J	0.54 UJ	13 J	0.33 U	36,000 J	4.7 J	13 J	720	120,000 J	17	3,700 J	290 J
UEP	OU4-UEP-38A-SC	0	0.5	16-Oct-08	4,300 J	0.70 J	23 J	42 J	0.62 UJ	16 J	0.37 U	48,000 J	5.9 J	6.9 J	540	130,000 J	12 J	2,300 J	150 J
UEP	OU4-UEP-39A-SC	0	1	16-Oct-08	7,600 J	0.61 UJ	65 J	50 J	0.61 UJ	43 J	0.37 U	31,000 J	8.6 J	4.8 J	330	190,000 J	14	2,400 J	150 J
UEP	OU4-UEP-40A-SC	0	1	16-Oct-08	2,300 J	0.89 J	80 J	60 J	0.63 UJ	-- R	0.38 U	38,000 J	8.0 J	7.5 J	320	240,000 J	44	1,400 J	130 J
UEP	OU4-UEP-41A-SC	0	0.5	16-Oct-08	8,200	0.62 U	83 J	32	0.77 J	13 U	0.47 J	50,000	28 J	14 J	500 J	140,000	21	3,900	470 J
UEP	OU4-UEP-41B-SC	0.5	2	16-Oct-08	11,000	7.8	790 J	300	0.78 UJ	16 U	0.89 J	12,000	91 J	69 J	280 J	130,000	160	3,100	260 J
UEP	OU4-UEP-42A-SC	0	0.33	16-Oct-08	7,500	0.56 U	130 J	14	0.66 J	17 J	0.53 J	41,000	14 J	13 J	260 J	160,000	12	3,900	510 J
UEP	OU4-UEP-42B-SC	0.33	2.5	16-Oct-08	4,300	9.6	540 J	360	0.63 UJ	13 U	0.82 J	4,000	62 J	77 J	150 J	99,000	170	1,000	110 J
UEP	OU4-UEP-43A-SC	0	1	16-Oct-08	3,000 J	0.75 J	71 J	55 J	0.61 UJ	23 J	0.37 U	41,000 J	9.8 J	6.0 J	230	200,000 J	46	1,800 J	120 J
UEP	OU4-UEP-44A-SC	0	0.33	16-Oct-08	1,700 J	0.57 J	81 J	45 J	0.52 UJ	41 J	0.31 U	28,000 J	9.1 J	2.4 J	160	210,000 J	32	1,000 J	66 J
UEP	OU4-UEP-45A-SC	0	1	16-Oct-08	6,000	0.63 J	31 J	39	0.62 UJ	13 U	0.37 UJ	26,000	7.2 J	7.6 J	240 J	120,000	9.7	5,900	190 J
UEP	OU4-UEP-46A-SC	0	1.5	16-Oct-08	8,400	1.4 J	100 J	65	0.65 UJ	5.5 U	0.39 UJ	10,000	25 J	11 J	1,700 J	73,000	28	6,600	97 J
UEP	OU4-UEP-47A-SC	0	3	16-Oct-08	4,000	0.60 J	1.8 UJ	22	0.52 UJ	2.2 U	0.31 UJ	3,500	4.2 J	2.8 J	470 J	12,000	1.6 J	4,600	54 J
UEP	OU4-UEP-47B-SC	3	6	16-Oct-08	4,900	0.47 J	7.6 J	36	0.58 UJ	2.5 U	0.35 UJ	3,600	7.4 J	6.5 J	790 J	19,000	4.3	5,000	110 J
	Minimum				**1,700**	**ND**	**ND**	**14**	**ND**	**ND**	**ND**	**3,500**	**4.2**	**2.4**	**150**	**12,000**	**1.6**	**1,000**	**54**
	Median				**4,450**	**0.73**	**78**	**44**	**ND**	**16**	**ND**	**34,500**	**8.9**	**7.6**	**345**	**150,000**	**22.5**	**2,800**	**140**
	Average				**5,394**	**1.6**	**129**	**74**	**0.62**	**19**	**0.43**	**31,394**	**19**	**15**	**483**	**142,389**	**38.8**	**3,294**	**206**
	Maximum				**11,000**	**9.6**	**790**	**360**	**0.78**	**43**	**0.89**	**73,000**	**91**	**77**	**1,700**	**240,000**	**170**	**7,000**	**540**

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	Background Limits (A1)				**16,445**	**0.94**	**13**	**171**	**1**	**24**	**0.32**	**22,614**	**11**	**12**	**58**	**19,502**	**11**	**6,314**	**526**
	Residential				**77,000**	**31**	**0.39**	**15,000**	**160**	**16,000**	**70**	**NA**	**280**	**23**	**3,100**	**55,000**	**400**	**NA**	**1,800**
	Industrial				**990,000**	**410**	**1.6**	**190,000**	**2,000**	**200,000**	**810**	**NA**	**1,400**	**300**	**41,000**	**720,000**	**800**	**NA**	**23,000**
	Ecological SLV				**NA**	**0.27**	**9.79**	**330**	**21**	**0.5**	**0.36**	**NA**	**26**	**13**	**28**	**NA**	**11**	**NA**	**220**
FEP-1	OU4-FEP-58A-SC	0	0.25	17-Oct-08	24,000	0.57 J	7.4	150	1.4 J	14 J	0.31 U	22,000	11 J	19 J	500	36,000	15	11,000	930
	OU4-FEP-59A-SC	0	0.5	17-Oct-08	26,000	0.90 J	6.9	150	1.6	15	0.41 J	15,000	12	38	640	35,000	15	13,000	980
FEP-2	OU4-FEP-57A-SC	0	0.25	17-Oct-08	2,600	0.53 U	4.1	8.6	0.53 UJ	22 UJ	0.32 U	160,000	3.9 J	1.2 J	42	170,000	4.5	900	60
	OU4-FEP-60A-SC	0	0.25	17-Oct-08	1,500	0.52 UJ	4.4	18	0.52 U	11 U	0.31 U	42,000	1.9 J	1.4 J	31	120,000	3.4	580	40
FEP-3	OU4-FEP-56A-SC	0	0.25	18-Oct-08	2,000	1.0 J	0.36 U	11	0.10 U	8.7 U	0.062 U	42,000	1.7	3.6	23	60,000	7.9	820	55
FEP-4	OU4-FEP-53A-SC	0	0.5	18-Oct-08	1,400	0.55 UJ	1.9 U	7.4	0.55 U	23 U	0.33 U	18,000	1.9 U	6.1	35	250,000	4.8	720	42
	OU4-FEP-54A-SC	0	0.25	18-Oct-08	2,600	0.84 J	2.5 J	29	0.60 U	13 U	0.36 U	49,000	2.3 J	6.6	64	170,000	16	990	61
	OU4-FEP-55A-SC	0	0.5	18-Oct-08	2,200	0.92 J	3.2	28	0.60 U	13 U	0.36 U	41,000	3.9 J	6.2	55	150,000	17	910	56
	Minimum				**1,400**	**ND**	**ND**	**7.4**	**ND**	**ND**	**ND**	**15,000**	**ND**	**1.2**	**23**	**35,000**	**3.4**	**580**	**40**
	Median				**2,400**	**0.71**	**3.7**	**23**	**ND**	**ND**	**ND**	**41,500**	**3.1**	**6.2**	**49**	**135,000**	**11**	**905**	**58**
	Average				**7,788**	**0.73**	**3.8**	**50**	**0.74**	**15**	**0.31**	**48,625**	**4.8**	**10**	**174**	**123,875**	**10**	**3,615**	**278**
	Maximum				**26,000**	**1.0**	**7.4**	**150**	**1.6**	**23**	**0.41**	**160,000**	**12**	**38**	**640**	**250,000**	**17**	**13,000**	**980**
FEP-5	OU4-FEP-48B-SC	0.5	5	09-Oct-08	6,500	9.2 J	210	720	0.15 J	12 U	2.4	670	46	56	300	100,000	500	1,600	53 J
	OU4-FEP-48C-SC	9	12	09-Oct-08	9,500	12 J	1,400	1,100	0.31 J	17 U	2.2	500	180	66	450	150,000	200	280	30 J
	OU4-FEP-49B-SC	0.5	4	09-Oct-08	6,400	9.1 J	420	760	0.25 U	10 U	1.8	1,300	89	71	430	98,000	400	780	39 J
	OU4-FEP-50B-SC	0.5	2	09-Oct-08	11,000	8.4 J	630	340	0.42 J	14 U	1.9	790	100	37	570	150,000	1100	640	32 J
	OU4-FEP-52B-SC	0.5	4	09-Oct-08	9,200	9.4 J	740	520	0.53 J	16 U	2.7	1,500	130	44	490	140,000	800	820	42 J
	Minimum				**6,400**	**8.4**	**210**	**340**	**ND**	**ND**	**1.8**	**500**	**46**	**37**	**300**	**98,000**	**200**	**280**	**30**
	Median				**9,200**	**9.2**	**630**	**720**	**0.31**	**ND**	**2.2**	**790**	**100**	**56**	**450**	**140,000**	**500**	**780**	**39**
	Average				**8,520**	**9.6**	**680**	**688**	**0.33**	**ND**	**2.2**	**952**	**109**	**55**	**448**	**127,600**	**600**	**824**	**39**
	Maximum				**11,000**	**12**	**1,400**	**1,100**	**0.53**	**ND**	**2.7**	**1,500**	**180**	**71**	**570**	**150,000**	**1,100**	**1,600**	**53**
Soils																			
LEP	OU4-LEP-01A-SC	1.5	7	05-Oct-08	12,000	0.29 J	4.5	70	0.55	2.4 U	0.11 J	3,900	14	13	330 J	21,000	5.0	6,000	300
	OU4-LEP-01B-SC	15	18	05-Oct-08	8,800	0.32 J	5.3	71	0.46	2.3 U	0.072 J	3,800	9.3	7.2	110 J	16,000	4.5	4,400	250
	OU4-LEP-02A-SC	20	25	06-Oct-08	11,000	0.38 J	24	77	1.8	17	0.069 J	5,100	11	6.7	38 J	18,000	6.0	5,200	280
	OU4-LEP-02B-SC	29	32	06-Oct-08	9,500	1.1 J	5.4	70	0.32 J	2.4 U	0.067 U	3,700	11	5.2	560 J	16,000	4.8	5,800	200
	OU4-LEP-03A-SC	5	8	06-Oct-08	24,000	0.49 J	15	89	1.0	21	0.25 J	4,400	21	18	420 J	25,000	8.5	9,900	490
	OU4-LEP-03B-SC	15	18	06-Oct-08	13,000	0.57 J	10	110	0.44	7.5	0.076 J	17,000	13	7.3	26 J	20,000	6.2	6,500	330
	OU4-LEP-04A-SC	3	8	07-Oct-08	8,000	0.39 J	7.0	61	0.31 J	2.3 U	0.065 U	3,800	10	4.2	99 J	19,000	4.8	3,200	140
	OU4-LEP-04B-SC	11	16	07-Oct-08	8,000	0.33 J	6.7	99	0.36	2.3 U	0.075 J	9,300	9.5	6.6	36 J	17,000	4.5	4,400	350
	OU4-LEP-05A-SC	3	7	07-Oct-08	27,000	0.42 J	35 J	140	1.1 J	140	0.53 J	9,600	16	25	150 J	30,000	12	12,000	1,600
	OU4-LEP-05B-SC	12	15	07-Oct-08	11,000	0.59 J	11 J	140	0.42 J	2.5 U	0.12 J	20,000	13	11	25 J	21,000	7.2	6,000	660
	OU4-LEP-18B-SC	1.5	3	18-Oct-08	8,400	0.20 J	7.6	52	0.60 U	27	0.36 U	2,700	7.5	8.5	170	43,000	5.5	2,800	140
	OU4-LEP-19B-SC	1.7	3	15-Oct-08	37,000 J	0.46 J	14 J	89 J	1.3 J	34 J	0.26 J	8,300 J	25 J	29 J	1,000	42,000 J	9.8	14,000 J	710 J
	OU4-LEP-20B-SC	1	3	19-Oct-08	30,000	0.53 J	24 J	120 J	1.5 J	27 UJ	0.38 U	10,000 J	31	27	640	43,000	11	15,000	670
	OU4-LEP-21B-SC	1.5	3	19-Oct-08	10,000	0.34 J	17 J	92 J	0.62 U	26 UJ	0.37 U	7,500 J	14	6.1	200	60,000	5.6	3,800	170
	OU4-LEP-22B-SC	1.5	2.5	18-Oct-08	17,000	0.42 J	37	90	1.0 J	11	0.37 U	4,500	21	16	310	21,000	6.7	7,200	340
	OU4-LEP-23B-SC	2	3	18-Oct-08	23,000	0.51 J	39 J	77 J	1.2 J	22 J	0.36 U	4,700 J	21	21	520	29,000	8.1	10,000	510
	OU4-LEP-24B-SC	1.5	3	30-Oct-08	28,000	2.0 J	40	110	2.3	31	0.58 J	5,300	26	25	710	30,000	9.6	12,000	730
	OU4-LEP-25B-SC	1.5	3	19-Oct-08	18,000	0.43 J	15 J	90 J	0.90 J	26 J	0.35 U	5,000 J	13	15	320	20,000	6.7	7,400	430
	OU4-LEP-26B-SC	1	3	15-Oct-08	16,000 J	0.40 J	7.0 J	91 J	0.30 J	12 J	0.071 U	6,500 J	13 J	5.3 J	74	36,000 J	7.1	4,700 J	190 J
	OU4-LEP-27B-SC	2	3	18-Oct-08	26,000	0.52 J	49 J	72 J	1.3 J	110 J	0.37 U	12,000 J	16	17	550	34,000	9.2	9,600	1,000
	OU4-LEP-28B-SC	1	3	18-Oct-08	8,900	0.33 J	7.1 J	62 J	0.56 U	2.4 UJ	0.34 U	2,400 J	6.7	4.3	92	19,000	5.8	3,000	120
	OU4-LEP-29C-SC	2	5	17-Oct-08	16,000	0.31 J	17	83	0.60 UJ	23 J	0.36 U	9,200	10 J	5.6 J	190	39,000	7.3	5,600	250
	OU4-LEP-30C-SC	2.5	6	17-Oct-08	17,000	0.63 U	41 J	100	1.2 J	50 J	0.38 U	7,100 J	12 J	25 J	130 J	25,000	11	8,600	1,900
	OU4-LEP-31C-SC	2.5	6	17-Oct-08	5,200	0.55 U	5.7	54	0.55 UJ	2.3 UJ	0.33 U	3,000	5.8 J	3.4 J	52	19,000	3.3	2,400	120
	OU4-LEP-32C-SC	3	6	17-Oct-08	18,000	0.41 J	19	98	0.92 J	43 J	0.34 U	12,000	11 J	15 J	420	25,000	9.4	7,000	1,100
	Minimum				**5,200**	**ND**	**4.5**	**52**	**ND**	**ND**	**ND**	**2,400**	**5.8**	**3.4**	**25**	**16,000**	**3.3**	**2,400**	**120**
	Median				**16,000**	**0.42**	**15**	**89**	**0.62**	**21**	**ND**	**5,300**	**13**	**11**	**190**	**25,000**	**6.7**	**6,000**	**340**
	Average				**16,432**	**0.52**	**19**	**88**	**0.86**	**26**	**0.27**	**7,232**	**14**	**13**	**287**	**27,520**	**7.2**	**7,060**	**519**
	Maximum				**37,000**	**2.0**	**49**	**140**	**2.3**	**140**	**0.58**	**20,000**	**31**	**29**	**1,000**	**60,000**	**12**	**15,000**	**1,900**

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
UEP	OU4-UEP-06A-SC	15.5	20	14-Oct-08	28,000	0.43 J	11 J	160 J	0.79	25 J	0.37 J	7,800	15	12	110 J	37,000	12	9,700	710 J
UEP	OU4-UEP-06B-SC	30	35	14-Oct-08	5,600	0.27 J	7.0 J	57 J	0.23 J	2.5 UJ	0.071 U	2,100	8.3	4.1	42 J	12,000	3.3	2,400	140 J
UEP	OU4-UEP-07A-SC	5	8	08-Oct-08	12,000	0.30 J	17 J	68	0.62 J	5.8	0.085 J	12,000	14	6.1	210 J	28,000	6.1	3,400	160
UEP	OU4-UEP-07B-SC	17	20	08-Oct-08	16,000	0.37 J	10 J	110	0.43 J	2.4 U	0.10 J	3,500	12	7.7	52 J	25,000	7.3	5,900	320
UEP	OU4-UEP-08A-SC	3	6	08-Oct-08	2,100	0.25 J	17	42	0.10 U	4.3 U	0.062 U	2,400	3.9 J	1.9	20	10,000	2.5 J	1,000	61 J
UEP	OU4-UEP-08B-SC	10	13	08-Oct-08	4,300	0.26 J	27	62	0.11 J	4.4 U	0.064 U	3,900	6.7	2.9	35	13,000	3.8	2,000	110 J
UEP	OU4-UEP-09A-SC	4	7	14-Oct-08	21,000	0.52 J	35 J	190 J	0.37 J	9.7 J	0.08 U	10,000	24	7.6	100 J	40,000	12	7,400	240 J
UEP	OU4-UEP-09B-SC	16	20	14-Oct-08	9,200	0.36 J	8.0 J	100 J	0.34 J	2.5 UJ	0.07 U	3,900	11	5.0	31 J	15,000	4.2	3,700	230 J
UEP	OU4-UEP-10A-SC	3	5	12-Oct-08	24,000	0.56 J	71 J	170 J	0.42	13 J	0.09 J	4,500	25	6.9	100 J	36,000	11	7,400	240 J
UEP	OU4-UEP-10B-SC	17	20	12-Oct-08	8,500	0.47 J	11 J	81 J	0.36	2.5 UJ	0.11 J	40,000	8.0	6.0	14 J	12,000	3.6	3,600	420 J
UEP	OU4-UEP-11A-SC	15	20	09-Oct-08	12,000	0.32 J	13	81	0.39	13	0.065 U	7,400	5.8	3.9	22	12,000	5.8	3,700	350 J
UEP	OU4-UEP-11B-SC	31	35	09-Oct-08	12,000	0.38 J	6.3	100	0.37	4.5 U	0.065 U	3,200	8.0	6.3	30	18,000	6.6	5,800	540 J
UEP	OU4-UEP-33B-SC	0.5	3	18-Oct-08	4,000	0.23 J	9.0	47	0.54 U	10	0.32 U	5,500	3.3 J	1.8 J	51	19,000	4.5	1,300	63
UEP	OU4-UEP-34B-SC	2	3	17-Oct-08	6,600	0.30 J	37	62	0.56 UJ	11 J	0.34 U	8,200	5.7 J	2.7 J	120	32,000	5.4	2,300	95
UEP	OU4-UEP-35B-SC	1.5	3	16-Oct-08	14,000	0.45 J	92 J	140	0.64 UJ	27	0.38 UJ	7,100	16 J	7.2 J	230 J	34,000	9.1	5,300	230 J
UEP	OU4-UEP-36B-SC	1	3	15-Oct-08	19,000 J	0.46 J	49 J	120 J	0.35 J	66 J	0.092 J	11,000 J	12 J	6.3 J	280	42,000 J	9.8	5,300 J	250 J
UEP	OU4-UEP-37B-SC	1.5	3	15-Oct-08	22,000 J	0.66 J	120 J	150 J	0.36 J	52 J	0.12 J	12,000 J	19 J	9.2 J	380	51,000 J	15	7,200 J	350 J
UEP	OU4-UEP-38B-SC	0.5	3	16-Oct-08	25,000 J	0.45 J	67 J	130 J	0.38 J	36 J	0.086 J	9,700 J	18 J	7.7 J	320	63,000 J	11	7,800 J	300 J
UEP	OU4-UEP-39B-SC	1	3	16-Oct-08	23,000 J	0.39 J	46 J	110 J	0.30 J	58 J	0.076 U	12,000 J	12 J	5.0 J	210	60,000 J	10	6,100 J	230 J
UEP	OU4-UEP-40B-SC	1	3	16-Oct-08	26,000 J	0.53 J	110 J	130 J	0.38 J	56 J	0.083 J	13,000 J	17 U	6.1 J	240	58,000 J	14	7,200 J	280 J
UEP	OU4-UEP-41C-SC	2	3	16-Oct-08	27,000	0.55 J	52 J	150	1.1 J	12	0.41 UJ	12,000	34 J	16 J	430 J	37,000	15	10,000	470 J
UEP	OU4-UEP-42C-SC	2.5	6	16-Oct-08	18,000	0.60 U	25 J	100	0.80 J	26	0.36 UJ	10,000	14 J	8.9 J	130 J	27,000	8.8	6,800	390 J
UEP	OU4-UEP-43B-SC	1	3	16-Oct-08	7,700 J	0.36 J	68 J	60 J	0.16 J	7.3 J	0.069 U	3,600 J	10 J	3.5 J	60	19,000 J	4.8	2,500 J	120 J
UEP	OU4-UEP-44B-SC	0.33	3	16-Oct-08	23,000 J	0.56 J	120 J	130 J	0.32 J	31 J	0.074 U	9,400 J	20 J	5.5 J	87	47,000 J	12	7,100 J	220 J
UEP	OU4-UEP-45B-SC	1	3	16-Oct-08	16,000	0.83 J	58 J	110	0.40 J	6.6 J	0.091 J	9,900	16 J	6.5 J	120 J	42,000	14	6,000	250 J
UEP	OU4-UEP-46B-SC	1.5	3	16-Oct-08	14,000	0.63 J	42 J	100	0.51 J	10 J	0.098 J	13,000	10 J	5.2 J	160 J	49,000	16	4,400	200 J
UEP	OU4-UEP-47C-SC	6	9	16-Oct-08	15,000	0.40 J	41 J	95	0.89 J	7.4	0.36 UJ	8,200 J	9.7 J	13 J	230 J	27,000	7.9	4,500	540 J
	Minimum				**2,100**	**ND**	**6.3**	**42**	**ND**	**ND**	**ND**	**2,100**	**ND**	**1.8**	**14**	**10,000**	**2.5**	**1,000**	**61**
	Median				**15,000**	**0.43**	**37**	**100**	**0.38**	**10**	**ND**	**8,200**	**12**	**6.1**	**110**	**32,000**	**8.8**	**5,300**	**240**
	Average				**15,370**	**0.44**	**43**	**106**	**0.45**	**19**	**0.16**	**9,085**	**13**	**6.5**	**141**	**32,037**	**8.7**	**5,178**	**278**
	Maximum				**28,000**	**0.83**	**120**	**190**	**1.1**	**66**	**0.41**	**40,000**	**34**	**16**	**430**	**63,000**	**16**	**10,000**	**710**
FEP-1	OU4-FEP-58B-SC	0.5	3	17-Oct-08	5,700	0.27 J	5.4	70	0.57 U	21	0.34 U	5,400	4.9 J	2.2 J	43	26,000	5.6	1,700	75
FEP-1	OU4-FEP-59B-SC	1	3	17-Oct-08	6,000	0.21 J	5.1	81	0.56 U	5.4 J	0.33 U	4,600	5.6	5.7	70	27,000	5.2	2,300	140
FEP-2	OU4-FEP-16A-SC	2	3.5	28-Oct-08	5,500	0.54 U	6.3	76	0.54 U	23 U	0.32 U	5,100	7.2	2.9	39	17,000	4.9	2,100	99
FEP-2	OU4-FEP-16B-SC	65	66.5	28-Oct-08	9,800	0.70 UJ	7.0	97	0.53 U	22 U	0.32 U	11,000	56	4.7	20	18,000	7.2	3,800	420
FEP-2	OU4-FEP-17A-SC	2	3.5	28-Oct-08	5,000	0.54 U	9.1	87	0.54 U	23 U	0.33 U	5,300	9.3	2.5 J	34	21,000	4.9	1,700	90
FEP-2	OU4-FEP-57B-SC	0.25	3	17-Oct-08	5,100	0.19 J	5.3	71	0.55 UJ	4.0 J	0.33 U	4,500	2.8 J	2.0 J	41	26,000	5.0	1,500	70
FEP-2	OU4-FEP-60B-SC	0.25	3	17-Oct-08	5,700	0.29 J	7.9	83	0.54 U	6.0	0.32 U	6,400	4.3 J	3.1	45	20,000	5.3	2,000	97
FEP-3	OU4-FEP-56B-SC	0.25	1	18-Oct-08	7,100	0.32 J	8.1	98	0.56 U	15	0.34 U	7,900	6.5	6.6	45	33,000	11	2,100	110
FEP-4	OU4-FEP-14A-SC	2	3.5	29-Oct-08	9,500	1.2 J	14	90	0.58 U	24 U	0.35 U	9,300	13	7.1	44	51,000	6.9	2,800	130
FEP-4	OU4-FEP-14B-SC	5	6.5	29-Oct-08	7,100	0.58 UJ	12	65	0.56 U	23 U	0.33 U	6,700	11	6.1	31	30,000	5.5	3,000	140
FEP-4	OU4-FEP-14C-SC	45	46.5	29-Oct-08	6,200	0.54 U	6.5	85	0.54 U	23 U	0.33 U	7,000	9.5	3.3	40	11,000	5.1	2,500	130
FEP-4	OU4-FEP-15A-SC	2	3.5	29-Oct-08	8,800	0.67 UJ	9.9	76	0.58 U	24 U	0.35 U	5,200	12	7.8	54	30,000	4.9	2,900	140
FEP-4	OU4-FEP-15B-SC	50	51.5	29-Oct-08	12,000	0.57 U	6.1	100	0.79 J	24 U	0.34 U	16,000	10	6.3	61	20,000	6.8	3,800	250
FEP-4	OU4-FEP-53B-SC	0.5	3	18-Oct-08	5,000	0.23 J	3.6	100	0.55 U	14	0.33 U	12,000	1.9 U	6.7	41	42,000	5.8	1,500	63
FEP-4	OU4-FEP-54B-SC	0.25	3	18-Oct-08	1,000	0.22 J	7.0	76	0.56 U	2.4 J	0.33 U	1,100	4.4 J	3.6	33	6,200	5.3	240	11
FEP-4	OU4-FEP-55B-SC	0.5	3	18-Oct-08	4,700	0.25 J	4.0	100	0.57 U	15	0.34 U	7,400	2.9 J	3.7	41	32,000	5.6	1,200	57
	Minimum				**1,000**	**ND**	**3.6**	**65**	**ND**	**ND**	**ND**	**1,100**	**ND**	**2**	**20**	**6,200**	**4.9**	**240**	**11**
	Median				**5,850**	**0.43**	**6.8**	**84**	**ND**	**ND**	**ND**	**6,550**	**6.9**	**4.2**	**41**	**26,000**	**5.4**	**2,100**	**105**
	Average				**6,513**	**0.46**	**7.3**	**85**	**0.57**	**17**	**ND**	**7,181**	**10**	**4.6**	**43**	**25,638**	**5.9**	**2,196**	**126**
	Maximum				**12,000**	**1.20**	**14**	**100**	**0.79**	**24**	**ND**	**16,000**	**56**	**7.8**	**70**	**51,000**	**11**	**3,800**	**420**
FEP #5	OU4-FEP-12A-SC	11	15	13-Oct-08	8,700	0.38 J	150 J	110 J	0.26 J	2.3 UJ	0.065 U	2,500	26	2.3	58 J	17,000	6.5	1,900	75 J
FEP #5	OU4-FEP-12B-SC	41	45	13-Oct-08	11,000	0.31 J	15 J	89 J	0.37	2.3 UJ	0.067 U	5,600	12	3.6	30 J	13,000	4.9	2,800	120 J
FEP #5	OU4-FEP-13A-SC	6	8	12-Oct-08	7,600	0.68 J	86 J	95 J	0.22 J	2.3 UJ	0.065 U	1,300	18	2.6	160 J	18,000	6.0	2,400	79 J
FEP #5	OU4-FEP-13B-SC	40	43	12-Oct-08	9,800	0.42 J	22 J	91 J	0.44	3.2 J	0.069 U	8,100	13	3.9	78 J	12,000	8.4	2,800	150 J
FEP #5	OU4-FEP-48D-SC	12	15	09-Oct-08	11,000	0.35 J	55	120	0.47	4.6 U	0.066 U	3,200	22	2.5	44	13,000	5.3	2,600	97 J
FEP #5	OU4-FEP-49C-SC	5	8	09-Oct-08	5,600	0.33 J	190	100	0.16 J	4.5 U	0.065 U	1,500	21	1.5	18	28,000	6.6	1,200	50 J
FEP #5	OU4-FEP-50C-SC	2	5	09-Oct-08	7,900	0.28 J	200	110	0.19 J	4.4 U	0.063 U	1,500	24	1.6	26	36,000	6.9	1,500	64 J
FEP #5	OU4-FEP-51B-SC	1	5	09-Oct-08	5,200	0.30 J	54 J	64	0.18 J	2.2 U	0.063 U	4,100	11	1.2	51 J	17,000	7.4	1,100	50
FEP #5	OU4-FEP-52C-SC	5	8	09-Oct-08	6,400	0.25 J	160	68	0.20 J	4.4 U	0.063 U	1,300	23	1.5	16	20,000	4.7	1,300	55 J
	Minimum				**5,200**	**0.25**	**15**	**64**	**0.16**	**ND**	**ND**	**1,300**	**11**	**1.2**	**16**	**12,000**	**4.7**	**1,100**	**50**
	Median				**7,900**	**0.33**	**86**	**95**	**0.22**	**ND**	**ND**	**2,500**	**21**	**2.3**	**44**	**17,000**	**6.5**	**1,900**	**75**
	Average				**8,133**	**0.37**	**104**	**94**	**0.28**	**ND**	**ND**	**3,233**	**19**	**2.3**	**53**	**19,333**	**6.3**	**1,956**	**82**
	Maximum				**11,000**	**0.68**	**200**	**120**	**0.47**	**ND**	**ND**	**8,100**	**26**	**3.9**	**160**	**36,000**	**8**	**2,800**	**150**

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
	Background Limits (A1)				**0.031**	**1.7**	**12**	**3,365**	**0.8**	**NA**	**0.54**	**2,093**	**0.61**	**15**	**2.9**	**57**	**61**	**2.04**	**2.24**
	Residential				**23**	**390**	**1,600**	**NA**	**390**	**NA**	**390**	**NA**	**5.1**	**NA**	**230**	**390**	**23,000**	**0.193(4)**	**0.260(4)**
	Industrial				**310**	**5,100**	**20,000**	**NA**	**5,100**	**NA**	**5,100**	**NA**	**66**	**NA**	**3,100**	**5,200**	**310,000**	**3.70(4)**	**8.40(4)**
	Ecological SLV				**0.01**	**2**	**22.7**	**NA**	**0.52**	**NA**	**4.2**	**NA**	**1**	**NA**	**NA**	**7.8**	**46**	**50.6**	**43.9**
VLT Materials																			
LEP Base	OU4-LEP-29B-SC	0.5	2	17-Oct-08	0.4	2.6 J	8.5 J	1,300	3.1 J	270 J	0.79 U	620	0.53 U	9.14	1.73	16 J	7.3 J	3.32	0.601 J
LEP Base	OU4-LEP-30B-SC	0.5	2.5	17-Oct-08	0.15 J	4.9 J	4.7 J	770	1.9 J	330 J	0.80 U	1500	0.54 U	9.57	3.99	13 J	7.6 J	2.65	1.24
LEP Base	OU4-LEP-31B-SC	0.33	2.5	17-Oct-08	0.17	1.3 J	6.7 J	1,300	1.4 J	200 J	0.78 U	480 J	0.52 U	9.37	3.17	18 J	8.7 J	2.67	1.16
LEP Base	OU4-LEP-32B-SC	0.5	3	17-Oct-08	0.32	2.8 J	7.2 J	1,500	5.4 J	320 J	0.79 U	900	0.53 U	7.36	2.84	16 J	11 J	1.90	1.01 U
FEP Cap	OU4-FEP-48A-SC	0	0.5	09-Oct-08	0.5	3.3	6.2	1,000 J	3.4	340 J	0.15 U	160 J	0.26 J	10.1	6.28	16	11	3.00	1.19
FEP Cap	OU4-FEP-49A-SC	0	0.5	09-Oct-08	1.0 J	2.6	5.3	1,000 J	3.2	420 J	0.15 U	48 J	0.10 U	10.0	4.63	14	11	4.33	1.46
FEP Cap	OU4-FEP-50A-SC	0	0.5	09-Oct-08	0.79	5	8.3	1,200 J	9.1	330 J	0.15 U	77 J	0.38 J	12.7	4.79	23	14	3.81	1.48
FEP Cap	OU4-FEP-51A-SC	0	0.5	09-Oct-08	0.21	3	5.2	910 J	2.9	350 J	0.15 U	100 J	0.17 J	9.57	4.42	15	9.7 J	3.77	1.25
FEP Cap	OU4-FEP-52A-SC	0	0.5	09-Oct-08	0.86	3.8	4.5	720 J	4.1	300 J	0.15 U	52 J	0.22 J	8.66	3.2	14	7.3 J	3.75	1.19
	Minimum				**0.15**	**1.3**	**4.5**	**720**	**1.4**	**200**	**ND**	**48**	**ND**	**7.36**	**1.73**	**13**	**7.3**	**1.90**	**ND**
	Median				**0.40**	**3.0**	**6.2**	**1,000**	**3.2**	**330**	**ND**	**160**	**ND**	**9.57**	**3.99**	**16**	**9.7**	**3.32**	**1.19**
	Average				**0.49**	**3.3**	**6.3**	**1,078**	**3.8**	**318**	**ND**	**437**	**0.36**	**9.61**	**3.89**	**16**	**9.7**	**3.24**	**1.18**
	Maximum				**1.0**	**5.0**	**8.5**	**1,500**	**9.1**	**420**	**ND**	**1500**	**0.54**	**12.7**	**6.28**	**23**	**14**	**4.33**	**1.48**
Pond Sediments																			
LEP	OU4-LEP-18A-SC	0	0.25	18-Oct-08	0.025	4.7 J	2.8 J	3,700	1.3 J	450 J	0.79 U	21,000	4.3	16.7	2.61	9.3	7.6 J	0.686 J	2.17
LEP	OU4-LEP-19A-SC	0	1	15-Oct-08	0.065 J	0.62 UJ	46 J	1,200	1.3 J	370 J	0.93 U	11,000	0.62 UJ	8.01	26.4	28 J	120 J	0.916 J	1.35
LEP	OU4-LEP-20A-SC	0	0.25	19-Oct-08	0.056	1.1 J	33	1,300	1.6 J	410 J	0.96 U	16,000	1.1 J	12.5	23.3	27 J	94 J	0.849 J	1.50
LEP	OU4-LEP-21A-SC	0	0.5	19-Oct-08	0.042	0.94 J	2.6 U	860	1.4 J	560 J	0.86 U	25,000	0.57 U	23.1	9.15	4.4 J	7.5 UJ	1.18	1.66
LEP	OU4-LEP-22A-SC	0	0.5	18-Oct-08	0.083	1.7 J	43	1,500	2.8 J	510 J	1.1 U	14,000	1.1 J	11.8	39.7	28	110 J	0.682 J	1.89
LEP	OU4-LEP-23A-SC	0	0.25	18-Oct-08	0.082	1.6 J	57	1,400	2.8 J	460 J	1.0 U	11,000	1.1 J	12.4	60.5	44	140 J	0.353 J	1.55
LEP	OU4-LEP-24A-SC	0	0.5	19-Oct-08	0.047	5.3 J	35	4,200	2.1 J	300 J	1.0 U	22,000	2.0 J	29.5	42.4	39 J	100 J	0.508 J	2.56
LEP	OU4-LEP-25A-SC	0	0.25	19-Oct-08	0.051	4.7 J	19	4,000	2.0 J	420 J	0.95 U	17,000	2.3 J	9.72	1.87	17 J	56 J	1.14	1.14
LEP	OU4-LEP-26A-SC	0	0.25	15-Oct-08	0.081 J	11 J	11 J	9,100	1.5 J	210 J	0.81 U	21,000	6.5 J	34.3	4.43	26 J	11 J	0.705 U	3.92
LEP	OU4-LEP-27A-SC	0	0.33	18-Oct-08	0.14	2.6 J	21	2,800	4.2 J	750 J	1.2 U	29,000	1.2 J	16.0	29.8	24 J	60 J	0.716 J	3.68
LEP	OU4-LEP-28A-SC	0	0.25	18-Oct-08	0.063 U	6.6 J	2.4 U	6,900	0.97 J	200 J	0.79 U	18,000	5.7	22.9	3.33	13 J	6.8 UJ	0.735 J	4.71
LEP	OU4-LEP-29A-SC	0	0.5	17-Oct-08	0.053	10	3.9 J	7,300	1.5 J	810 J	0.82 U	21,000	6.6	34.1	3.16	10 J	11 J	0.572 J	4.60 U
LEP	OU4-LEP-30A-SC	0	0.5	17-Oct-08	0.051	8.6	11 J	5,800	1.5 J	370 J	0.85 U	29,000	5.1	42.0	14.0 J	9.2 J	26 J	0.524 J	3.65
LEP	OU4-LEP-31A-SC	0	0.33	17-Oct-08	0.027	8.9	2.9 J	6,500	1.2 J	280 J	0.80 U	18,000	5.4	33.9	2.40	14 J	6.9 UJ	0.524 U	4.47
LEP	OU4-LEP-32A-SC	0	0.5	17-Oct-08	0.043	10	16 J	8,700	1.9 J	390 J	0.92 U	30,000	5.0	11.7	11.4	18 J	49 J	1.21	1.42
	Minimum				**ND**	**ND**	**ND**	**860**	**0.97**	**200**	**ND**	**11000**	**ND**	**8.01**	**1.87**	**4.4**	**ND**	**ND**	**ND**
	Median				**0.05**	**4.7**	**16**	**4,000**	**1.5**	**410**	**ND**	**21000**	**2.3**	**16.7**	**11.4**	**18**	**49**	**0.705**	**2.17**
	Average				**0.06**	**5.2**	**20**	**4,351**	**1.9**	**433**	**ND**	**20,200**	**3.2**	**21.2**	**18.3**	**21**	**54**	**0.753**	**2.68**
	Maximum				**0.14**	**11.0**	**57**	**9,100**	**4.2**	**810**	**ND**	**30000**	**6.6**	**42.0**	**60.5**	**44**	**140**	**1.21**	**4.71**
UEP	OU4-UEP-33A-SC	0	0.5	18-Oct-08	0.26	14	9.1	10,000	6.9	210 J	0.79 U	16,000	18	167	31.7	30	24 J	2.25	16.7
UEP	OU4-UEP-34A-SC	0	2	17-Oct-08	0.19	23	12 J	10,000	11 J	660 J	0.84 U	13,000	15	189	34.0	44 J	37 J	3.24	24.3
UEP	OU4-UEP-35A-SC	0	1.5	16-Oct-08	1.1	20 J	8.9 J	9,300	27 J	350 J	0.96 UJ	19,000	38	65.3	13.9	28	26 J	1.88	7.65
UEP	OU4-UEP-36A-SC	0	1	15-Oct-08	1.4 J	32 J	9.4 J	12,000	76 J	690 J	0.97 U	22,000	48 J	88.5	16.6	58 J	19 J	2.01	12.1
UEP	OU4-UEP-37A-SC	0	1.5	15-Oct-08	0.48 J	8.7 J	14 J	9,500	9.1 J	240 J	0.81 U	17,000	20 J	64.8	9.70	28 J	38 J	1.88	7.01
UEP	OU4-UEP-38A-SC	0	0.5	16-Oct-08	0.39 J	6.1 J	6.9 J	7,900	6.6 J	280 J	0.94 U	16,000	14 J	48.2	5.57	44 J	140 J	1.59	5.09
UEP	OU4-UEP-39A-SC	0	1	16-Oct-08	0.53 J	7.6 J	4.8 J	9,700	17 J	250 J	0.92 U	20,000	30 J	55.8	4.28	39 J	37 J	1.00	5.88
UEP	OU4-UEP-40A-SC	0	1	16-Oct-08	1.3 J	15 J	12 J	9,000	25 J	440 J	0.94 U	28,000	45 J	42.6	4.96	33 J	21 J	1.27	5.72
UEP	OU4-UEP-41A-SC	0	0.5	16-Oct-08	0.37	16 J	14 J	11,000	7.9 J	300 J	0.92 UJ	13,000	24	102	62.5	22	58 J	2.74	13.5
UEP	OU4-UEP-41B-SC	0.5	2	16-Oct-08	7.8	19 J	150 J	4,200	45 J	580 J	1.2 UJ	8,200	38	151	104	44	77 J	4.08	19.4
UEP	OU4-UEP-42A-SC	0	0.33	16-Oct-08	0.10	8.1 J	13 J	13,000	4.5 J	230 J	0.84 UJ	20,000	36	83.5	34.8	17	45 J	1.52	8.86
UEP	OU4-UEP-42B-SC	0.33	2.5	16-Oct-08	2.9	10 J	180 J	1,700	20 J	230 J	0.94 UJ	6,100	42	62.8	21.4	58	74 J	2.71	10.3
UEP	OU4-UEP-43A-SC	0	1	16-Oct-08	1.2 J	13 J	8.2 J	9,000	42 J	300 J	0.92 U	23,000	39 J	55.3	6.71	36 J	27 J	1.60	7.65
UEP	OU4-UEP-44A-SC	0	0.33	16-Oct-08	0.95	12 J	3.4 J	14,000	39 J	190 J	0.79 U	26,000	57 J	60.5	6.73	39 J	10 J	1.10	6.35
UEP	OU4-UEP-45A-SC	0	1	16-Oct-08	0.38	6 J	9.6 J	6,900	8.0 J	370 J	0.93 UJ	14,000	20	35.6	7.80	31 J	21 J	1.73	3.76
UEP	OU4-UEP-46A-SC	0	1.5	16-Oct-08	0.58	6.2 J	14 J	5,200	6.0 J	460 J	0.98 UJ	4,300	14	40.4	17.2	39	45 J	2.50	4.61
UEP	OU4-UEP-47A-SC	0	3	16-Oct-08	0.053	1.7 J	6.0 J	1,000	1.2 J	250 J	0.78 UJ	38 J	0.52 U	8.10	1.43	15	8.5 J	0.817 J	0.845 J
UEP	OU4-UEP-47B-SC	3	6	16-Oct-08	0.071	2.0 J	39 J	2,000	1.2 J	380 J	0.88 UJ	390	2.7 J	12.5	13.0	19	31 J	1.37	1.45
	Minimum				**0.053**	**1.7**	**3.4**	**1,000**	**1.2**	**190**	**ND**	**38**	**ND**	**8.10**	**1.43**	**15**	**8.5**	**0.817**	**0.845**
	Median				**0.51**	**11**	**11**	**9,150**	**10**	**300**	**ND**	**16,000**	**27**	**61.7**	**13.5**	**35**	**34**	**1.81**	**7.33**
	Average				**1.1**	**12**	**29**	**8,078**	**20**	**356**	**ND**	**14,779**	**28**	**74.1**	**22.0**	**35**	**41**	**1.96**	**8.95**
	Maximum				**7.8**	**32**	**180**	**14,000**	**76**	**690**	**ND**	**28,000**	**57**	**189**	**104**	**58**	**140**	**4.08**	**24.3**

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
FEP-1	OU4-FEP-58A-SC	0	0.25	17-Oct-08	0.13	1.8 J	18 J	5,500	1.3 J	410 J	0.77 U	1,400	0.79 J	15.0	5.50	37 J	78 J	2.33	1.98
	OU4-FEP-59A-SC	0	0.5	17-Oct-08	0.11	1.7 J	29	5,300	1.5 J	340 J	0.80 U	1,800	0.75 J	14.6	6.69	39	100 J	2.29	1.97
FEP-2	OU4-FEP-57A-SC	0	0.25	17-Oct-08	0.023	13	2.4 UJ	9,900	1.1 J	530 J	0.80 U	16,000	10	57.1	6.09	19 J	6.9 UJ	0.618 J	6.47
	OU4-FEP-60A-SC	0	0.25	17-Oct-08	0.067	7.1	3.5 J	6,900	0.97 J	440 J	0.78 U	12,000	9.7	55.3	4.09	14	22 J	0.666 J	5.38
FEP-3	OU4-FEP-56A-SC	0	0.25	18-Oct-08	0.083	2.7	2.0	1,800	0.43 J	360 J	0.15 U	2,200	0.54	45.9	9.44	1.6	4.2 J	3.11	6.03
FEP-4	OU4-FEP-53A-SC	0	0.5	18-Oct-08	0.036	0.94 J	2.5 U	710	0.82 U	270 J	0.82 U	1,400	0.55 U	6.73	0.859	1.9 U	12 J	0.764 J	1.22
	OU4-FEP-54A-SC	0	0.25	18-Oct-08	0.029	5.1 J	2.8 J	3,500	1.5 J	770 J	0.91 U	7,000	0.60 U	34.9	3.52	14	7.9 U	2.65	5.35
	OU4-FEP-55A-SC	0	0.5	18-Oct-08	0.11	5.9 J	3.3 J	3,600	1.7 J	490 J	0.90 U	7,400	0.68 J	42.2	2.74	15	22 J	3.04	6.57
	Minimum				**0.023**	**0.94**	**ND**	**710**	**ND**	**270**	**ND**	**1400**	**ND**	**6.73**	**0.859**	**ND**	**ND**	**0.618**	**1.22**
	Median				**0.075**	**3.9**	**3.1**	**4,450**	**1.2**	**425**	**ND**	**4,600**	**0.72**	**38.6**	**4.80**	**15**	**17**	**2.31**	**5.37**
	Average				**0.074**	**4.8**	**7.9**	**4,651**	**1.2**	**451**	**ND**	**6,150**	**3.0**	**34.0**	**4.87**	**18**	**32**	**1.93**	**4.37**
	Maximum				**0.13**	**13**	**29**	**9,900**	**1.7**	**770**	**ND**	**16,000**	**10**	**57.1**	**9.44**	**39**	**100**	**3.11**	**6.57**
FEP-5	OU4-FEP-48B-SC	0.5	5	09-Oct-08	84 J	14	120	2,600 J	23	280 J	1.7	630 J	30	191	50.7	12	420	4.59	22.9
	OU4-FEP-48C-SC	9	12	09-Oct-08	17 J	19	160	1,400 J	130	350 J	1.0	280 J	75	226	276	18	99	5.84	29.0
	OU4-FEP-49B-SC	0.5	4	09-Oct-08	14 J	15	170	2,100 J	49	360 J	1.5	340 J	48	191	102	20	230	4.79	24.7
	OU4-FEP-50B-SC	0.5	2	09-Oct-08	49	37	80	2,200 J	180	580 J	2.9	330 J	97	630	337	9.4	310	9.88	78.8
	OU4-FEP-52B-SC	0.5	4	09-Oct-08	26	36	91	2,400 J	160	410 J	3.4	350 J	88	748	404	12	690	14.0	94.6
	Minimum				**14**	**14**	**80**	**1,400**	**23**	**280**	**1.0**	**280**	**30**	**191**	**50.7**	**9.4**	**99**	**4.59**	**22.9**
	Median				**26**	**19**	**120**	**2,200**	**130**	**360**	**1.7**	**340**	**75**	**226**	**276**	**12**	**310**	**5.84**	**29.0**
	Average				**38**	**24**	**124**	**2,140**	**108**	**396**	**2.1**	**386**	**68**	**397**	**234**	**14**	**350**	**7.82**	**50.0**
	Maximum				**84**	**37**	**170**	**2,600**	**180**	**580**	**3.4**	**630**	**97**	**748**	**404**	**20**	**690**	**14.0**	**94.6**
Soils																			
LEP	OU4-LEP-01A-SC	1.5	7	05-Oct-08	0.059 UJ	1.7	13	1,900 J	0.46 J	340	0.17 U	490 J	0.15 J	10.8	15.3	50	49	1.06	1.19
	OU4-LEP-01B-SC	15	18	05-Oct-08	0.031 UJ	1.2	8.3	1,300 J	0.27 J	320	0.17 U	1,500 J	0.15 J	11.7	10.2	37	35	0.958 J	1.17 U
	OU4-LEP-02A-SC	20	25	06-Oct-08	0.039 UJ	3.4	8.4	2,200 J	0.45 J	230	0.17 J	3,800 J	0.21 J	9.48	3.87	54	39	1.08	1.20
	OU4-LEP-02B-SC	29	32	06-Oct-08	0.11 UJ	5.1	8.2	1,800 J	1.1	250	0.17 U	2,900 J	0.13 J	9.40	3.36	44	30	1.5	1.26
	OU4-LEP-03A-SC	5	8	06-Oct-08	0.045 UJ	1.7	20	3,900 J	0.57 J	260	0.18 U	1,600 J	0.22 J	10.1	23.4	91	71	1.45	1.64
	OU4-LEP-03B-SC	15	18	06-Oct-08	0.055 UJ	0.59 UJ	8.5	1,800 J	0.30 J	240	0.18 U	5,000 J	0.20 J	8.93	2.31	72	42	1.39	1.56
	OU4-LEP-04A-SC	3	8	07-Oct-08	0.091 UJ	2.7	5.8	1,800 J	0.62 J	250	0.16 U	1,200 J	0.38 J	13.5	7.60	42	25	1.14	1.26
	OU4-LEP-04B-SC	11	16	07-Oct-08	0.043 UJ	1.6	7.0	1,200 J	0.25 J	260	0.16 U	1,300 J	0.22 J	7.73	2.64	42	32	0.824 J	0.972 J
	OU4-LEP-05A-SC	3	7	07-Oct-08	0.019 UJ	32	25	5,700	0.50 J	140 J	0.19 J	8,300	0.37 J	9.95	13.3	75	84 J	1.38	1.45
	OU4-LEP-05B-SC	12	15	07-Oct-08	0.051 UJ	5.1	8.9	1,600	0.29 J	86 J	0.18 U	4,200	0.21 J	8.91	2.43	77	41 J	1.27	1.61
	OU4-LEP-18B-SC	1.5	3	18-Oct-08	0.014 U	0.86 J	9.1	2,600	0.90 U	320 J	0.90 U	3,900	0.60 U	13.6	7.49	18	25 J	0.918 J	1.56
	OU4-LEP-19B-SC	1.7	3	15-Oct-08	0.032 J	1.5 J	26 J	6,200	0.48 J	42 J	0.24 J	900	0.26 J	11.7	17.9	160 J	89 J	1.18	1.31
	OU4-LEP-20B-SC	1	3	19-Oct-08	0.055	2.9 J	32	3,900	1.2 J	490 J	0.95 U	850	0.63 U	14.8	31.3	100 J	110 J	1.53	1.70
	OU4-LEP-21B-SC	1.5	3	19-Oct-08	0.024 J	1.2 J	7.4	3,500	1.3 J	320 J	0.94 U	4,600	0.62 U	9.50	2.96	45 J	29 J	0.651 J	1.52
	OU4-LEP-22B-SC	1.5	2.5	18-Oct-08	0.015 U	0.91 J	20	2,100	0.92 U	250 J	0.92 U	540	0.61 U	12.5	30.9	64	71 J	0.917 U	0.986 J
	OU4-LEP-23B-SC	2	3	18-Oct-08	0.032	17 J	29	2,600	1.1 J	450 J	0.91 U	2,400	0.61 U	14.2	31.1	69 J	81 J	0.897 U	1.80
	OU4-LEP-24B-SC	1.5	3	30-Oct-08	1.0	3.9 J	32	3,900	1.1 J	520 J	0.97 U	1,900	1.3 J	10.6	46.6	150	110 J	1.26	1.48
	OU4-LEP-25B-SC	1.5	3	19-Oct-08	0.035	7.4 J	20	3,100	0.89 U	360 J	0.89 U	3,500	0.59 U	19.7	21.9	55 J	66 J	0.54 U	2.20
	OU4-LEP-26B-SC	1	3	15-Oct-08	0.040 J	1.6 J	8.6 J	3,900	0.51 J	36 J	0.18 U	2,000	0.23 J	11.8	4.63	40 J	33 J	1.27	1.43
	OU4-LEP-27B-SC	2	3	18-Oct-08	0.018 J	36 J	29	5,100	1.1 J	460 J	0.93 U	7,200	1.2 J	13.0	27.6	78 J	74 J	0.991 J	1.70
	OU4-LEP-28B-SC	1	3	18-Oct-08	0.013 U	4.0 J	6.3	2,000	0.84 U	360 J	0.84 U	730	0.56 U	10.9	6.08	25 J	27 J	1.09	1.21
	OU4-LEP-29C-SC	2	5	17-Oct-08	0.014 U	3.1 J	11 J	4,100	0.89 UJ	410 J	0.89 U	2,000	0.60 U	15.0	8.32	38 J	42 J	0.809 J	1.54
	OU4-LEP-30C-SC	2.5	6	17-Oct-08	0.029	11	26 J	4,200 J	0.95 UJ	380 J	0.95 U	6,200	0.63 U	8.81	5.12	40 J	64 J	0.855 J	0.897 J
	OU4-LEP-31C-SC	2.5	6	17-Oct-08	0.013 U	3.3 J	5.2 J	1,300	0.82 UJ	310 J	0.82 U	830	0.55 U	21.5	6.57	27 J	20 J	0.916 J	1.45
	OU4-LEP-32C-SC	3	6	17-Oct-08	0.014 J	12	15 J	4,000	0.85 UJ	380 J	0.85 U	4,900	0.56 U	26.2	16.1	45 J	52 J	0.591 J	3.17
	Minimum				**ND**	**ND**	**5.2**	**1,200**	**ND**	**36**	**ND**	**490**	**ND**	**7.73**	**2.31**	**18**	**20**	**ND**	**ND**
	Median				**ND**	**3.1**	**11**	**2,600**	**0.84**	**320**	**ND**	**2,000**	**0.55**	**11.7**	**8.32**	**50**	**42**	**1.06**	**1.45**
	Average				**0.08**	**6.5**	**16**	**3,028**	**0.75**	**299**	**0.56**	**2,910**	**0.47**	**12.6**	**14.0**	**62**	**54**	**1.06**	**1.49**
	Maximum				**1.0**	**36**	**32**	**6,200**	**1.3**	**520**	**0.97**	**8,300**	**1.3**	**26.2**	**46.6**	**160**	**110**	**1.53**	**3.17**

Table 3-3. Solids Geochemical Results by Material Type and Pond Location

	Sample Name	Begin Depth	End Depth	Sample Date	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Thallium	Thorium	Uranium	Vanadium	Zinc	Radium-226	Radium-228
		ft bgs	ft bgs		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pCi/g	pCi/g
UEP	OU4-UEP-06A-SC	15.5	20	14-Oct-08	0.089	13	15	5,100	0.47 J	96 J	0.19 J	1,500	0.36 J	14.0 J	5.33	49	70	0.981 J	1.10
UEP	OU4-UEP-06B-SC	30	35	14-Oct-08	0.031	2.6	4.8	730	0.18 UJ	73 J	0.18 U	560	0.12 J	10.6 J	4.99	38	24	1.13	1.17
UEP	OU4-UEP-07A-SC	5	8	08-Oct-08	0.098	2.5	8.8	1,800	1.2	72 J	0.17 U	1,500	1.4	30.7	14.4	61	36 J	1.31	2.68
UEP	OU4-UEP-07B-SC	17	20	08-Oct-08	0.023 UJ	1.3	9.1	2,100	0.33 J	4.1 UJ	0.17 U	1,300	0.34 J	10.4	4.26	54	51 J	1.73	1.89
UEP	OU4-UEP-08A-SC	3	6	08-Oct-08	0.015 UJ	0.69 J	2.4	520 J	0.55 J	330 J	0.15 U	370 J	2.7	16.7	2.85	19	11	1.06	1.04
UEP	OU4-UEP-08B-SC	10	13	08-Oct-08	0.020 UJ	1.1	3.6	750 J	0.31 J	360 J	0.16 U	570 J	1.7	6.64 J	2.07	31	17	1.04	1.28
UEP	OU4-UEP-09A-SC	4	7	14-Oct-08	0.12	2.7	12	3,400	0.54 J	110 J	0.20 J	1,100	0.38 J	14.6 J	7.87	61	49	1.99	2.20
UEP	OU4-UEP-09B-SC	16	20	14-Oct-08	0.041	0.86 J	7.1	930	0.18 UJ	89 J	0.18 U	980	0.14 J	8.95 J	2.93	48	31	1.20	1.17
UEP	OU4-UEP-10A-SC	3	5	12-Oct-08	0.17	24	11	3,100	1.8 J	27 J	0.19 U	2,400	1.4	22.9 J	12.1	63	50	1.50	2.89
UEP	OU4-UEP-10B-SC	17	20	12-Oct-08	0.048	1.9	5.6	830	0.20 J	55 J	0.17 U	1,700	0.17 J	9.32 J	3.00	38	26	1.24	1.26
UEP	OU4-UEP-11A-SC	15	20	09-Oct-08	0.037 UJ	0.76 J	5.7	2,100 J	0.34 J	460 J	0.16 U	3,700 J	0.16 J	7.86	3.48	46	26	1.05	1.28
UEP	OU4-UEP-11B-SC	31	35	09-Oct-08	0.022 UJ	0.92 J	7.7	1,900 J	0.21 J	400 J	0.16 U	1,000 J	0.2 J	8.25	1.54	35	36	1.28	1.33
UEP	OU4-UEP-33B-SC	0.5	3	18-Oct-08	0.013 U	1.6 J	2.7 J	1,500	0.81 U	290 J	0.81 U	1,300	0.54 U	12.3	2.01	16	32 J	0.933 U	1.27
UEP	OU4-UEP-34B-SC	2	3	17-Oct-08	0.013 U	3.7 J	4.7 J	2,000	3.2 J	320 J	0.84 U	1,800	1.3 J	17.7	4.46	26 J	770 J	1.11	1.88
UEP	OU4-UEP-35B-SC	1.5	3	16-Oct-08	0.13	15 J	11 J	3,200	4.5 J	450 J	0.95 UJ	2,200	5.8	17.0	12.3	46	46 J	1.16	1.88
UEP	OU4-UEP-36B-SC	1	3	15-Oct-08	0.22 J	4.3 J	8.6 J	5,500	8.5 J	76 J	0.19 U	3,100	9.2 J	17.8	6.36	38 J	40 J	1.55	2.71
UEP	OU4-UEP-37B-SC	1.5	3	15-Oct-08	0.81 J	20 J	12 J	5,200	8.7 J	52 J	0.20 U	4,300	13 J	31.8	11.3	78 J	46 J	1.47	3.68
UEP	OU4-UEP-38B-SC	0.5	3	16-Oct-08	0.14 J	4.0 J	12 J	5,400	1.9 J	85 J	0.19 U	5,100	3.1 J	17.7	7.08	66 J	45 J	1.69 J	2.18
UEP	OU4-UEP-39B-SC	1	3	16-Oct-08	0.15 J	1.8 J	8.7 J	5,800	1.8 J	82 J	0.19 U	4,300	3.7 J	15.7	4.32	47 J	36 J	1.70	2.27
UEP	OU4-UEP-40B-SC	1	3	16-Oct-08	0.15 J	13 J	8.9 J	6,200	4.7 J	55 J	0.39 J	3,900	6.1 J	20.8	10.1	54 J	44 J	1.63	2.79
UEP	OU4-UEP-41C-SC	2	3	16-Oct-08	0.085	31 J	21 J	3,900	2.3 J	500 J	1.0 UJ	3,300	8.0	38.8	80.1	88	91 J	1.78	4.14
UEP	OU4-UEP-42C-SC	2.5	6	16-Oct-08	0.017 J	33 J	15 J	3,300	0.90 UJ	510 J	0.9 UJ	4,200	1.8 J	14.6	21.3	51	53 J	1.32	1.68
UEP	OU4-UEP-43B-SC	1	3	16-Oct-08	0.067 J	0.94 J	5.7 J	1,600	2.4 J	130 J	0.17 U	940	5.1 J	23.5	11.6	33 J	22 J	1.14	1.63
UEP	OU4-UEP-44B-SC	0.33	3	16-Oct-08	0.14	6.0 J	11 J	4,000	2.9 J	-- R	0.18 U	2,900	7.4 J	28.7	8.83	59 J	40 J	1.75	3.42
UEP	OU4-UEP-45B-SC	1	3	16-Oct-08	0.83	33 J	9.6 J	3,300	6.0 J	580 J	0.19 UJ	2,700	8.7	45.5	22.1	52	36 J	1.70	4.24
UEP	OU4-UEP-46B-SC	1.5	3	16-Oct-08	0.28	7.1 J	9.4 J	4,300	3.3 J	440 J	0.18 J	3,200	7.5	13.4	19.2	63	31 J	1.38	1.70
UEP	OU4-UEP-47C-SC	6	9	16-Oct-08	0.025	4.9 J	30 J	2,200	0.90 UJ	560 J	0.90 UJ	720	0.60 U	11.6	19.8	80	100 J	1.32	1.41
	Minimum				**ND**	**0.69**	**2.4**	**520**	**ND**	**ND**	**ND**	**370**	**ND**	**6.64**	**1.54**	**16**	**11**	**ND**	**1.04**
	Median				**0.085**	**3.7**	**8.9**	**3,100**	**1.2**	**120**	**ND**	**1,800**	**1.7**	**15.7**	**7.08**	**49**	**40**	**1.32**	**1.88**
	Average				**0.14**	**8.6**	**9.7**	**2,987**	**2.2**	**239**	**0.35**	**2,246**	**3.4**	**18.1**	**11.3**	**50**	**69**	**1.38**	**2.08**
	Maximum				**0.83**	**33**	**30**	**6,200**	**8.7**	**580**	**1.0**	**5,100**	**13**	**45.5**	**80.1**	**88**	**770**	**1.99**	**4.24**
FEP-1	OU4-FEP-58B-SC	0.5	3	17-Oct-08	0.014 U	0.57 U	4.1 J	1,600	0.85 U	350 J	0.85 U	2,400	1.2 J	9.95	3.33	18	16 J	0.914 J	0.989 J
FEP-1	OU4-FEP-59B-SC	1	3	17-Oct-08	0.013 U	0.56 U	5.5 J	1,400	0.84 U	290 J	0.84 U	2,800	0.56 U	10.7	3.31	20	94 J	0.906 J	1.27
FEP-2	OU4-FEP-16A-SC	2	3.5	28-Oct-08	0.013 U	0.95 J	3.5 J	1,200	0.81 U	190 J	0.81 U	1,100	1.0 J	5.22	4.53	20	22 J	1.07	1.02
FEP-2	OU4-FEP-16B-SC	65	66.5	28-Oct-08	0.013 U	4.5 J	12	2,000	0.79 U	250 J	0.79 U	1,500	0.53 U	7.32	2.47	27	42 J	1.46	1.78
FEP-2	OU4-FEP-17A-SC	2	3.5	28-Oct-08	0.013 U	1.7 J	3.9 J	1,200	0.81 U	280 J	0.81 U	1,800	0.54 U	7.68	2.06	16	15 J	0.93 J	1.22
FEP-2	OU4-FEP-57B-SC	0.25	3	17-Oct-08	0.013 U	0.55 U	3.7 J	1,500	0.82 UJ	380 J	0.82 U	2,200	0.62 J	12.1	3.59	15 J	16 J	0.993 J	1.18
FEP-2	OU4-FEP-60B-SC	0.25	3	17-Oct-08	0.013 U	0.54 U	4.7 J	1,500	0.81 U	280 J	0.81 U	1,500	0.54 U	10.6	3.18	18	23 J	0.971 J	1.16
FEP-3	OU4-FEP-56B-SC	0.25	1	18-Oct-08	0.013 U	5.1 J	6.9	3,200	0.84 U	350 J	0.84 U	1,400	0.79 J	36.0	7.78	20	21 J	1.36	3.60
FEP-4	OU4-FEP-14A-SC	2	3.5	29-Oct-08	0.014 U	1.8 J	4.8 J	3,000	0.87 U	220 J	0.87 U	1,600	0.73 J	84.6	7.78	27	27 J	1.54	5.90
FEP-4	OU4-FEP-14B-SC	5	6.5	29-Oct-08	0.013 U	0.99 J	5.2 J	1,400	0.84 U	210 J	0.84 U	1,900	0.56 U	22.4	10.9	27	44 J	1.30	2.29
FEP-4	OU4-FEP-14C-SC	45	46.5	29-Oct-08	0.013 U	0.96 J	5.1 J	1,100	0.82 U	200 J	0.82 U	740	0.54 U	10.0	8.76	21	28 J	1.37	1.51
FEP-4	OU4-FEP-15A-SC	2	3.5	29-Oct-08	0.014 U	0.79 J	5.9	2,400	0.86 U	300 J	0.86 U	1,300	0.58 U	33.8	11.5	25	58	1.01	2.54
FEP-4	OU4-FEP-15B-SC	50	51.5	29-Oct-08	0.014 U	1.4 J	8.6	1,800	0.86 U	230 J	0.86 U	540 J	0.57 U	6.54	9.58	39	50 J	1.39	1.58
FEP-4	OU4-FEP-53B-SC	0.5	3	18-Oct-08	0.013 U	3.1 J	3.6 J	3,300	0.82 U	280 J	0.82 U	1,800	0.56 J	21.8	1.27	12	14 J	1.06	2.36
FEP-4	OU4-FEP-54B-SC	0.25	3	18-Oct-08	0.022 J	2.6 J	3.1 J	440	0.84 U	58 J	0.84 U	220	0.56 U	36.8	4.30	15	13 J	1.01	3.14
FEP-4	OU4-FEP-55B-SC	0.5	3	18-Oct-08	0.014 U	2.4 J	3.7 J	2,700	0.85 U	290 J	0.85 U	1,600	0.57 U	25.9	2.87	14	51 J	1.15	2.58
	Minimum				**ND**	**ND**	**3.1**	**440**	**ND**	**58**	**ND**	**220**	**ND**	**5.22**	**1.27**	**12**	**13**	**0.91**	**0.99**
	Median				**ND**	**1.2**	**4.8**	**1,550**	**ND**	**280**	**ND**	**1,550**	**ND**	**11.4**	**3.95**	**20**	**25**	**1.07**	**1.68**
	Average				**ND**	**1.8**	**5.3**	**1,859**	**ND**	**260**	**ND**	**1,525**	**0.7**	**21.3**	**5.45**	**21**	**33**	**1.15**	**2.13**
	Maximum				**ND**	**5**	**12**	**3,300**	**ND**	**380**	**ND**	**2,800**	**1.2**	**84.6**	**11.5**	**39**	**94**	**1.54**	**5.9**
FEP #5	OU4-FEP-12A-SC	11	15	13-Oct-08	0.26	2.4	3.4	2,100	27 J	170 J	0.16 U	230	17	15.7 J	30.4	25	19	1.28	1.38
FEP #5	OU4-FEP-12B-SC	41	45	13-Oct-08	0.013 U	0.62 J	4.1	1,600	0.28 J	170 J	0.17 U	590	0.16 J	8.05 J	15.1	43	31	1.24	2.23
FEP #5	OU4-FEP-13A-SC	6	8	12-Oct-08	0.49	1.3	3.5	2,800	15 J	200 J	0.16 U	200	18	11.7 J	18.1	27	20	1.28	1.30
FEP #5	OU4-FEP-13B-SC	40	43	12-Oct-08	0.14	1.6	5.7	1,500	1.7 J	340 J	0.17 U	390	0.91	13.0 J	11.6	45	34	1.51	2.03
FEP #5	OU4-FEP-48D-SC	12	15	09-Oct-08	0.28	3.9	3.1	2,700 J	7.9	470 J	0.16 U	300 J	36	43.3	89.4	29	25	1.12	3.17
FEP #5	OU4-FEP-49C-SC	5	8	09-Oct-08	0.13 J	1.5	1.7	3,000 J	9.2	460 J	0.16 U	360 J	26	16.5	36.5	15	12	1.11	1.82
FEP #5	OU4-FEP-50C-SC	2	5	09-Oct-08	0.19	2.2	1.6	4,100 J	14	450 J	0.16 U	430 J	22	27.2	53.2	21	14	1.06	2.40
FEP #5	OU4-FEP-51B-SC	1	5	09-Oct-08	0.030	1.9	1.5	1,900 J	2.6	490 J	0.16 U	240	11	55.8	18.2	14	11	1.14	4.32
FEP #5	OU4-FEP-52C-SC	5	8	09-Oct-08	0.30	0.87 J	1.7	2,200 J	7.7	490 J	0.16 U	210 J	13	13.4	35.9	17	14	0.822 J	1.39
	Minimum				**ND**	**0.62**	**1.5**	**1,500**	**0.28**	**170**	**ND**	**200**	**0.16**	**8.05**	**11.6**	**14**	**11**	**0.822**	**1.3**
	Median				**0.19**	**1.6**	**3.1**	**2,200**	**7.9**	**450**	**ND**	**300**	**17**	**15.7**	**30.4**	**25**	**19**	**1.14**	**2.03**
	Average				**0.20**	**1.8**	**2.9**	**2,433**	**9.5**	**360**	**ND**	**328**	**16.0**	**22.7**	**34.3**	**26**	**20**	**1.17**	**2.23**
	Maximum				**0.49**	**4**	**5.7**	**4,100**	**27**	**490**	**ND**	**590**	**36**	**55.8**	**89.4**	**45**	**34**	**1.51**	**4.32**

U - Analyte not detected above laboratory detection limit (< reported value).
J - Reported value is an estimated concentration.
UJ - Analyte not detected at an estimated detection limit concentration (< reported value).
R - Rejected, not to be used for any purpose.
NA - Not analyzed
ND - Not detected

Other chemical differences are observed between the older UEP sediments and the sediments sampled from the LEP and FEPs 1-4, which may be explained by changes in: 1) the mineralogy of the ore body as mining progressed; and/or 2) ore processing or waste material management methods. Although not as elevated as sediments in the Thumb Pond, UEP sediments exhibit higher concentrations of the following analytes in comparison to the LEP and FEPs 1-4: arsenic, chromium, lead, mercury, selenium, thallium, thorium, radium-226 and radium-228.

A graphical comparison of Pond sediment and shallow soil chemistry for the same sample location is presented in Appendix E (E-2). Specific chemical data used in the comparison include Pond sediment analyses from Table 3-2 (deeper sediment sample interval, if available) and data for the subjacent shallow soil sample. Data for VLT materials were not used in the comparison. The analyte-specific plots in Appendix E2 show Pond sediment concentration along the X-axis and soil concentration along the Y-axis. A diagonal line across each plot indicates where sediment and soil concentrations would be equal. Plots with data points that generally cluster along the soil axis to the left of the diagonal line indicate that concentrations of the analyte being evaluated are higher in shallow soil than in Pond sediments. Plots with data points that generally cluster around the diagonal line indicate comparable analyte concentrations in shallow soil and Pond sediments. Finally, plots where the data points generally cluster along the sediment concentration axis to the right of the diagonal line indicate analyte concentrations are higher in Pond sediments than in underlying shallow soil.

The data presented in Appendix E2 plots indicate that sediments in the LEP, UEP and FEPs generally exhibit: 1) higher concentrations of copper, calcium, potassium, selenium, sodium, thorium, and uranium relative to the underlying soils; and 2) lower concentrations of aluminum, vanadium, and zinc relative to underlying soils. Arsenic concentrations in the FEP and UEP soils and Pond sediments are about equal. LEP arsenic concentrations in underlying soils are typically greater than Pond sediment concentrations. Barium concentrations are higher in FEP sediments relative to underlying soils, and barium concentrations in LEP and UEP sediments are generally lower relative to underlying soils. Concentrations of magnesium, manganese and molybdenum in Pond sediments and underlying soils do not exhibit any clear trends.

Soils

Concentrations of analytes in soils underlying the Pond areas are generally consistent with background concentration ranges for soil samples from, and statistical calculations of background concentration limits for, background reference sub-Area A-1. The following analytes were found in concentrations that exceed background concentration limits in select Pond areas: arsenic, copper, iron, mercury, molybdenum, selenium, thallium and uranium. Figures 3-2 through 3-14 illustrate the distribution of chemicals in Pond sediments, VLT, and subjacent soils.

Only the FEPs were clearly constructed over the alluvial fan soil type characterized by background soil sampling in sub-Area A1. Although no background concentration limits have been calculated for the soil types that underlie the LEP and UEP (see Figure 2-7), the following summary for median values (Table 3-3) are compared to sub-Area A1 background concentration limits for consistency. With the exception of arsenic and the two radium isotopes, the calculated background concentration limits for sub-Area A1 are significantly less than the residential and industrial RSLs summarized in Table 2-2. Ecological SLVs (Table 2-2) are less than background limits for antimony, boron, copper, manganese, mercury, molybdenum and selenium.

Arsenic - The background concentration limit for arsenic is 13 mg/kg. The median concentration of arsenic in soils under the LEP is 15 mg/kg, 37 mg/kg for soils under the UEP, and 86 mg/kg for soils under the Thumb Pond. The occurrence of elevated arsenic concentrations in Pond sediments and underlying soils (Figure 3-2) in the northwest portion of the UEP and the Thumb Pond is consistent with the operational history of these Ponds (i.e., disposal of calcine tailings) and the area of elevated radiological survey results (described in Section 8.0).

Copper - The background concentration limit for copper is 58 mg/kg. The median concentration of copper in soils under the LEP is 190 mg/kg, and 110 mg/kg for soils beneath the UEP. As shown in Figure 3-3, elevated copper concentrations in Pond sediments and underlying soils are common in the northern portions of the UEP and the Thumb Pond, and the entire LEP. With one exception (OU-4-UEP-11), all sample locations with shallow and deep soil samples show that the shallow soil copper concentration is greater than the deep soil copper concentration. With one exception (OU-4-FEP-59), copper does not exceed background concentrations in soils underlying the four FEPs.

Iron - The background concentration limit for iron is 19,502 mg/kg. The median concentration of soils underlying the LEP is 25,000 mg/kg, 32,000 mg/kg for soils under the UEP, and 26,000 mg/kg for soils beneath the FEPs. The median concentration of iron in soils under the Thumb

Pond is less than the background limit for iron (see Table 3-3 and Figure 3-4). Pond sediments typically exhibit higher iron concentrations than underlying soils. With few exceptions, shallow soil iron concentrations are greater than the deep soil iron concentration.

Mercury - The background concentration limit for mercury is 0.031 mg/kg. The median concentration of mercury in soils under the UEP is 0.085 mg/kg and 0.19 mg/kg for soils under the Thumb Pond. A large number of mercury results were reported below laboratory detection limits for LEP soils. With one exception (OU4-UEP-45), mercury in Pond sediments is higher than in the underlying soils (Figure 3-5).

Molybdenum - The background concentration limit for molybdenum is 1.7 mg/kg. The median concentration of molybdenum in soils under the LEP is 3.1 mg/kg and 3.7 mg/kg for soils under the UEP. A number of FEP soil samples exceed the background concentration limit (Figure 3-6). The relative concentrations of molybdenum in Pond sediments vs. subjacent soils, and in shallow vs. deep soils, do not appear to be consistent in any of the Ponds.

Nickel - The background concentration limit for nickel is 12 mg/kg. The median concentration of nickel in soils under the LEP is 11 mg/kg and 8.9 mg/kg for soils beneath the UEP. Nickel does not exceed the background concentration limit under any of the FEPs (Figure 3-7). The relative concentrations of nickel in Pond sediments vs. subjacent soils, and in shallow vs. deep soils, do not appear to be consistent in the Ponds.

Selenium - The background concentration limit for selenium is 0.8 mg/kg. Selenium is elevated above the background limit in soils under the UEP with a median concentration of 1.2 mg/kg and under the Thumb Pond with a median concentration of 7.9 mg/kg (Figure 3-8). The highest concentrations of selenium in soils occur beneath the Thumb Pond, with values up to 27 mg/kg (the highest selenium concentrations occur in overlying sediments with values up to 180 mg/kg).

Thallium - The background concentration limit for thallium is 0.61 mg/kg. Thallium is found at concentrations above the background limit in the soils under the UEP (median value of 1.7 mg/kg) and beneath the Thumb Pond (median value of 17 mg/kg). Figure 3-9 indicates that the highest thallium concentrations in soils occur under the Thumb Pond, with values up to 36 mg/kg (the highest thallium concentrations occur in overlying sediments, with values up to 97 mg/kg).

Uranium - The background concentration limit for uranium is 2.9 mg/kg. Uranium is found at levels that are higher than background soils under all the Ponds (Figure 3-10). Soils underlying the LEP have a median value of 8.32 mg/kg, and soils beneath the UEP have a median value of 7.08 mg/kg. Soils underlying FEPs 1-4 soils have a median value of 3.95 mg/kg, and soils beneath the Thumb Pond have a median value of 30.4 mg/kg. The highest concentrations of uranium in soils occur beneath the Thumb Pond, with values up to 89.4 mg/kg (the highest uranium concentrations occur in overlying sediments, with values up to 404 mg/kg).

Zinc - The background concentration limit for zinc is 61 mg/kg. The median values of zinc beneath the LEP and UEP are 42 and 40 mg/kg, respectively. Lower median values for zinc are found in soils underlying FEPs 1-4 and the Thumb Pond, 25 and 19 mg/kg, respectively. Soils underlying the ‘wet’ areas of the LEP have the highest zinc concentrations, up to 110 mg/kg at OU-4-LEP-20 (Figure 3-11).

Radium-226 - The background concentration limit for radium-226 is 2.04 pCi/g. The median concentration of radium-226 in soils under the LEP is 1.06 pCi/g and 1.32 pCi/g for soils under the UEP. Radium-226 does not exceed the background concentration limit under any of the FEPs (Figure 3-12). Generally, radium-226 values in Pond sediments are greater than subjacent soils.

Radium-228 - The background concentration limit for radium-228 is 2.24 pCi/g. The median concentration of radium-228 in soils beneath the LEPs is 1.45 pCi/g and 1.88 pCi/g for soils beneath the UEP. Radium-228 locally exceeds the background concentration limit under in soils beneath the FEPs (Figure 3-13), although the median value is less than the limit. In general, with few exceptions, radium-228 concentrations in Pond sediments exceed underlying soil values.

Radium-226 + 228 - Combined values of the two radioisotopes in soils beneath the Ponds are presented in Figure 3-14.

SECTION 4.0
GROUNDWATER GEOCHEMICAL DATA

Results of groundwater grab samples collected from the area of the Ponds in October 2008 are presented in Table 4-1, which also includes the drinking water maximum contaminant levels (MCLs) for each analyte provided for comparison (the MCL values include both primary and secondary standards). Secondary MCLs are non-enforceable guidelines for chemicals that may cause cosmetic effects (e.g., skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. Analytical results for select chemicals resulting from the October 2008 grab sampling event, along with analytical results from the third quarter (September) 2008 sampling of Pond area groundwater monitor wells, are presented in Figures 4-1 through 4-23. These figures illustrate the distribution of the following analytes: sulfate, pH (field), alkalinity, total organic carbon, arsenic, barium, boron, calcium, chloride, chromium, copper, iron, magnesium, manganese, molybdenum, nickel, selenium, silicon, sodium, uranium, zinc, and radium-226/228 combined.

Excluding sulfate, grab sample results presented in Table 4-1 and Figures 4-2 through 4-23 should reviewed in the context of quality control limitations associated with the sampling methods used for the collection of grab samples. Grab sample collection by bailer with delayed filtration and preservation likely resulted in some degree of sample oxidation. Based on similar use of grab sampling techniques in the Process Areas (Brown and Caldwell, 2005a), and subsequent monitor well data from wells installed at the borehole locations where groundwater grab samples were obtained (e.g., the *2008 Annual Groundwater Monitoring Report*; Brown and Caldwell, 2009b), grab samples typically yield higher concentration than samples obtained from monitor wells subject to more rigorous field quality control procedures. In addition, groundwater grab sample data cannot be directly correlated with groundwater monitor well sample data from the shallow hydrostratigraphic zone because grab samples are obtained immediately below the water table within a shorter interval than monitor well samples, which are collected from a 20-foot screen interval generally positioned some distance below the water table.

Because of its chemical character (i.e., it typically behaves as a non-reactive solute in groundwater and its concentration is not affected by changes in redox conditions), sulfate results for grab samples and monitor well samples may be comparable (recognizing the differences in aquifer intervals sampled), as demonstrated by Process Areas monitor well data (Brown and Caldwell, 2005a and 2009b). Contours for sulfate concentrations in October 2008 grab samples and September 2008 monitor wells samples, described below, likely provide a good representation of shallow zone conditions. Distributions of sulfate and other select chemicals are also described below, with references to median values presented in Table 4-1:

Sulfate – Sulfate contours (Figure 4-1) indicate that sulfate concentrations are highest under the northwest portion of the UEP (in excess of 20,000 mg/L) and follow a north-northwest trend through the topographically low 'wet' area of the LEP.

Arsenic - The MCL for arsenic is 0.01 mg/L. The highest observed levels of arsenic are beneath the Thumb Pond (concentrations of 0.17 and 0.2 mg/L), and the median concentration is 0.21 mg/L (Figure 4-5).

Cadmium - The MCL for cadmium is 0.005 mg/L (Figure 4-8). The highest observed levels of cadmium are in the northwest portion of the UEP with concentrations of 0.10 and 0.13 mg/L (median concentration is 0.021 mg/L).

Copper - The MCL for copper is 1.3 mg/L (Figure 4-12). The highest observed levels of copper are in the north central portion of the UEP with concentrations of 31 and 92 mg/L (the median concentration for copper in the grab samples is 1.6 mg/L, only slightly above the MCL).

Iron - The highest observed levels of iron are in the northwest portion of the UEP and the Thumb Pond, with concentrations of 4700, 6400 and 8300 mg/L (overall median concentration of 870 mg/L). There is no primary MCL for iron - the secondary MCL is 0.3 mg/L (Figure 4-13).

Selenium - The MCL for selenium is 0.05 mg/L. Only two locations exceed the MCL which are located in the north central portion of the UEP with concentrations of 0.091 and 0.1 mg/L (Figure 4-18).

Uranium - The MCL for uranium is 0.030 mg/L (Figure 4-21). The highest observed concentrations of uranium are in the north central portion of the UEP and the Thumb Pond, with concentrations of 1.3, 2.5 and 2.6 mg/L (the median concentration of all grab samples is 0.29 mg/L).

Radium-226/228 - The MCL for combined radium-226/228 is 5 pCi/L (Figure 4-23). The highest observed levels of Radium-226/228 are in the north central portion of the UEP and the Thumb Pond, with concentrations of 5.44 and 12.01 pCi/L (the median concentration of all grab samples is 1.81 pCi/L).

Table 4-1. Groundwater Geochemical Results

SampleName	Duplicate	Field Parameters		Water Quality Parameters (Lab)											Metals					
		pH	Specific Conductivity	Total Alkalinity	Bicarbonate Alkalinity	Carbonate Alkalinity	Total dissolved solids	Total organic carbon	Chloride	Fluoride	Sulfate	Nitrate	Nitrite	Nitrate-Nitrite	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron
		pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Drinking Water MCL==>		**NA**	**NA**	**NA**	**NA**	**NA**	**500[b]**	**NA**	**250[b]**	**2.0[b]**	**250[b]**	**10**	**1**	**NA**	**0.05-0.2[b]**	**0.006**	**0.01**	**2**	**0.004**	**NA**
OU4-LEP-01-GW		6.47	25,175	740	740	2.0 U	26,000	4.9	860	9.7 J	16,000	1.2 UJ	1.8 UJ	3.0 UJ	3.5	0.002 U	0.007 U	0.160	0.0031 J	19
OU4-LEP-02-GW		6.74	8,849	1,300	1,300	2.0 U	7,600	11	850	1.5 J	3,300	0.064 J	0.45 U	0.51 U	0.08 U	0.003	0.002	0.140 J	0.0002 U	10
OU4-LEP-03-GW		NA	NA	52	52	2.0 U	17,000	9.0	970	46	9,300	0.6 UJ	0.9 UJ	1.5 UJ	33	0.001 J	0.004	0.042 J	0.0078	15
OU4-LEP-04-GW		6.86	8,700	500	500	2.0 U	7,500	6.4	710	2.2 J	4,000	0.24	0.45 U	0.51 U	0.04 U	0.001 J	0.001	0.034 J	0.0002 U	7.8
OU4-LEP-04-GW-FD	Dup	NA	NA	480	480	2.0 U	7,300	6.5	720	2.3 J	4,000	0.21	0.9 U	0.96 U	0.08 U	0.001 J	0.002	0.032 J	0.0002 U	8.2
OU4-LEP-05-GW		4.23	19,103	2.0 U	2.0 U	2.0 U	23,000	9.2	1,400	77	14,000	6.0 U	9.0 U	15 U	150	0.004 U	0.014 UJ	0.039	0.042	17
OU4-UEP-06-GW		3.81	27,820	2.0 U	2.0 U	2.0 U	60,000	10	350	160	40,000	0.6 U	4.5 U	5.1 U	1,000	0.020 U	0.070 U	0.055 J	0.18	11
OU4-UEP-07-GW		4.30	22,218	2.0 U	2.0 U	2.0 U	35,000	11	460	230	21,000	6.0 U	9.0 U	15 U	200	0.010 U	0.035 UJ	0.020 U	0.019 J	12
OU4-UEP-08-GW		3.68	18,869	2.0 U	2.0 U	2.0 U	15,000	16	320	NA	23,000	1.2	1.8	3.0 U	1,100	0.020	0.070	0.040	0.16	7.9
OU4-UEP-09-GW		4.67	9,872	2.0 U	2.0 U	2.0 U	12,000	3.0	150	13	6,800	0.6 U	0.9 U	1.5 U	16	0.010 U	0.035 U	0.020 U	0.019 J	6.7
OU4-UEP-10-GW		6.60	9,866	700	700	2.0 U	8,900	4.4	160	6.8	5,300	0.6	0.9	1.5 U	0.2	0.001 J	0.007	0.039	0.0010	11
OU4-UEP-10-GW-FD	Dup	NA	NA	720	720	2.0 U	9,500	2.4	170	7.1	5,200	0.6	0.9	1.5 U	0.04	0.001 J	0.005	0.043	0.0004	10
OU4-UEP-11-GW		4.95	8,716	2.0 U	2.0 U	2.0 U	11,000	4.0	110	20	6,600	0.6 U	0.9 U	1.5 U	12	0.010 U	0.035 U	0.021 J	0.010 J	4.9
OU4-FEP-12-GW		4.00	15,407	2.0 U	2.0 U	2.0 U	29,000	7.2	250	600	19,000	0.6 UJ	90 UJ	91 UJ	560	0.010 U	0.20	0.038 J	0.062	1.3 J
OU4-FEP-13-GW		4.35	11,243	2.0 U	2.0 U	2.0 U	9,300	6.4	130	100	11,000	0.6	0.9	1.5 U	240	0.008	0.17	0.027 J	0.033	2.0
OU4-FEP-14-GW		6.53	7,749	710	710	2.0 U	8,300	3.4	1,600	16	4,300	0.3 U	0.09 U	0.39 U	0.2 U	0.003 J	0.004 U	0.028	0.0019 J	4.2
OU4-FEP-15-GW		4.84	8,048	2.0 U	2.0 U	2.0 U	10,000	3.3	160	18	6,100	0.3 U	0.09 U	0.39 U	22	0.002 U	0.007 U	0.017	0.0083	2.5
OU4-FEP-15-GW-FD	Dup	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OU4-FEP-16-GW		7.43	3,241	610	610	2.0 U	2,600	5.7	51	0.61	1,200	7.3 J	0.2 J	7.5 J	0.04 U	0.002 J	0.001	0.032	0.0002 U	3.1
MINIMUM[c]:		**3.68**	**3,241**	**ND**	**ND**	**ND**	**2,600**	**3.0**	**51**	**0.6**	**1,200**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**1.3**
MEDIAN:		**4.84**	**9,872**	**ND**	**ND**	**ND**	**11,500**	**6.4**	**335**	**18**	**8,050**	**ND**	**ND**	**ND**	**19**	**ND**	**0.011**	**0.036**	**0.0092**	**7.9**
AVERAGE:		**5.30**	**13,658**	**289**	**289**	**ND**	**17,638**	**7.2**	**533**	**87**	**11,931**	**1.7**	**7.6**	**9.3**	**209**	**0.0066**	**0.041**	**0.047**	**0.034**	**8.5**
MAXIMUM:		**7.43**	**27,820**	**1,300**	**1,300**	**ND**	**60,000**	**16**	**1,600**	**600**	**40,000**	**7.3**	**90**	**91**	**1,100**	**0.020**	**0.20**	**0.16**	**0.18**	**19**

Table 4-1. Groundwater Geochemical Results

SampleName	Duplicate	Metals																		
		Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Drinking Water MCL==>		**0.005**	**NA**	**0.1**	**NA**	**1.3**	**0.3[(b)]**	**0.015**	**NA**	**NA**	**0.05[(b)]**	**0.002**	**NA**	**NA**	**NA**	**NA**	**0.05**	**NA**	**0.10[(b)]**	**NA**
OU4-LEP-01-GW		0.017	400	0.0070 U	1.2	0.097	56	0.003 U	0.60 U	850	160	0.0001 U	0.062	1.1	0.4 U	19	0.013 J	48	0.003 U	6,400
OU4-LEP-02-GW		0.0018	600	0.0011 J	0.064	1.1	0.03 U	0.0003 U	0.21	220	14	0.0001 U	0.42	0.12 J	0.04 U	8.0	0.0072	63	0.0003 U	1,700
OU4-LEP-03-GW		0.021	410	0.0046	1.3	4.3	260	0.0006 U	0.30 U	570	96	0.0001 U	0.050	0.97 J	0.2 U	11	0.021	22	0.0006 U	3,600
OU4-LEP-04-GW		0.00099 J	450	0.00085 J	0.033	0.017	3.9	0.0003 U	0.22 J	250	13	0.0001 U	0.39	0.052 J	0.1 U	9.0	0.0039	46	0.0003 U	1,500
OU4-LEP-04-GW-FD	Dup	0.00096 J	450	0.00074 J	0.029	0.017	3.8	0.0003 U	0.21	250	13	0.0001 U	0.38	0.049 J	0.04 U	9.6	0.0043	47	0.0003 U	1,600
OU4-LEP-05-GW		0.038	400	0.064	1.6	6.6	1,600	0.006 U	0.45 U	870	140	0.00021	0.011 J	1.3	0.32 J	7.6	0.024 J	110	0.006 U	3,000
OU4-UEP-06-GW		0.13	470	0.35	5.5	31	8,300	0.030 U	1.5 U	2,000	260	0.00016 J	0.040 J	4.6	3.6	20 J	0.10 J	89	0.030 U	2,700
OU4-UEP-07-GW		0.10	410	0.035 U	3.9	2.2	4,700	0.015 U	0.90 U	1,300	21	0.00011 J	0.024 J	3.6	1.8	11 U	0.035 J	72	0.015 U	2,800
OU4-UEP-08-GW		0.084 J	460	0.90	4.2	92	3,500	0.030	1.6	1,300	140	0.00023	0.047 J	4.3	7.7	15	0.091 J	110	0.030	1,700
OU4-UEP-09-GW		0.021 J	380	0.035 U	0.96 J	1.8	540	0.015 U	0.30 U	450	91	0.00042	0.010 U	0.84	0.2 U	6.7	0.015 U	65	0.015 U	1,400
OU4-UEP-10-GW		0.00059 J	430	0.0035	0.045	0.010	25	0.0015	0.20 J	190	5.4	0.0001 U	0.22	0.082	0.1	3.3	0.0061 J	33	0.0015	2,200
OU4-UEP-10-GW-FD	Dup	0.00062 J	410	0.0014	0.032	0.015	23	0.0006	0.12	190	5.2	0.0001 U	0.20	0.063	0.02 U	4.4	0.0036 J	33	0.0006	2,200
OU4-UEP-11-GW		0.038 J	390	0.035 U	1.1 J	1.3	1,200	0.015 U	0.45 J	320	57	0.0001 U	0.011 J	1.2	0.2 U	5.9	0.015 U	57	0.015 U	950
OU4-FEP-12-GW		0.092	450	0.44 J	2.8 J	5.1	6,400	0.015 U	1.5 U	670	140	0.0001 U	0.036 J	2.5	3.5	39	0.043 J	28	0.015 U	310
OU4-FEP-13-GW		0.050	430	0.095	1.5	3.4	3,200	0.012	0.77 J	520	96	0.0001 U	0.008	0.92	2.5	60	0.019 J	14	0.012	620
OU4-FEP-14-GW		0.00055 U	480	0.0035 U	0.20	0.012	74	0.0015 U	0.22 J	600	7.4	0.0001 UJ	0.012	0.20	0.1 U	9.4	0.0049 J	37	0.0015 U	840
OU4-FEP-15-GW		0.020	410	0.0070 U	0.40	0.130	1,400	0.003 U	0.30 U	240	50	0.0005 UJ	0.003 J	0.14	0.2 U	17	0.0071 J	17	0.003 U	770
OU4-FEP-15-GW-FD	Dup	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OU4-FEP-16-GW		0.00016 J	170	0.00082 J	0.013	0.007	0.015 U	0.0003 U	0.10	28	0.95	0.0001 UJ	0.072	0.0061	0.053	5.3	0.0076	52	0.0003 U	600
MINIMUM[(c)]:		**ND**	**170**	**ND**	**0.013**	**0.007**	**ND**	**ND**	**ND**	**28**	**0.95**	**ND**	**ND**	**0.006**	**ND**	**ND**	**ND**	**14**	**ND**	**310**
MEDIAN:		**0.021**	**420**	**0.021**	**1.2**	**1.6**	**870**	**ND**	**ND**	**545**	**74**	**ND**	**0.038**	**0.95**	**ND**	**10**	**0.015**	**50**	**ND**	**1,600**
AVERAGE:		**0.038**	**421**	**0.12**	**1.6**	**9.3**	**1,954**	**0.009**	**0.60**	**649**	**81**	**0.0002**	**0.089**	**1.4**	**1.3**	**15**	**0.026**	**54**	**0.0093**	**1,943**
MAXIMUM:		**0.13**	**600**	**0.90**	**5.5**	**92**	**8,300**	**0.030**	**1.6**	**2,000**	**260**	**0.0005**	**0.42**	**4.6**	**7.7**	**60**	**0.10**	**110**	**0.030**	**6,400**

Table 4-1. Groundwater Geochemical Results

SampleName	Duplicate	Metals							Radiochemicals										
		Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Alpha, gross	Beta, gross	Radium-226	Radium-228	Ra-226 + Ra-228[a]	Thorium-228	Thorium-230	Thorium-232	Uranium-234	Uranium-235	Uranium-238
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
Drinking Water MCL==>		**NA**	**0.002**	**NA**	**NA**	**0.30**	**NA**	**5[b]**	**15**	**NA**	**NA**	**NA**	**5**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
OU4-LEP-01-GW		13	0.002 U	0.24 U	0.04 U	0.10	0.0070 U	0.97	22.5 J	115 U	0.618 J	1.41	2.03	0.643 U	0.742 U	0.629 U	52.5	1.35	36.7
OU4-LEP-02-GW		5.9	0.0002 U	0.024 U	0.004 U	0.44	0.0057	0.11	287 J	136	0.694 J	1.16	1.85	0.221 U	0.286 U	0.217 U	223	6.55	172
OU4-LEP-03-GW		7.5	0.0004 U	0.12 U	0.02 U	0.32	0.0023 J	2.7	85.0 J	66.3 U	0.422 J	1.23	1.65	0.719 U	0.534 U	0.534 U	130	4.39	97.7
OU4-LEP-04-GW		5.2	0.0002 U	0.06 U	0.01 U	0.26	0.0007 U	0.031	166 J	69.7	0.309 J	1.46	1.77	0.155 U	0.124 U	0.174 U	118	4.12	94.6
OU4-LEP-04-GW-FD	Dup	5.5	0.0002 U	0.024 U	0.004 U	0.26	0.0007 U	0.030	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OU4-LEP-05-GW		5.4	0.004 U	0.18 U	0.03 U	0.54	0.20	3.9	99.7 J	205	0.482 J	2.11	2.59	0.350 U	0.915	0.515 J	224	8.77	171
OU4-UEP-06-GW		6.8	0.020 U	0.6 U	0.1 U	2.6	2.7	16	533 J	548	8.85	3.16	12.01	3.46	1.57	1.96	1,010	44.7	829
OU4-UEP-07-GW		7.5	0.010 U	0.36 U	0.06 U	0.21	0.096 J	12	97.6 U	146 U	0.658 J	1.37	2.03	0.203 U	0.199 U	0.199 U	68.8	2.63	55.1
OU4-UEP-08-GW		4.0	0.020	0.24	0.04	2.5	2.2	16	639	521	1.19	3.15 J	4.34	3.13	2.96	1.46	1,010	30.5	768
OU4-UEP-09-GW		4.0	0.010 U	0.12 U	0.02 U	0.087	0.035 U	2.2	12.8 J	45.7 U	0.868 J	0.596 U	1.46	0.294 U	0.288 U	0.288 U	23.1	0.687	17.5
OU4-UEP-10-GW		7.0	0.001	0.06	0.01	0.44	0.0035	0.029 J	186 J	99.6	0.290 U	0.664 U	0.95 U	0.282 U	0.197 U	0.197 U	245	6.45	164
OU4-UEP-10-GW-FD	Dup	6.9	0.0004 J	0.012 U	0.002 U	0.42	0.0014	0.038 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OU4-UEP-11-GW		4.3	0.010 U	0.06 U	0.01 U	0.025 U	0.035 U	4.5	7.57 U	45.8 U	0.299 J	0.627 U	0.93	0.188 U	0.150 U	0.150 U	3.37	0.068 J	2.45
OU4-FEP-12-GW		12	0.041 J	0.6 U	0.1 U	1.3	2.0	13	200	404	4.16	1.28	5.44	1.45	2.07	0.551 J	462	12.1	343
OU4-FEP-13-GW		9.0	0.020 J	0.24	0.04	0.38	0.95	5.3	45.7 J	138	2.18	2.00	4.18	0.158 UJ	0.181 J	0.155 U	157	5.12	122
OU4-FEP-14-GW		5.8	0.001 U	0.06 U	0.01 U	0.18	0.0035 U	0.18	52.7	67.4	0.161 U	0.799 U	0.96 U	0.408 UJ	0.349 UJ	0.285 UJ	109	2.44	56.0
OU4-FEP-15-GW		6.1	0.002 U	0.12 U	0.02 U	0.090	0.0070 U	1.2	26.7 J	54.1	0.851 J	0.758 J	1.61	0.239 UJ	0.191 UJ	0.191 UJ	39.6	1.25	31.3
OU4-FEP-15-GW-FD	Dup	NA	NA	NA	NA	NA	NA	NA	8.16 J	62.0	0.852 J	0.882 J	1.73	0.378 UJ	0.206 UJ	0.206 UJ	39.9	1.08	30.6
OU4-FEP-16-GW		2.7	0.0002 U	0.012 U	0.002 U	0.20	0.0056	0.017 J	160	52.4	0.236 U	0.726 U	0.96 U	0.101 UJ	0.0981 UJ	0.0981 UJ	150	2.88	67.5
MINIMUM[c]:		**2.7**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.017**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**3.37**	**0.068**	**2.45**
MEDIAN:		**6.0**	**ND**	**ND**	**ND**	**0.29**	**0.021**	**2.5**	**99**	**107**	**0.638**	**1.255**	**1.812**	**ND**	**ND**	**ND**	**140**	**4.26**	**96.2**
AVERAGE:		**6.6**	**0.0089**	**0.19**	**0.032**	**0.60**	**0.52**	**4.9**	**164**	**170**	**1.392**	**1.406**	**2.798**	**0.750**	**0.678**	**0.475**	**252**	**8.38**	**189**
MAXIMUM:		**13**	**0.041**	**0.60**	**0.10**	**2.6**	**2.7**	**16**	**639**	**548**	**8.85**	**3.16**	**12.01**	**3.46**	**2.96**	**1.96**	**1,010**	**44.7**	**829**

[a] Calculated result for Ra-226 + Ra-228
[b] Secondary MCL; all others are Primary MCL.
[c] Minimum, Median, Average, and Maximum values do not include duplicate sample results.
U - Analyte not detected above laboratory detection limit (< reported value).
J - Reported value is an estimated concentration.
UJ - Analyte not detected at an estimated detection limit concentration (< reported value).
NA - Not analyzed
ND - Not detected

SECTION 5.0
MWMP LEACHATE GEOCHEMICAL DATA

This section of the RAC DSR summarizes leach test results for soil samples collected beneath the Pond solids and liner materials (asphalt and VLT). These samples were subjected to the MWMP (ASTM E2242), which is a common test for mine waste materials (e.g., waste rock, spent ore) in Nevada. In addition, this section describes previous leach test results from a limited number of VLT samples collected by the Nevada Division of Environmental Protection (NDEP) in 2002 prior to the implementation of a temporary capping action performed by NDEP.

The MWMP consists of a single-pass column leach test conducted over a 24-hour period, using a soil sample leached with an extraction fluid at a ratio of 1:1 (extraction fluid:sample). The MWMP uses Type II reagent grade water that had been slightly acidified to simulate naturally occurring meteoric water in Nevada. From a chemical standpoint, the MWMP does not represent the potential leaching effect of more acidic solutions that would have infiltrated through the soils during Pond operations (e.g., spent ore solutions from the vat leaching process) or the low-pH standing water that seasonally accumulates in the ‘wet’ areas of the LEP. With the possible exception of the ‘wet’ areas of the LEP, the MWMP represents potential leaching effect for the Ponds under existing conditions. Hydraulically, given the 1:1 ratio of extraction fluid to sample, the MWMP does not represent: 1) existing conditions, with the possible exception of soils that are near/at saturation; or 2) Pond operational conditions

5.1 MWMP Leach Test Results

As described in Section 2.0, MWMP samples were initially collected as large volume soil samples from the interval starting at the top of the contact with underlying soils to a total depth of 15 feet bgs in 8 of the 17 borehole locations represented in Figure 2-8. The MWMP leaching procedure was completed by SEM Laboratory, and the analysis of the leachate was completed by TestAmerica laboratories for metals and radiochemicals.

Leachate chemical results are presented in Table 5-1, and select analytes are presented in Figures 5-1 through 5-8 for the following metals respectively: arsenic, chromium, copper, iron, manganese, nickel, radium-226/228, and uranium. A discussion of observations of specific analytes is provided below:

Arsenic - Arsenic (Figure 5-1) was detected in only two of the eight leachate samples from soils underlying the UEP and the Thumb Pond (concentrations of 0.024 and 0.14 mg/L). The MCL for arsenic is 0.01 mg/L.

Chromium - Chromium (Figure 5-2) was detected in five of the eight leachate samples, of which only two exceeded the MCL (0.1 mg/L).

Copper - Copper (Figure 5-3) was detected in all leachate samples. Six of the eight samples exceeded the MCL (1.3 mg/L). The highest value was 110 mg/L from the soil sample (OU-4-LEP-01) under the northern portion of the 'wet area' of the LEP.

Iron - Iron (Figure 5-4) was detected in six of the eight leachate samples. The highest values of 780 and 590 mg/L resulted from soil samples below the northern portion of the 'wet area' of the LEP and FEP-4, respectively.

Manganese - Manganese (Figure 5-5) was detected in all leachate samples. The highest values of 120 and 55 mg/L were obtained from soil samples beneath the northern and southern portions of the LEP 'wet' area, respectively. A value of 46 mg/L was obtained from a sample beneath the northwest portion of the UEP.

Nickel - Nickel (Figure 5-6) was detected in all leachate samples. The highest values of 3.2 and 1.9 mg/L were obtained from soil samples beneath the north cell of the LEP (OU-4-LEP-01 in the 'wet' area) and FEP-4, respectively.

Uranium - Uranium (Figure 5-7) in leachate was detected at concentrations that exceeded the MCL (0.030 mg/L) in all samples. The highest concentrations of uranium were from soils (OU-4-LEP-01) under the north cell of the LEP in the 'wet' area (2.6 mg/L), the northwest portion of the UEP (0.94 mg/L), and FEP-4 (0.95 mg/L).

Radium-226/228 combined - Combined radium-226/228 was detected in 6 of 8 samples, with one value (12.7 pCi/L at OU-4-FEP-15) that exceeded the MCL (5 pCi/L; Figure 5-8).

5.2 Previous VLT Leach Test Results

NDEP performed whole rock analysis and leach testing of six VLT samples (plus two duplicate samples) from two locations within the Oxide Tailings OU using the Synthetic Precipitation Leaching Procedure (SPLP; SW846 Method 1312). Briefly, SPLP Method 1312 is generally similar to the MWMP in that it is designed to determine the mobility (i.e., leaching potential) of chemicals. It differs from the MWMP in that the SPLP uses an extraction fluid at a ratio of 20:1 (extraction fluid:sample) and an extraction fluid made of sulphuric and nitric acids and reagent water at a pH of 5.0 (value used west of the Mississippi River). Given these test procedures (i.e., a much higher ratio of extraction fluid at a lower pH) relative to the MWMP, the SPLP is a more aggressive leach test.

A description of NDEP's sampling and analysis plan for the VLT materials, and the analytical results are provided in Appendix G. Tables 5-2 and 5-3 summarize the whole rock and leach test analytical results, respectively, for the eight samples (including two duplicate samples) collected by NDEP. Analytical results for the samples are provided in Appendix G. A brief summary of the whole rock and SPLP data is presented below, and a comparison of whole rock chemical data vs. SPLP leach results is provided in graphical format in Appendix G.

The SPLP leachate results presented in Table 5-3 indicate that aluminum, beryllium, calcium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium and zinc were leached from the VLT materials in concentrations that exceeded their respective detection limits. Of these, only aluminum, beryllium, copper and manganese exceeded a primary or secondary MCL. The graphs presented in Appendix G indicate good to excellent correlation coefficients between the whole rock and leachate data for copper and manganese ($R^2 = 0.85$ and $R^2 = 0.92$, respectively), but not for the other analytes. The occurrence of copper in the leachate is consistent with spent ore characteristics (i.e., not all the metal that was the subject of acid leaching during ore processing was leached from the oxide ores). The range of pH values (4.79 to 5.13) is similar enough to the reagent pH value of 5.0 to suggest that no acid generation resulted from the leach test.

Because the MWMP was used for soils underlying the Ponds, they cannot be compared in any rationale way to the SPLP results for VLT materials reported by NDEP. However, given the nature of the two leaching procedures, one may anticipate that the SPLP would result in lower pH values and higher metal concentrations in the leachate.

Table 5-1. MWMP Leachate Chemical Results

Sample Name	Metals																			
	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Drinking Water MCL==>	**0.05-0.2[(b)]**	**0.006**	**0.01**	**2.0**	**0.004**	**NA**	**0.005**	**NA**	**0.1**	**NA**	**1.3**	**0.3[(b)]**	**0.015**	**NA**	**NA**	**0.05[(b)]**	**0.002**	**NA**	**NA**	**NA**
OU4-LEP-01A-MW	890	0.010 U	0.035 U	0.040 J	0.16	1.2	0.066	460	0.16	3.7	110	780	0.015	0.86	1,000	120	0.00092 J	0.010 U	3.2	12
OU4-LEP-03A-MW	35	0.002 U	0.007 U	0.061	0.011	8.6	0.019	210	0.007 U	0.85	3.9	120	0.003 U	0.19 J	340	55	0.0007 J	0.002 U	0.68	0.10 U
OU4-LEP-05A-MW	0.17	0.002 U	0.007 U	0.10	0.002 U	15	0.0027 J	130	0.007 U	0.13	0.028	0.03 U	0.003 U	0.066 J	160	16	0.0001 UJ	0.34	0.14	0.04 U
OU4-UEP-07A-MW	130	0.002 U	0.007 U	0.041	0.056	1.3	0.024	490	0.007 U	1.1	15	140	0.020	0.30	180	46	0.00068 J	0.002 U	1.0	0.10 U
OU4-UEP-08A-MW	82	0.002 U	0.007 U	0.036	0.022	1.1	0.0072 J	530	0.0098 J	0.38	9.7	1.0	0.007 J	0.25	110	10	0.0001 UJ	0.002 U	0.35	0.038 J
OU4-UEP-10A-MW	0.04 U	0.0006 J	0.14	0.015	0.0002 U	4.5	0.00036 J	400	0.0012 J	0.00099 J	0.014	0.015 U	0.0003	0.14	80	0.06	0.0001 UJ	0.17	0.0026	0.068
OU4-FEP-13A-MW	130	0.002 U	0.024	0.061	0.035	0.52	0.0096 J	530	0.051	0.33	14	4.0	0.024	0.23	130	7.0	0.0002 J	0.0078 J	0.52	0.19
OU4-FEP-15A-MW	410	0.010 J	0.035 U	0.027 J	0.066	0.52	0.014 J	500	0.15	1.7	4.3	590	0.015 U	0.49	420	30	0.0001 U	0.014 J	1.9	8.4
MINIMUM:	**ND**	**ND**	**ND**	**0.015**	**ND**	**0.5**	**0.0004**	**130**	**ND**	**0.0010**	**0.014**	**ND**	**ND**	**0.066**	**80**	**0.06**	**ND**	**ND**	**0.0026**	**ND**
MEDIAN:	**106**	**ND**	**ND**	**0.041**	**0.029**	**1.3**	**0.012**	**475**	**0.0084**	**0.62**	**7.0**	**62**	**0.011**	**0.24**	**170**	**23**	**0.0002**	**0.0089**	**0.60**	**0.10**
AVERAGE:	**210**	**0.0038**	**0.033**	**0.048**	**0.044**	**4.1**	**0.018**	**406**	**0.049**	**1.0**	**20**	**204**	**0.011**	**0.32**	**303**	**36**	**0.0004**	**0.068**	**0.97**	**2.6**
MAXIMUM:	**890**	**0.010**	**0.14**	**0.10**	**0.16**	**15**	**0.066**	**530**	**0.16**	**3.7**	**110**	**780**	**0.024**	**0.86**	**1,000**	**120**	**0.0009**	**0.34**	**3.2**	**12**

Table 5-1. MWMP Leachate Chemical Results - Continued

Sample Name	Metals												Radiochemicals							
	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Alpha, gross	Beta, gross	Radium-226	Radium-228	Ra-226 + Ra-228[a]	Thorium-228	Thorium-230	Thorium-232
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
Drinking Water MCL==>	**NA**	**0.05**	**NA**	**0.10[b]**	**NA**	**NA**	**0.002**	**NA**	**NA**	**0.30**	**NA**	**5[b]**	**15**	**NA**	**NA**	**NA**	**5**	**NA**	**NA**	**NA**
OU4-LEP-01A-MW	3.7 U	0.078 J	17	0.015 U	410	2.9	0.010 U	0.12 U	0.02 U	2.6	0.55	9.4	554	446	0.579 J	2.2 UJ	2.78	1.86	1.68	0.989
OU4-LEP-03A-MW	3.9	0.019 J	20	0.003 U	2,600	4.1	0.002 U	0.06 U	0.01 U	0.24	0.007 U	1.4	78.2	86.2	0.685 J	0.873 J	1.56	0.287 U	0.227 U	0.227 U
OU4-LEP-05A-MW	3.2	0.011 J	6.4	0.003 U	1,900	1.9	0.002 U	0.024 U	0.004 U	0.14	0.058	0.11 UJ	76.5	47.4	0.206 UJ	0.667 UJ	0.87 U	0.132 U	0.128 U	0.128 U
OU4-UEP-07A-MW	1.8 U	0.024	27	0.003 U	210	2.3	0.002 U	0.06 U	0.01 U	0.94	0.007 U	2.6	114	245	0.577 J	1.04 UJ	1.62	0.293 U	0.81	0.219 J
OU4-UEP-08A-MW	0.74 U	0.0099 J	25	0.003 U	200	2.1	0.005 J	0.012 U	0.002 U	0.24	0.007 U	1.0	66.5	82.1	0.306 J	0.534 UJ	0.84	0.407	0.319 J	0.128 U
OU4-UEP-10A-MW	1.6	0.085	57	0.0003 U	1,500	7.4	0.0002 U	0.012 U	0.002 U	0.081	0.14	0.015 UJ	51.8	26.1 U	0.22 UJ	0.603 UJ	0.82 U	0.18 U	0.174 U	0.174 U
OU4-FEP-13A-MW	58	0.046	51	0.003 U	91	2.8	0.077	0.024 U	0.004 U	0.87	0.007 U	1.0	194	284	0.543 J	0.742 J	1.29	0.154 U	0.149 U	0.149 U
OU4-FEP-15A-MW	1.8 U	0.018 J	36	0.015 U	26	1.0	0.012 J	0.06 U	0.01 U	0.95	0.10	3.1	110 J	750	2.85	9.85 J	12.70	1.68 J	16.2 J	4.39 J
MINIMUM:	**ND**	**0.0099**	**6.4**	**ND**	**26**	**1.0**	**ND**	**ND**	**ND**	**0.081**	**ND**	**ND**	**52**	**ND**	**ND**	**ND**	**0.82**	**ND**	**ND**	**ND**
MEDIAN:	**2.5**	**0.022**	**26**	**ND**	**310**	**2.6**	**ND**	**ND**	**ND**	**0.56**	**0.033**	**1.2**	**94**	**166**	**0.56**	**ND**	**1.4**	**ND**	**0.27**	**ND**
AVERAGE:	**9.3**	**0.036**	**30**	**ND**	**867**	**3.1**	**0.014**	**ND**	**ND**	**0.76**	**0.11**	**2.3**	**156**	**246**	**0.75**	**2.1**	**2.8**	**0.62**	**2.5**	**0.80**
MAXIMUM:	**58**	**0.085**	**57**	**ND**	**2,600**	**7.4**	**0.077**	**ND**	**ND**	**2.6**	**0.55**	**9.4**	**554**	**750**	**2.9**	**10**	**13**	**1.86**	**16**	**4.4**

[a] Calculated result for Ra-226 + Ra-228
[b] Secondary MCL; all others are Primary MCL.
U - Analyte not detected above laboratory detection limit (< reported value).
J - Reported value is an estimated concentration.
UJ - Analyte not detected at an estimated detection limit concentration (< reported value).
NA - Not analyzed
ND - Not detected

Table 5-2. NDEP VLT Whole Rock Analytical Results

Sample Name	Metals																						
	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
YVLT1-1																							
Result	10000	4.85	11.8	69.6	<0.40	<0.40	7320	5.90	<4.00	2290	17700	8.75	8110	58.4	1.85	8.28	888	5.21	<2.00	248	<0.20	27.2	18.6
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT1-2																							
Result	7910	3.45	8.95	73.5	<0.40	<0.40	5690	6.06	<4.00	1590	20900	8.75	5960	58.9	0.449	7.14	992	4.01	<2.00	136	0.21	24.3	22.4
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT1-2 DUPLICATE																							
Result	8840	3.24	12.8	73.8	<0.40	<0.40	5890	6.99	<4.00	1780	26100	9.88	6480	63.6	0.412	8.08	1080	4.23	<2.00	138	<0.20	28.6	24.9
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT1-3																							
Result	8690	2.78	12.3	82.7	<0.40	<0.40	6010	4.92	<4.00	2390	23000	6.94	6780	86.1	0.538	7.89	709	2.48	<2.00	157	<0.20	24.5	23.6
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT3-1																							
Result	5930	5.41	10.7	59.2	<0.40	<0.40	7090	4.62	<4.00	1410	13300	8.04	6111	45.9	0.619	6.89	862	5.53	<2.00	149	0.226	16.1	15.1
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT3-2																							
Result	6380	3.47	14.3	68.6	<0.40	<0.40	6170	6.93	<4.00	928	17100	8.83	6560	44.3	0.488	9.58	1210	5.01	<2.00	<100	0.363	24.4	15.3
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT3-2 DUPLICATE																							
Result	6500	3.52	17.7	70.1	<0.40	<0.40	5830	6.70	<4.00	837	16700	9.62	6690	45.3	0.490	10.5	1280	5.19	<2.00	<100	0.60	24.8	15.0
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
YVLT3-3																							
Result	6730	1.73	19.6	59.0	<0.40	<0.40	7780	6.33	<4.00	1530	22400	10.1	5990	46.9	0.354	8.77	1250	8.61	<2.00	153	0.46	29.7	20.1
Detection Limit	4.00	0.60	1.00	4.00	0.40	0.40	100	1.00	4.00	2.00	200	1.40	20.0	1.0	0.020	4.00	500	2.00	2.00	100	0.20	4.00	10.0
EPA Method	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B

Table 5-3. NDEP VLT SPLP Analytical Results

Parameter	Sample (all results in mg/L)								Nevada Drinking Water[1]	
	YVLT1-1	YVLT1-2	YVLT1-2D	YVLT1-3	YVLT3-1	YVLT3-2	YVLT3-2D	YVLT3-3	Primary MCL[2]	Secondary MCL
Aluminum	1.71	2.79	3.28	1.73	2.26	0.52	3.19	1.35	--	0.05-0.2[5]
Arsenic	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.05	--
Barium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	2.0	--
Beryllium	0.117	0.116	0.102	0.149	0.134	0.180	0.122	0.140	0.004	--
Boron	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	--	--
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	--
Calcium	175	195	192	158	232	170	157	154	--	--
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	--
Cobalt	0.036	0.027	0.034	0.065	0.023	0.023	0.023	0.036	--	--
Copper	45.7	25.8	34.5	48.5	33.5	10.0	8.8	14.1	1.3[6]	1.0[3]
Iron	0.124	0.029	0.033	0.116	0.121	0.038	1.850	0.050	--	0.3[3],0.6[4]
Lead	0.009	0.009	0.009	0.009	0.012	0.012	0.012	0.009	0.015[6]	--
Magnesium	17.1	21.5	26.0	16.8	17.2	7.1	6.5	10.0	--	125[3], 150[4]
Manganese	0.401	0.336	0.417	0.689	0.253	0.092	0.082	0.200	--	0.05[3], 0.1[4]
Mercury	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	0.002	--
Nickel	0.031	0.029	0.036	0.035	0.027	0.027	0.027	0.031	0.1	--
Potassium	1.83	1.24	1.33	1.35	2.57	2.91	2.92	2.08	--	--
Selenium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.05	--
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--	0.1[5]
Sodium	18.9	15.6	14.0	16.5	18.6	15.1	12.7	15.6	--	--
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	--
Vanadium	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	--	--
Zinc	0.330	0.295	0.265	0.428	0.340	0.277	0.132	0.279	--	5.0[3]
pH of final Leachate[A]	5.13	4.79	4.80	5.08	4.92	5.38	4.86	5.13	--	6.5-8.5[3]

Notes:

[A] Initial pH approximately 5.0.

Analytical results from sequential leach testing (SPLP) conducted by NDEP (2002; see Appendix A).

"D" indicates Duplicate Sample.

All analyses conducted using EPA Method 200.7 (ICP/AES.

[1] Units are milligrams per liter (mg/L) unless otherwise noted.

[2] Federal primary standards of 7-1-93 are incorporated by reference in NAC 445A.453.

[3] Nevada Secondary recommended maximum contaminant levels.

[4] Nevada Secondary (enforceable) maximum contaminant levels.

[5] Federal Secondary maximum contaminant levels.

[6] Value is action level for treatment technique for lead and copper.

SECTION 6.0
DATA QUALITY SUMMARY

This section of the RAC DSR describes the data quality of analytical results for the geochemical samples submitted to the TestAmerica Laboratories (Irvine and Richland) for groundwater, solids and leachate samples. The laboratory analytical reports and data validation reports are provided in Appendices E and F, respectively.

6.1 Data Quality Summary

A total of 16 normal and 2 field duplicate water matrix samples were collected and analyzed. In addition, 8 normal soil samples were leached according to the MWMP protocols and the resulting aqueous leachates were analyzed. All aqueous samples were analyzed for the full list of parameters in Table 2-5 with the exception of the following, as noted in Table 6-1:

- The leachate samples were not analyzed by Methods E300, SM2320B, SM2540C, SM4500, and SM5310B because of a miscommunication to field personnel that only metals analysis was required on the leachate samples.
- One of the groundwater field duplicate samples was not analyzed by Methods E900.0, E903.0, E904, and HASL 300 because sufficient volume for duplicate analysis of these methods could not be obtained.

Overall, the aqueous data meet the data quality objectives. All data was considered usable for the stated purposes. Completeness goals are met for every method and analyte. The primary issues that resulted in data qualification of aqueous results were:

- Low matrix spike recoveries for mercury;
- Low matrix spike recoveries for radium-228; and
- Laboratory pH analyses being performed past the 24 hour holding time.

A total of 132 normal and 14 field duplicate solid matrix samples were analyzed for the full list of parameters in Table 2-2 with the exception of the following, as noted in Table 6-2:

- Four of the field duplicate samples were not analyzed for radium-226 and radium-228 by Method E901.1 nor for thorium and uranium by Method SW6020.

Overall, the data meet the data quality objectives. Two boron results and one silicon result have been rejected due to extremely low matrix spike recoveries. Rejected results are not usable for any purpose. All non-rejected data was considered usable for the stated purposes. Completeness goals were met for every method and analyte. The primary issues that resulted in data qualification include:

- Poor duplicate precision and matrix spike recoveries not within acceptance criteria for various metals by Methods SW6010B and SW6020; and
- Blank contamination and high matrix spike recoveries for mercury by Method SW7471A.

Results qualified as estimated should be used with caution. Tables 6-1 and 6-2, respectively, provide a summary of the number of groundwater/leachate and solid media samples analyzed by each method, and the number of results that were qualified for each method.

Table 6-1. Analytical Completeness by Method for Groundwater and Leachate Samples

				Number of Results				Completeness	
Method	Parameter	Samples Analyzed (N+FD)	Analytes per sample	Total	Rejected	Estimated due to QC deficiencies	Estimated due to >MDL but <PQL	Percent usable	Percent quantitative*
E200.7	ICP Metals	24+2	13	338	0	5	11	100%	98.5%
E200.8	ICPMS Metals	24+2	18	468	0	24	77	100%	94.9%
E245.1	Mercury	24+2	1	26	0	10	2	100%	61.5%
E300	Anions	16+2	6	108	0	21	5	100%	80.6%
E900.0	Gross Alpha and Beta	24+1	2	50	0	12	0	100%	76.0%
E903.0	Total Alpha Radium (Ra-226)	24+1	1	25	0	7	15	100%	72.0%
E904	Radium-228	24+1	1	25	0	9	4	100%	64.0%
HASL 300	Isotopic Thorium and Uranium	24+1	6	150	0	16	6	100%	89.3%
SM2320B	Alkalinity (As $CaCO^3$)	16+2	4	72	0	0	0	100%	100%
SM2540C	Total Dissolved Solids	16+2	1	18	0	0	0	100%	100%
SM4500	pH (lab)	16+2	1	18	0	18	0	100%	0%
SM5310B	Total Organic Carbon	16+2	1	18	0	2	0	100%	88.9%

* Note: Estimations due solely to results <PQL do not affect the calculated completeness
Calculations do not include any required field or laboratory QC samples, except field duplicates.
N = normal environmental samples FD = field duplicate samples

Table 6-2. Analytical Completeness by Method for Solid Samples

				Number of Results				Completeness	
Method	Parameter	Samples Analyzed (N+FD)	Analytes per sample	Total	Rejected	Estimated due to QC deficiencies	Estimated due to >MDL but <PQL	Percent usable	Percent quantitative*
E901.1	Radium-226 and-228	132+10	2	284	0	2	40	100%	99.3%
SW6010	ICP Metals	132+14	9	1314	3	424	34	99.8	67.7%
SW6020	ICPMS Metals	132+14	18	2628	0	852	510	100%	67.6%
SW7471	Mercury	132+14	1	146	0	44	5	100%	69.9%

* Note: Estimations due solely to results <PQL do not affect the calculated completeness
Calculations do not include any required field or laboratory QC samples, except field duplicates.
N = normal environmental samples FD = field duplicate samples

SECTION 7.0
VADOSE ZONE PROPERTIES AND PRELIMINARY MODELING RESULTS

As described in the RAC Work Plan, the conceptual model for the Ponds and the data quality objectives (DQOs) for Pond characterization activities indicated the potential for the percolation of meteoric water to mobilize chemicals from soils to the subjacent shallow alluvial aquifer under existing conditions. Chemical impacts to soils in select areas beneath the Ponds have been identified based on the results presented in Section 3.0 and, as described in Section 4.0, the shallow hydrostratigraphic zone of the alluvial aquifer beneath the UEP and LEP exhibits the highest concentrations of chemicals within the Site boundary.

As described in the RAC Work Plan, ARC proposed to collect geotechnical samples to support vadose (unsaturated) zone modeling of the unsaturated alluvial (soil) profile beneath the Ponds. Section 7.1 summarizes the geotechnical data and the hydraulic properties of the soils underlying the Ponds. The remainder of this section describes the approach, inputs and results of these modeling activities. A more detailed report of the preliminary vadose zone model simulations is provided as Appendix I of this RAC DSR.

7.1 Geotechnical Samples and Analyses

As described in Section 2.0, 16 core samples of alluvial fan materials (native soils) were collected at shallow and deep intervals during the characterization activities. These samples were submitted to the DBS Laboratory for a comprehensive analysis of the following quantitative unsaturated hydraulic properties: grains size distribution, in-situ moisture content, bulk density, saturated hydraulic conductivity (Ksat), Atterberg limits, soil suction versus moisture content relationships, and soil water characteristic curves. In addition, five samples of Pond sediments were submitted to the AMEC Laboratory for the following unsaturated hydraulic properties: grain size analysis, bulk density measurements, and Ksat measurements. Laboratory reports for the geotechnical samples are included in Appendix I.

Gravimetric water content (i.e., mass wetness) is defined as the mass of water in a soil divided by the mass of the soil. Determination of the gravimetric water content is done by weighing the soil sample as it is received, drying the soil in an oven at 105° Celsius, and then re-weighing the sample. Volumetric water content (i.e., volume wetness) is defined as the volume of water contained in a sample divided by the total volume of the sample. Both terms (volumetric and gravimetric water content) are used in this RAC DSR. Volumetric moisture content is an input to the vadose zone models described below and in Appendix I. Gravimetric and volumetric moisture contents are related according to the following:

$$\theta = \omega \rho b / \rho w$$

and

$$\omega = \theta \rho w / \rho b$$

where: θ = volumetric water content;
ω = gravimetric water content;
ρb = soil dry bulk density; and
ρw = density of water.

The bulk density of water is approximately equal to 1 gram/cubic centimeter (g/cc). Since the bulk density of soils is generally greater than that of water, volumetric water content is normally greater than gravimetric water content (Hillel, 1980). Generally, for the alluvial fan materials that underlie the Ponds, the volumetric water content is approximately 1.6 times greater than the gravimetric water content, based on the average dry bulk density of the 16 reported values for soils presented in Table 7-1. In clay-rich soils, the relative volume of water at saturation can exceed the porosity of the dry soil because these soils swell upon wetting (Hillel, 1980). Although gravimetric moisture contents were not reported for the five pond sediment samples included in Table 7-1, based on the average dry bulk density for these samples, the gravimetric water content would be approximately equal to the volumetric water content for these samples.

Degree of saturation is another important measure of soil moisture that expresses the volume of water present in the soil with respect to the volume of the pores in the soil (Hillel, 1980). Therefore, if a soil has a porosity of 35 percent, and the volumetric water content is 35 percent, then the soil is considered to be 100 percent saturated. Degree of saturation values reported in Table 7-1 range from 9.9 percent to 116.2 percent. Saturation values that exceed 100 percent are generally a result of the presence of swelling clays, as described above.

Wet bulk density (Table 7-1) is an expression of the total mass of a moist soil per unit volume. This measure of soil properties is strongly dependent upon the moisture content of the soil (Hillel, 1980).

The calculated porosity of a soil is an index of the relative pore volume in the soil, and is calculated by dividing the volume of the air plus the volume of water in a soil by the total volume of the soil. The porosity of soils is generally between 30 and 60 percent. Coarse grained soils generally have a lower porosity than fine grained soils (Hillel, 1980). The porosity values reported in Table 7-1 range between 30.1 percent and 44 percent.

The Ksat value of a soil (Table 7-1) describes the property of the soil to transmit water, and is the ratio of flux to hydraulic gradient. On an order of magnitude scale, these values typically range from 1.0E-02 to 1.0E-03 centimeters per second (cm/sec) for sandy soil and from 1.0E-04 10^{-4} to 1.0E-07 10^{-7} cm/sec for clayey soils (Hillel, 1980). Ksat values reported for soils in Table 7-1 range from 4.9E-03 cm/sec to ≤10.0E-10 cm/sec. The Ksat value reported for the pond sediments in Table 7-1 range from 7.6E-06 cm/sec to 6.5E-07 cm/sec.

The samples submitted to TestAmerica (Section 3.0) for geochemical analyses (with associated gravimetric moisture contents) were placed in plastic zip-lock bags after collection and shipped to the lab. The gravimetric moisture contents reported by TestAmerica, therefore, did not represent in-situ conditions because they were subjected to drying during storage and shipment. Volumetric moisture contents were not reported for these samples because dry bulk densities were not determined.

Results of particle size and Atterberg Limits analyses for the evaporation ponds soil samples are presented in Table 7-2. The particle size analyses are conducted by classifying the relative percentage of the various size fractions of the soil by a combination of sieve and hydrometer analyses. A general classification of the soil is then provided (i.e., sand, clayey sand, etc.).

Atterberg Limits are used to determine the gravimetric moisture content at which a soil changes from one consistency state to another (e.g., from a hard, brittle solid to a moldable plastic semisolid; Hillel, 1980). The 'liquid limit' describes the gravimetric moisture content at which the soil-water system changes from a viscous liquid to a plastic body. The plastic limit is the gravimetric moistures content at which the soil stiffens from a plastic to a semi-rigid state. The plasticity index is the difference between the liquid and the plastic limits. The plasticity index is generally taken to be an indication of a soil's clay content and nature (Hillel, 1980). These soil properties, along with other input data described below, were included in the preliminary vadose modeling for the soil profiles described in Section 3.1 and depicted in Figure 3-1.

7.2 Vadose Zone Flux Modeling Approach and Concepts

Development of a one-dimensional numerical unsaturated flow model for the soils underlying the Ponds included the following inputs: 1) meteorological data from climate stations with a sufficient period of record located in a setting with precipitation and evaporation conditions analogous to Site conditions; 2) the field and laboratory data described below, and in previous sections of this RAC DSR; 3) the generalized Pond material types and soil profiles shown in Figure 3-1; and 4) the appropriate modeling software that can accommodate the complexities of the hydraulic properties of the Pond materials and native soils. Five base-case simulations were performed for the profiles shown in Figure 3-1, which included two simulations for the LEP (one for the 'wet' areas and one for the peripheral 'dry' areas). As stated in the RAC Work Plan, the objective of vadose zone modeling is to determine: "the potential for current or future sourcing of chemicals to groundwater".

Table 7-1. Geotechnical Soil Hydraulic Properties

			Moisture/Bulk Density						Saturated Hydraulic Conductivity		
			Moisture Content		Dry Bulk Density	Wet Bulk Density	Saturation	Calculated Porosity	K_{sat}	Method of Analysis	
Sample Number	Matrix	Lab[(1)]	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	(g/cm^3)	(g/cm^3)	(%)	(%)	(cm/sec)	Constant Head	Falling Head
OU4-LEP-01A-SG	Soil	DBS	25.6	42.8	1.67	2.10	116.2	36.9	3.9E-07		X
OU4-LEP-01B-SG	Soil	DBS	21.7	35.9	1.65	2.01	95.5	37.6	6.8E-07		X
OU4-LEP-03A-SG	Soil	DBS	32.8	49.4	1.51	2.00	114.6	43.1	≤8.5E-10		X
OU4-LEP-03B-SG	Soil	DBS	18.2	30.2	1.66	1.96	81.0	37.3	1.5E-07		X
OU4-LEP-05A-SG	Soil	DBS	25.3	39.7	1.56	1.96	96.9	40.9	≤2.8E-08		X
OU4-LEP-05B-SG	Soil	DBS	29.1	43.1	1.48	1.92	98.0	44.0	≤1.1E-08		X
OU4-UEP-07A-SG	Soil	DBS	14.1	21.1	1.49	1.70	48.1	43.8	5.5E-04	X	
OU4-UEP-07B-SG	Soil	DBS	23.0	36.4	1.58	1.95	90.4	40.3	6.5E-08		X
OU4-UEP-08A-SG	Soil	DBS	2.2	3.7	1.66	1.69	9.9	37.5	4.9E-03	X	
OU4-UEP-08B-SG	Soil	DBS	13.1	21.4	1.63	1.85	55.7	38.4	1.6E-04	X	
OU4-UEP-10A-SG	Soil	DBS	22.6	38.0	1.68	2.06	104.2	36.5	5.0E-08		X
OU4-UEP-10B-SG	Soil	DBS	23.3	40.2	1.73	2.13	115.5	34.8	8.4E-08		X
OU4-FEP-13A-SG	Soil	DBS	12.9	22.7	1.75	1.98	67.0	33.8	5.3E-06		X
OU4-FEP-13B-SG	Soil	DBS	17.8	33.0	1.85	2.18	109.6	30.1	1.1E-06		X
OU4-FEP-15A-SG	Soil	DBS	12.0	21.9	1.83	2.04	70.5	31.1	7.1E-05	X	
OU4-FEP-15B-SG	Soil	DBS	15.5	25.4	1.64	1.90	66.8	38.0	1.6E-04	X	
OU4-UEP-61-SED	Sed	AMEC	22.2		1.05				2.8E-06		X
OU4-UEP-62-SED	Sed	AMEC	55.7		0.99				7.6E-06		X
OU4-LEP-63-SED	Sed	AMEC	36.0		1.02				6.5E-07		X
OU4-LEP-64-SED	Sed	AMEC	39.3		1.07				1.5E-06		X
OU4-FEP-65-SED	Sed	AMEC	36.7		0.99				4.7E-06		X

Note: [(1)] DBS: Daniel B. Stephens and Associates (Albuquerque, NM); AMEC (Sparks, NV)

Table 7-2. Geotechnical Particle Size and Soil Classification

	Summary of Particle Size Characteristics								Summary of Atterberg Tests			
Sample Number	d_{10} (mm)	d_{50} (mm)	d_{60} (mm)	C_u	C_c	ASTM Classification		USDA Classification	Liquid Limit	Plastic Limit	Plasticity Index	Laboratory Classification
OU4-LEP-01A-SG	0.087	0.29	0.41	4.7	0.81	SP-SM	Poorly-graded sand with silt	Sand	---	---	---	ML
OU4-LEP-01B-SG	0.041	0.36	0.47	11	2.5	SW-SM	Well-graded sand with silt	Loamy Sand †	---	---	---	ML
OU4-LEP-03A-SG	0.0041	0.18	0.22	54	16	SM	Silty sand	Loamy Sand	---	---	---	ML
OU4-LEP-03B-SG	0.0017	0.021	0.028	16	2.5	CL-ML	Silty clay	Silt Loam	25	20	5	CL-ML
OU4-LEP-05A-SG	0.00016	0.0024	0.0036	23	0.67	CH	Fat clay	Silty Clay	81	23	58	CH
OU4-LEP-05B-SG	0.0011	0.13	0.17	155	11	SC	Clayey sand	Sandy Loam	48	19	29	CL
OU4-UEP-07A-SG	0.048	0.59	0.95	20	0.97	SM	Silty sand	Loamy Sand †	---	---	---	ML
OU4-UEP-07B-SG	0.00045	0.15	0.21	467	16	SC	Clayey sand	Sandy Loam	35	17	18	CL
OU4-UEP-08A-SG	0.088	0.71	1.0	11	1.1	SW-SM	Well-graded sand with silt	Sand †	---	---	---	ML
OU4-UEP-08B-SG	0.00076	0.043	0.065	86	8.9	ML	Sandy silt	Loam	36	26	10	ML
OU4-UEP-10A-SG	7.2E-05	0.0027	0.0054	75	0.81	CH	Fat clay with sand	Clay	50	18	32	CH
OU4-UEP-10B-SG	0.0010	0.011	0.027	27	0.85	CL	Sandy lean clay	Loam	27	15	12	CL
OU4-FEP-13A-SG	0.036	0.22	0.31	8.6	1.3	SM	Silty sand	Sand †	---	---	---	ML
OU4-FEP-13B-SG	0.0095	0.26	0.47	49	3.2	SM	Silty sand	Sandy Loam †	---	---	---	ML
OU4-FEP-15A-SG	0.021	0.41	0.64	30	2.2	SM	Silty sand	Loamy Sand †	---	---	---	ML
OU4-FEP-15B-SG	0.022	0.51	0.89	40	1.3	SM	Silty sand with gravel	Loamy Sand †	---	---	---	ML

Notes:

d_{50} = Median particle diameter

† Greater than 10% of sample is coarse material

Modeling Code

Initially, ARC attempted to use the modeling code HYDRUS 3D to simulate meteoric water flux in the vadose zone beneath the Ponds. This software was found to have numerical stability problems in some of the simulations, likely due to the complexity of the Pond material profiles. In addition, technical support for the HYDRUS software was inadequate to evaluate model simulation issues. Subsequently, ARC selected the variably-saturated modeling code SVFlux™ (SoilVision Systems, 2008) to perform the numerical model simulations.

In addition to numerous tools that SVFlux™ can apply to evaluating simulation results, and the access to software support, it provides a graphical interface for model parameter inputs (e.g., model domain geometry, location of the water table, material properties and soil types, and climate conditions). SVFlux™ processes the user's model, and writes a script file for the linked software FlexPDE™, which solves the partial differential equations governing unsaturated flow. The graphical interface also provides model outputs in formats that can be used to document and understand simulation results, as presented in Appendix I.

Climate Data

Atmospheric input data for the model simulations included precipitation, potential evaporation, monthly average relative humidity and temperature obtained through the Western Regional Climate Center web site (http://www.wrcc.dri.edu/). Daily precipitation data used in the model simulations were obtained for the Yerington, Nevada Coop site #269229. A 35-year record was initially chosen for the simulations. However, model simulation runs for this length of time were excessively lengthy. In addition, flux characteristics within the soil column stabilized in a shorter time frame (0 to 5 years) for the simulations. Therefore, a shorter, but still representative, climate record was used for the simulations, from June 1972 through May 1987 (the simulation years are not coincident with a water year or calendar year, but are more likely to reflect the precipitation received in the water year rather than the calendar year, given the limited precipitation during the summer months).

As seen in Table 7-3, this 15-year period includes the range of average annual precipitation rates expected at the Site, represented by a greater number of below average (dry) years (late 1970s to early 1980s) followed by a shorter number of above average (wet) years early to mid-1980s) including one year (8.99 inches in simulation year 11) that was 75 percent greater than the 5.12-inch annual average for the 95-year period of record (1914 through 2008) at Site # 269229 (the annual precipitation value for calendar year 1983 was 10.49 inches).

Table 7-3. Annual Precipitation Values for Simulation Period

Simulation Year (Water Year)	Model Precipitation Input (inches/meters)
1 (1972/73)	5.50/(0.1397)
2 (1973/74)	3.13/(0.0795)
3 (1974/75)	5.95/(0.1511)
4 (1975/76)	4.02/(0.1021)
5 (1976/77)	4.69/(0.1191)
6 (1977/78)	4.58/(0.1163)
7 (1978/79)	3.51/(0.0892)
8 (1979/80)	4.61/(0.1171)
9 (1980/81)	3.88/(0.0986)
10 (1981/82)	2.78/(0.0706)
11 (1982/83)	8.99/(0.2283)
12 (1983/84)	7.68/(0.1951)
13 (1984/85)	7.26/(0.1844)
14 (1985/86)	7.96/(0.2022)
15 (1986/87)	3.96/(0.1006)

Precipitation values were converted to metric units for consistency with other model inputs, and were input to the vadose zone models on a daily basis. The modeled temporal distribution of precipitation intensity was globally set to a parabolic distribution over an eight-hour period. Evaporation data used in the model simulations are based on pan evaporation data obtained for the Lahontan, Nevada Coop site #264349, located approximately 30 miles north of the Site (evaporation data are not available for the Yerington, Nevada Coop site). The Lahontan site was selected based on its proximity to the Site and the climatic similarity to the Site. Pan evaporation data are available as monthly average values for the period of record at the Lahontan site.

Evaporation data used in the simulations were adjusted by a pan coefficient of 0.7 to correct for factors (e.g., storage and transfer of heat to the water from the sides of the evaporation pan), which may increase the evaporation rate in an open pan with respect to the potential evaporation from a crop or bare soil (UNFAO, 1998). Pan coefficients may vary from approximately 0.35 to 0.85 for agricultural situations (e.g., bare soils; UNFAO, 1998). The effect of the pan coefficient is to lower the potential evaporative flux indicated by the pan evaporation data. Pan evaporation data were converted to metric units for consistency with other inputs in the Pond column models. Evaporation in the simulations was set to zero for days when precipitation occurred.

Material Properties

The physical properties of the Pond materials and underlying soils, and the climate conditions at the Site, control the upward or downward movement of soil water in the vadose zone. Pond sediment and soil profiles (Figure 3-1) were developed to represent the general distribution of material types observed during the October 2008 field sampling program and two key hydraulic properties (gravimetric moisture content and degree of saturation) resulting from laboratory testing of the geotechnical samples. Appendix I provides a list of the soil types used in the numerical models, the method used to fit the soil water characteristic curves (SWCCs) to the soils, and the method used to estimate the unsaturated hydraulic conductivity curves. Appendix I also contains plots of the SWCCs and the unsaturated hydraulic conductivity curves used in the numerical models.

As indicated above (Section 2.2.1), and discussed in Appendix I, hydraulic property values for soils underlying the LEP were collected from boreholes proximal to ‘wet’ (seasonally ponded) areas. As a result, the characteristics of the alluvial soils underlying these peripheral areas are not well represented in the LEP ‘dry’ areas numerical column model. The anticipated gradation in subsurface hydraulic properties from the ‘wet’ areas towards the UEP and/or FEP 5 (e.g., less saturated soils) would likely result in a range of soil moisture responses (i.e., magnitude and direction of flux rates) that differ from the simulated responses in the vadose zone model for the LEP ‘dry’ areas.

Boundary Conditions

Lateral boundary conditions were designated as no-flow boundaries for each of the five Pond column models. Each model was assigned an upper boundary that represented atmospheric conditions (i.e., precipitation and evaporation) for the simulation period, and a lower boundary that consisted of either a gradient boundary or the water table. Because of the relatively greater depth to groundwater beneath the FEPs (up to 65 feet bgs), a gradient boundary was used for the lower boundary condition to eliminate unrealistic potential of the model to wick excessive water from the water table at this depth. Column models for the LEP ('wet' and 'dry' areas), UEP and Thumb Pond used the water table for the lower boundary (about 45 feet for the Thumb Pond and about 20 feet for the LEP and UEP) because, at these more shallow depths, the water table would be expected to have a greater influence on soil water flux.

Initial Conditions

Initial moisture conditions for the Pond sediment-soil profile models were developed by using SVFlux™ to establish a linear distribution of pressure head and the associated moisture content between the water table and the upper model boundary. Moisture conditions in some of the profile models were at or near equilibrium (i.e., quasi steady-state condition) with boundary conditions at the start of the simulation for the LEP dry areas and the Thumb Pond, and some required up to approximately five years to equilibrate (approximately 1,800 days for the UEP, and approximately 1,500 days for FEPs 1 through 4).

The equilibration period was required to allow initial moisture conditions established by SVFlux™ to approach a quasi steady-state condition resulting from the climatic conditions used in the simulations for each profile model. Equilibrium was indicated by a cessation of any long-term drying or wetting trends exhibited by the models (i.e., no seasonal wetting and/or drying). Initial conditions for the LEP 'wet' areas simulation were at or near-saturation, which was established by the simulation of a constant (five centimeter) head at the upper model boundary for a period of approximately five years.

7.3 Model Simulations and Results

Simulations for the five profile models (Figure 3-1) are described below, including estimated cumulative and annual average soil moisture flux rates (either up or down). Reasonable agreement was achieved between observed and simulated saturation percentage values in the shallow and deep soils underlying the Ponds, indicating the appropriateness of the models for predictive simulations (Table 7-4; a single saturation percentage value was obtained for the shallow and deep soils beneath the Thumb Pond and FEPs 1-4, and three saturation percentage values were obtained for the shallow and deep soils beneath the LEP and the UEP).

Observed saturation percentages in the LEP were similar between the three borehole locations (the shallow samples were at or near saturation, 97 to 116 percent, and the deep samples ranged from 81 to 98 percent saturation). Equating the oversaturated results to 100 percent, the simulated saturation percentages for the LEP were within approximately 10 percent of the observed shallow and deep saturation percentages, as seen in Table 7-4 (bold-faced saturation percentage values indicate the selected observed value for comparison with simulated values). Moisture conditions in the UEP varied considerably from one borehole location to another (Table 7-4), indicating distinctly different vadose zone conditions at each of the three locations.

Table 7-4. Comparison of Observed and Simulated Saturation Percentages

Pond Area	DPT Borehole Number	Observed Saturation Percentage (shallow/deep)[1]	Simulated Saturation Percentage (shallow/deep)[2]
LEP	OU4-LEP-01	116/96	
	OU4-LEP-03	115/81	
	OU4-LEP-05[3]	**97/98**	85-90/90-95
UEP	OU4-UEP-07[4]	**48/90**	50-60/65-75
	OU4-UEP-08	10/56	
	OU4-UEP-10	104/115	
FEP 5	OU4-FEP-13	67/110	65-95/100
FEP 1-4	OU4-FEP-15	70/67	70-100/60

Notes:
[1]Saturation percentage of core sample from beneath the indicated Pond area (one-time event)
[2]Approximate range of saturation percentage over the period of the simulation for the indicated Pond area.
[3]Borehole and sample pair selected to compare observed/simulated saturation percentages for LEP dry area simulation.
[4]Borehole and sample pair selected to compare observed/simulated saturation percentages for UEP simulation.

The observed saturation values from borehole OU4-UEP-07 were used as the basis for comparison to the simulated saturation percentage for the UEP (Table 7-4). Simulated saturation percentage for the UEP was slightly greater than the saturation percentage observed for the shallow sample (range of two to 12 percent for simulation duration), and less than the saturation percentage observed for the deep sample by a range of 15 to 25 percent for the duration of the simulation (Table 7-4).

In general, the comparison of measured and simulated saturation percentages in the vadose zone models for a 'reasonable agreement' is expected to be within 30 percent (Dr. Murray Fredlund, 2009; personal communication). As described below, all vadose zone model results yielded comparison percentages from zero to 30 percent, indicating that the modeled profiles successfully simulated observed conditions. The simulations also indicated the importance of the near-surface condition in the Ponds with mineral salt crusts termed 'osmotic suction limit', which affect the evaporation rate from the surface of the Ponds, described in more detail in Appendix I

<u>LEP 'Wet' Areas Simulation</u>

Simulation of conditions in the 'wet' areas of the LEP required two sets of boundary conditions: 1) one to simulate the portion of the year when ponding occurs; and 2) a second to simulate the portion of the year when the ground surface is exposed to atmospheric conditions. Because SVFlux™ does not provide a means of changing a boundary condition during a simulation, which can be addressed by sensitivity analyses, a series of linked model simulations was created using alternating constant head and climate upper surface boundary conditions. A simulated water table was used for the lower model boundary condition as it was in the dry LEP model column (see below).

The alternating boundary condition for the 'wet' areas was created using a five-year simulation period with a constant head of five centimeters (cm). The five-year simulation using the constant head condition was then used as the starting moisture condition for a six-month simulation using the climate boundary condition represented by the six-month period from May through October,

2000. This climate period was chosen to represent a relatively dry summer that would result in a relatively high potential evaporation rate. Subsequently, a six-month constant-head simulation was run using the final moisture conditions of the six-month climate boundary condition simulation as the start of the next six-month period. This set of linked alternating boundary conditions simulations was continued for a total simulation time of five years.

Flux lines, a SVFlux™ tool for monitoring the flux of water at any depth within the column models, were designated in the VLT sub-liner base material, and approximately in the middle sections of the alluvial soils characterized as: 1) silty sand with clay; and 2) the silty sand unit (see Figure 3.1 and Appendix I). Moisture conditions were at or near saturation throughout the model domain for the beginning of the simulation of the LEP ‘wet’ area. This near-saturation condition was generated with a five-year constant head simulation that was used for the initial moisture conditions in the five-year linked climate boundary/constant head boundary simulation.

Saturation percentage declined to about 70 percent near the surface, and to values in the mid-90 percent range in the deeper portions of the profile, during the six-month climate simulation segments. These values returned to near-saturated conditions during the six-month constant-head simulation segments. The 5-year linked simulation period indicated a fairly constant downward net flux of soil water toward the water table. The cumulative flux at the deepest flux line in the profile was approximately 0.16 meters after 5 years of simulation (approximately 3.2 E-02 meters per year when averaged over the simulation period).

<u>LEP Non-Ponded Area Simulation</u>

Simulation of conditions in the unsaturated zone of the ‘dry’ (i.e., non-ponded) portions of the LEP was accomplished by applying the same climate data for the ‘wet’ areas to the upper boundary of the profile. The lower boundary condition was simulated by assigning a water table condition at the approximate depth of the water table in the LEP area (19 feet bgs). Initial moisture conditions for the model were established in SVFlux™ by imposing an initial head equal to the depth of the water table, which the program uses to establish throughout the model domain a linear trend of pore water pressure and the related moisture content.

A 15-year model simulation was run using the climate data discussed above (i.e., precipitation, potential evaporation, monthly average relative humidity and temperature). Three flux lines were included in the model to evaluate the movement of water at various depths of the simulated Pond sediment-soil profile. Similar to the LEP 'wet' areas model, flux lines were designated in the VLT sub-liner base material, and approximately in the middle sections of the alluvial soils characterized as: 1) silty sand with clay; and 2) the silty sand unit (Figure 3.1). This profile model was in equilibrium with the model boundary conditions at the start of the simulation.

As presented in Table 7-4, a comparison of observed versus simulated saturation percentage was used to assess the appropriateness of model for simulating actual conditions. Measured saturation percentages for the soil samples ranged from 97 to 116 percent for the shallow soil samples, and between 81 and 98 percent for the deeper soils. These values were represented in the simulations as 85 to 90 percent for shallow soils and 90 to 95 percent for deeper soils.

The dry (i.e., non-ponded) areas of the LEP simulation produced reasonable agreement between the observed and simulated saturation, with a difference range of seven to 12 percent for shallow and three to eight percent for deep profile sections through the duration of the simulation (Table 7-4). The degree of saturation in the VLT materials used as a liner sub-base was fairly dry throughout the simulation period (approximately 20 percent), but increased to about 65 percent in response to a large precipitation event. The deeper portions of the profile displayed a fairly constant saturation with time, indicating that the simulation started and remained in approximate equilibrium with model boundary conditions. For the 15-year simulation period, the model indicated a small downward net flux of water, approximately 0.013 meters after 15 years of simulation (approximately 8.7 E-04 meters per year when averaged over the simulation period). Because the same soil moisture conditions for the 'wet' areas simulation was used for the 'dry' areas simulation, and because the soil moisture conditions for the 'dry' areas of the LEP are more likely to be similar to the conditions observed in the UEP, the numerical simulation likely over-predicts downward flux to the water table.

UEP Simulation

Simulation of vadose conditions beneath the UEP was accomplished by applying the atmospheric boundary conditions described above to the upper boundary of the model. The lower boundary condition was simulated by the approximate depth of the water table in the UEP area (20 feet bgs). Initial moisture conditions for the model were established in SVFlux™ by imposing an initial head equal to the depth of the water table, which the program uses to establish a linear trend of pore water pressure and related moisture content throughout the model.

A 15-year model simulation was run using precipitation, potential evaporation, monthly average relative humidity and temperature data. Approximately 1,800 days of simulation time were required for the model to equilibrate with the model boundary conditions. This equilibration period was characterized by a gradual decline in storage through evaporative flux and drainage through the lower boundary. The following three flux lines were included in the model to evaluate the flux of soil water: Pond sediments, and the approximate middle of the silty sand with clay shallow soil, and in the middle of the deep soil silty sand unit (Figure 3-1).

As presented in Table 7-4, a comparison of observed versus simulated saturation percentages was used to assess the ability of the model to simulate actual conditions (saturation percentages varied considerably between the three UEP borehole locations). Saturation percentages ranged from 10 to 104 percent for the shallow soil samples, and from 56 to 115 percent for the deep soil samples. These values were represented in the simulations as follows: 50 and 60 percent of saturation for shallow soils and 65 and 75 percent saturation for the deep soils.

The UEP simulation produced a reasonable agreement between the observed and simulated saturation, with a difference range of two to 12 percent for shallow and 15 to 25 percent for deep levels through the duration of the simulation for one of the sample locations (OU4-UEP-07), but is somewhat wetter than conditions observed at OU4-UEP-08 and drier than conditions observed at OU4-UEP-10. The simulated saturation values ranged from 50 to 60 percent saturation for shallow soils, and from approximately 65 to 75 percent for deep soils.

For the 15-year simulation period, the model indicated a continuous upward net flux of water. The cumulative flux at the deepest flux line in the model was approximately 1.8 meters for 15 years of simulation (approximately 0.12 meters per year when averaged over the 15-year simulation period). For the 10-year period following the equilibration of the model (see above), the cumulative flux was approximately 1.5 meters (approximately 0.15 meters per year).

Thumb Pond Simulation

Simulation of vadose zone conditions in the Thumb Pond was accomplished by applying the atmospheric boundary conditions described above to the upper boundary of the column model. The lower boundary condition was simulated by assigning a water table condition at the approximate depth of the water table (45 feet bgs). Initial moisture conditions for the model were established in SVFlux™ by imposing an initial head equal to the depth of the water table, which the program uses to establish a linear trend of pore water pressure and related moisture content throughout the profile. Three flux lines were designated including one in the Pond sediments, and the other two within the shallow and deep soils (both characterized as silty sand with gravel). This model was approximately in equilibrium at the beginning of the simulation. A 15-year model simulation was run using precipitation, potential evaporation, monthly average relative humidity and temperature data.

A comparison of observed versus simulated saturation percentage was used to assess the appropriateness of model for simulating actual vadose zone conditions. The measured saturation percentages for the two samples collected from soils underlying the Thumb Pond were 67 and 110 percent for the shallow and deep soils, respectively. Simulated saturation percentages for the shallow soils varied between about 60 and 65 percent saturation, and the deeper portion of the alluvial soils were simulated at approximately 100 percent saturation. The osmotic suction limit effect on evaporation was most noticeable in the Thumb Pond simulation (see Appendix I).

The Thumb Pond simulation produced a reasonable agreement between the observed and simulated saturation, with a difference range of two to 28 percent for the shallow level and no difference for the deep level through the duration of the simulation if the over-saturated observed deep sample is equated to zero (Table 7-4). Observed saturation values were 67 percent for shallow soils and 115 percent for deeper soils. The respective simulated saturation values ranged from 60 to 65 and 100 percent saturation, respectively, for shallow and deep soils. For the majority of the 15-year simulation period, the model indicated a very small upward net flux of water. The cumulative flux rate was approximately 4.0 E-04 meters after 15 years of simulation (approximately 2.7 E-05 meters per year when averaged over the simulation period). The simulation indicated both upward and downward flux of soil water in the upper portion of the profile, and a relatively constant upward flux in the deeper portion of the profile.

FEPs 1-4 Simulation

Simulation of unsaturated zone conditions beneath the FEPs was accomplished by applying the atmospheric boundary conditions described above to the upper boundary of the model. The lower boundary condition was simulated by assigning a gradient boundary condition at a depth of 45 feet bgs (above the water table depth of 65 feet bgs) to eliminate potentially unrealistic soil moisture and saturation conditions from the water table. Initial moisture conditions for this model were established in SVFlux™ by imposing an initial head equal to the depth of the water table, used to establish a linear trend of pore water pressure and the related moisture content throughout the profile. A 15-year model simulation was run using precipitation, potential evaporation, monthly average relative humidity and temperature data.

Three flux lines were included near the top of the silty sand with gravel, near the middle of the silty sand with gravel, and near the bottom of the silty sand with gravel (Figure 3-1). Approximately 1,500 days of simulation time were required for the model to equilibrate with the model boundary conditions, a period characterized by a gradual decline in storage through evaporative flux and drainage through the lower boundary. A comparison of observed versus simulated saturation percentage was used to assess the appropriateness of the model for simulating actual vadose zone conditions. The measured saturation percentages were 70 and 67 percent, respectively, for the shallow and deep zone samples. Simulated saturation percentages for the shallow soils varied between about 50 and 70 percent of saturation, and between about 60 and 65 percent saturation for the deep soils.

As presented in Table 7-4, the FEP simulation resulted in a reasonable agreement between observed and simulated saturation values, with a difference range of zero to 30 percent for the shallow sections of the soil profile and a difference of seven percent for the deep sections of the soil profile through the duration of the simulation. The simulated saturation values ranged from 50 to 70 percent saturation for shallow soils and from 60 to 65 percent for deeper soils. The model indicated a small downward flux of soil water during the 15-year simulation period, with a cumulative flux rate at the deepest flux line in the profile of approximately 0.043 meters after 15 years (approximately 2.9 E-03 meters per year when averaged over the simulation period).

Based on the simulation results presented above, two of the Ponds (the LEP and FEPs 1-4), demonstrated the potential to flux meteoric water through the vadose zone to groundwater. The estimated flux rates described above, when integrated over the acreage values for these Ponds, result in the following annual estimated volumes of water that could potentially migrate to groundwater beneath these Ponds:

- Approximately 0.31 acre-feet per year (ac ft/yr) for the LEP 'dry' areas, based on an estimated flux rate of 0.0012 m/yr and an area of 79.5 acres, equivalent to 0.19 gpm;
- Approximately 1.13 ac ft/yr for the LEP 'wet' areas, based on an estimate flux rate of 0.016 m/yr and an area of 21.5 acres, equivalent to 0.70 gpm; and
- Approximately 0.15 ac ft/yr for FEP 1-4, based on an estimated flux rate of 0.0026 m/yr and an area of 17.8 acres, equivalent to 0.09 gpm.

As discussed above and shown in Figure 2-8, hydraulic property values for soils underlying the LEP were collected from boreholes proximal to 'wet' (intermittently ponded) areas, and that there is likely a gradation in subsurface properties towards the UEP and/or FEP 5 that would result in smaller downward deep flux rates, or possibly upward net flux rates, from these 'dry' LEP areas. Because the upper boundary climate condition input was the same for all models, it can be concluded that the different vadose zone simulation results (described above in terms of flux rates) and net soil water movement direction in the subsurface are strongly dependent on the physical and hydraulic characteristics of the Pond sediments and underlying alluvial soils.

For example, the deeper soils underlying the LEP and the UEP were observed to be similar (i.e., silty sand with clay and silty sand) as was the depth to groundwater, but the simulation results presented above indicated a net annual average downward flux for the LEP 'wet' area model and a net annual average upward flux for the UEP column model. This difference can be explained by: 1) Pond sediment thickness (i.e., the thicker sequence of very fine grained Pond sediments observed in the UEP can more readily retain and evaporate soil moisture); 2) Pond sediment characteristics (i.e., crystal formation in the LEP and associated osmotic suction differences); 3) the presence of the LEP liner (its precise role is uncertain, resulting in its exclusion from the LEP 'wet' area column model); and 4) the topographically depressed center portion of the LEP that, along with Pond sediment characteristics, serve to seasonally pond meteoric water and maintain (near) saturated conditions in the subsurface. The effect on simulation results of varying some model input parameters (i.e., the application of storm intensity or pan factor) was tested in the sensitivity simulations described in Appendix I. Given the limited available data for Pond sediment and soil hydraulic properties, the physical properties of these materials were not subjected to sensitivity analyses.

7.4 Sensitivity Analyses

The 'base-case' results presented above were designed to simulate the flux of soil water under observed hydraulic properties for Pond sediments (including the seasonal occurrence of standing water in the LEP 'wet' areas) and alluvial soils underlying the Ponds under anticipated climate conditions for the Site. A series of simulations were performed to test the sensitivity of the column models to changes in select input parameters and boundary conditions. The column models selected for sensitivity analyses were the: 1) UEP, to validate or refute the conclusion that, under all anticipated climate conditions, the UEP is a net evaporative soil moisture system; and 2) the LEP 'dry' areas because less confidence should be placed in the results for this column model due to the use of LEP 'wet' area soil hydraulic properties and because of the somewhat ambiguous results for the LEP 'dry' area column model, summarized below:

- an average net downward flux of water of approximately 0.0012 meters per year (m/yr) measured at the deep flux line;
- a cumulative annual deep flux range between an upward flux of 0.0002 m/yr and a downward flux of 0.0137 m/yr; and
- five of the simulation years for this model showed a downward net annual flux, and the remaining 10 simulation years indicated an upward net annual flux.

In addition, the LEP and UEP are the largest Ponds, have a similar thickness of underlying alluvial soils (i.e., vadose zone) with similar soil types, and exhibit sufficiently different Pond sediment characteristics to affect evaporative flux. Input parameters that were varied in the sensitivity simulations included: 1) the osmotic suction limit (i.e., the effect of mineral precipitates in the Pond sediments on the evaporation rate from the surface of the Ponds, see Appendix I); 2) the storm intensity (i.e., the time over which each storm event, and resulting precipitation rate, is distributed); 3) the pan factor applied to the pan evaporation data used to calculate potential evaporation; and 4) the use of a gradient boundary versus a water table boundary for the lower model boundary condition of the LEP 'dry' area and UEP profiles. A total of 14 sensitivity simulations were performed as follows:

- The osmotic suction and storm intensity inputs for each model were simulated at one higher and one lower value than the values used in the base-case simulations described above.
- Two lower pan factor values than the 0.7 value used in the base-case simulations were used.
- Each model was run with a gradient boundary for the lower boundary condition, and compared to the base-case results that incorporated a water table boundary condition.

Table 7-5 presents the input parameters that were used in the sensitivity analyses, the nature or magnitude of the parameter variations, and the resulting changes in evaporation, net climate boundary flux, and cumulative flux at the base of the profiles. As described in more detail in Appendix I, the sensitivity analyses indicated that the LEP 'dry' areas and UEP column models are:

- relatively sensitive to changes in model input parameters that influence the evaporative flux (i.e., the osmotic suction parameter and the potential evaporation);
- very sensitive to the type of lower boundary condition; and
- relatively insensitive to the storm intensity distribution.

Table 7-5. Summary of Model Sensitivity Results

Model	Sensitivity Variable	Variable Input Value	Average Precipitation (meters)	Average Annual Net Deep Flux[1] (meters)
Base Case Simulations				
LEP[2]	Lower Boundary Type	Head	0.1360	-0.0012
UEP[2]	Lower Boundary Type	Head	0.1372	0.2633
Sensitivity Simulations				
LEP	Osmotic Suction	30,000 KPa	0.1359	0.0200
LEP[3]	Osmotic Suction	120,000 KPa	0.1024	-0.0044
UEP	Osmotic Suction	30,000 KPa	0.1382	0.4343
UEP	Osmotic Suction	120,000 KPa	0.1396	0.0634
LEP[4]	Pan Factor	PF = 0.35	0.1372	0.0008
LEP[4]	Pan Factor	PF= 0.55	0.1371	0.0036
UEP	Pan Factor	PF = 0.35	0.1393	0.0799
UEP	Pan Factor	PF= 0.55	0.1373	0.1983
LEP	Storm Intensity	4-Hour Duration	0.1358	-0.0015
LEP	Storm Intensity	12-Hour Duration	0.1361	-0.0019
UEP	Storm Intensity	4-Hour Duration	0.1372	0.2633
UEP	Storm Intensity	12-Hour Duration	0.1382	0.2633
LEP	Lower Boundary Type	Gradient	0.1360	-0.0179
UEP	Lower Boundary Type	Gradient	0.1395	0.0083

Notes: [1]Negative values of deep flux indicate a downward net flux, positive values of deep flux indicate an upward net flux.
[2]Base-case simulation, presented here for comparison to sensitivity simulations
[3]Model was set to allow runoff for this simulation to improve numerical stability. Simulation was run for only 10 years because numerical stability problems.
[4]Model was set to allow runoff for this simulation to improve numerical stability.

SECTION 8.0
RADIOLOGICAL SURVEY RESULTS

8.1 Survey Results

A map of the Pond areas with the transect lines and radiological (gamma) survey results is shown in Figure 8-1. In general, the Ponds exhibited low gamma readings (i.e., less than 50 μR/hr) with the exception of the northwest corner of the UEP and the northern portion of the Thumb Pond. These areas of higher gamma readings are shown in Figure 8-2. The elevated readings in the Thumb Pond appear to correlate with red sediments that occur at, or very near, the surface where the VLT cap is thin or partially eroded. Higher gamma readings in the UEP were restricted to a thin strip along the west margin of the impoundment, and likely reflect the accumulation of 'red dust' (red sediments) from the Thumb Pond that have been transported by wind.

Lower gamma readings that are still elevated above the background values observed in the remaining Pond areas occur in the northwest sector of the UEP (Figure 8-2). This signature likely represents the sub-surface occurrence of red sediment, up to 12 inches thick, beneath the yellow sediments on the surface. As described in Section 3.1, these likely represent the oldest pond wastes that accumulated at the start of mining operations prior to segregation of waste types into separate Ponds.

FEPs 1-4 generally exhibited gamma readings below 50 μR/hr. A small section at the southern end of FEP-4, located directly west of the Thumb Pond and separated from the main portion of FEP-4 by a berm, exhibited elevated readings along the eastern edge and on the berm.

8.2 Conclusions

The majority of gamma levels measured in the Ponds (i.e., less than 50 μR/hr) are consistent with background readings at other Site locations. The northwestern corner of the UEP, especially along the northern portion of the western edge, contains elevated areas with gamma dose rates up to approximately 240 μR/hr. The edge of the UEP along this berm exhibited reading in the 100 to 250 µR/hr range. Broader areas extending out toward the center of the pond have dose rates ranging from 50 to 100 µR/hr, with limited areas between 100 to 150 µR/hr. Portions of the Thumb Pond where the VLT cap has been eroded and/or applied as a thin layer also exhibited elevated gamma radiation levels.

ARC recommends that a removal action for the elevated areas described above be performed (see Section 10.0). The most direct action would be to place a cap of VLT over the elevated areas of the UEP and add more VLT cap materials over portions of the Thumb Pond. A one-foot thick cap is expected to result in an eight-fold reduction in the gamma levels (e.g., a one-foot thick cap would reduce the maximum measured dose rate, 240 µR/hr, to approximately 30 µR/hr).

The radiological survey performed in October 2008 was performed to assist in the development of a removal action approach for the Ponds. As a part of the formal RI/FS process to determine a final remedy for the evaporation ponds (part of OU-4), additional radiological characterization activities would be performed in accordance with MARSSIM (EPA, 2000) requirements. ARC anticipates that subsequent radiological surveys in the Pond areas will satisfy MARSSIM requirements for a Final Status Survey (FSS) in areas not requiring further remediation. The FSS for areas requiring remediation would be performed after completion of the final remedy.

SECTION 9.0
UPDATED CONCEPTUAL MODEL

Physical and chemical elements of the conceptual model for the Ponds, presented in the RAC Work Plan, are updated in this section of the RAC DSR. Conceptual model information is presented for four periods: pre-mining, the Anaconda (1953-1978) and Arimetco (1988-1998) mining periods, and post-mining to the present. The conceptual model update for current condition of the Ponds is based on historic aerial photographs of the Site, and the field observations, analytical results and vadose model simulations summarized in previous sections of the RAC DSR. The updated conceptual model supports the recommended removal action, described in Section 10.0, and provides the basis for supplemental soil and groundwater investigations to be performed under a future remedial investigation for the Evaporation Ponds and Sulfide Tailings OU (groundwater investigations may also be implemented under the Site-Wide Groundwater OU).

Pre-Mining Period

Pre-mining conditions in the area of the future Anaconda evaporation ponds may be seen in the 1938 aerial photo (Figure 2-1), which includes an outline of the Site boundary for reference. Figure 2-1 shows dark-colored rectangular agricultural fields located within the northern Site boundary, coincident with the future oxide tailings area and the southern portion of the future finger ponds. An area of white-colored soils, located topographically below the agricultural fields (to the east in Figure 2-1), and extending north of the Site boundary along a north-northwest trend, is interpreted to represent evaporative deposits associated with agricultural tail water resulting from the flood irrigation of the fields. The white-soil area may represent an accumulation of salt deposits, and resembles a playa. Playas are common in Nevada, and are characterized by the upward flux of shallow groundwater to the atmosphere. Dark areas intermixed with the white soils likely represent standing or flowing agricultural tail water.

The white-colored soils are positioned in the area of the future Anaconda evaporation ponds and sulfide tailings (OU-4). The geometry and orientation of the white-colored soils indicates that the tail water filled a topographic low that trended north-northwest, close to the margin of the alluvial fan of the Singatse Range. The position and trend of the white-colored soils in the area of the northern Site boundary shown in the 1938 photo are coincident with the orientation of the 'wet' areas of the LEP and the SCS soil types (232, Delp Orizaba; 484, Orizaba Silty Clay Loam; and 121, Apian Loamy Sand) shown in Figure 2-7. In summary, soil conditions depicted in the 1938 photo indicate that soils underlying the future Pond areas had previously been impacted by agricultural activities prior to Anaconda mining operations.

Potential impacts of flood irrigation on soil and groundwater chemical conditions within the Walker River drainage basin are unknown. However, a study conducted by two scientists with the U.S. Geological Survey in the Carson Desert (i.e., the terminal hydrographic basin of the Carson River watershed) may provide an analogous conceptual model element, given that the two rivers: 1) originate in, and drain, adjacent and geologically similar portions of the Sierra Nevada; and 2) flow through geologically similar materials (e.g., volcanic and igneous rocks of the western portion of the Basin and Range, and associated alluvial fan and basin-fill materials). As such, ambient surface water quality conditions for the two rivers (i.e., not affected by anthropogenic activities) are expected to be similar.

An analysis of groundwater chemical conditions in the Carson Desert, resulting from the recharge of (largely agriculturally-impacted) Carson River water, was published by Welch and Lico (1998) in a paper entitled: *Factors controlling As and U in shallow ground water, southern Carson Desert, Nevada*. Elements of this study that may be applicable to the conceptual model for the pre-mining conditions in the area of the Ponds summarized as follows:

- Shallow groundwater in the southern Carson Desert (i.e., to a depth of 50 feet bgs) is divided into two areas: 1) aquifers beneath agricultural land, termed the 'lateral flow area'; and 2) groundwater in the 'upward flow area' (i.e., playa environments).

- The ultimate source of arsenic and uranium in shallow groundwater in the Carson Desert is the Carson River, which flows through basin fill sediments derived from volcanic and granitic sources rocks. Naturally occurring concentrations of these constituents are typically in excess of 100 micrograms per Liter (ug/L).
- Large differences in arsenic and uranium concentrations over small vertical and horizontal distances were observed in the Dodge Ranch lateral flow area of the Carson Desert (e.g., arsenic concentrations increased from 30 ug/L to more than 2,600 ug/L over a distance of less than 5,000 feet).
- Geochemical processes that affect groundwater chemistry in the shallow aquifer include evaporative concentration (evapotranspiration by plants and soil evaporation), redox and dissolution reactions and, to a lesser extent, adsorption.

The 1938 aerial photo (Figure 2-1) suggests that the soils and underlying shallow groundwater beneath the Pond areas prior to mining was subjected to recharge conditions and geochemical processes similar to those observed by Welch and Lico (1998) in the Carson Desert. The period of evapo-concentration of Walker River water cannot be quantified, but it is likely measured in decades, a very small fraction of the time (millions of years) that the Carson River flowed into the Carson Desert. Hydraulic and chemical conditions associated with the Ponds that resulted from the approximate 25-year Anaconda mining period are conceptualized to have resulted in more significant impacts to subjacent soils and groundwater, as described below.

<u>Anaconda Mining Period</u>

Figures 2-2, 2-3 and 2-4, respectively, provide a visual context for the construction and use of the Ponds. The following historical information for the Ponds has been reconstructed based on Site documents and aerial photos provided in Appendix A of the RAC Work Plan:

1952-53 Process Areas plant site was constructed; mining activities began with stripping of overburden and waste rock; first ore was delivered to the leaching plant.

1954 The UEP and portions of the current Sulfide Tailings area were used to evaporate spent solutions from the oxide vat leaching process (discharge point at the southern end of the current Sulfide Tailings area; solutions flowed by gravity to the low point in the area of the UEP). A berm/road constructed around the sides contained the pond solutions, of which the northern and western sides corresponded with the current margins of the UEP.

1965 The UEP was constructed to its current configuration, with the large pond area to the north and a small triangular pond at the southern tip (a berm along the eastern margin of the UEP separated spent oxide solutions from sulfide tailings). The Thumb Pond was in use (west and southwest margins of the UEP) to evaporate calcine flue dusts.

1967 No changes have occurred at the Unlined Evaporation Pond or the Thumb Pond.

1974-77 The UEP and Thumb Pond remained in service; the LEP and FEPs were constructed.

As described in the updated conceptual Site Model (CSM, Revision 3; Brown and Caldwell and Integral Consulting, Inc., 2009), oxide ores were processed in the Vat Leach Tanks by circulating acidic leach solutions within the tanks. Each tank had a capacity to hold approximately 12,000 dry tons of ore and 800,000 gallons of solution when filled to within 6 inches from the top. The vats typically operated on a 96-hour (5-day) or 120-hour (6-day) leaching cycle, with an additional 32 to 40 hour wash period, and 24 hours required to excavate and refill. The entire cycle required approximately 8 days, therefore 8 leach vats were installed and used to maximize efficiency (U.S. Bureau of Mines, 1958).

Once the ore was bedded into the tanks, sulfuric acid leach solutions were added to cover the ore. The initial concentration of acid during this conditioning period was 20 to 30 grams per liter (g/l) H_2SO_4, which was re-circulated through the tanks for three or more hours by drawing it off the bottom and air-lifting it to the top of the tank until the acid content dropped to less than 2 g/l. After leaching, the ore underwent three wash cycles which used primarily discharge water from the Peabody scrubber in the Acid Plant as well as fresh water from the supply well and final leach drain water. Approximately 1.4 million gallons of water were used per day for leach wash water (Anaconda Company, 1954).

Conceptually, the spent process solutions that were discharged to the area of the future Sulfide Tailings impoundment and the future Ponds, and subsequently to the Ponds themselves, would have been subject to a condition of constant standing water, as shown in Figure 2-4 (1977 aerial photo of the Ponds). This condition would have resulted in the infiltration of the solutions to the underlying shallow alluvial aquifer, less the amount that would have been evaporated.

Evaporation of the solutions would not have been significant during winter months, and the chemistry (i.e., high salt content) of the solutions would have limited evaporation rates (relative to fresh water) from the discharge areas and the Ponds.

Given the estimated discharge rate of leach wash water, up to 1,000 gallons per minute (gpm), percolation of the process solutions and the mounding effect would have created a groundwater mound and affected groundwater flow in the northern portion of the Site. In addition, given the chemical character of the solutions (i.e., acidic with elevated concentrations of sulfate, metals and radiochemicals), the spent ore solutions would have chemically affected the underlying soils and shallow groundwater. Although the precise nature and extent of these hydraulic and chemical effects are unknown, the following information supports an initial conceptual model of the resulting soil and groundwater impacts.

Soil Impacts

Chemicals with median concentrations that exceed background concentration limits (Sub-area A1 from the revised Background Soils Data Summary Report; Brown and Caldwell, 2009a) found in soils beneath the Ponds include arsenic, copper, iron, mercury, molybdenum, selenium, thallium and uranium. Locally, other chemicals found in elevated concentrations in Pond sediments occur in concentrations that exceed background concentration limits. The occurrence of chemicals with median values that exceed the statistically calculated background concentration limits in soils underlying the Ponds is summarized below:

Arsenic - The background concentration limit for arsenic is 13 mg/kg. The median value of arsenic in soils under the LEP is 15 mg/kg, 37 mg/kg for soils under the UEP, 6.8 mg/kg for soils under FEPs 1-4, and 86 mg/kg for soils under the Thumb Pond (Figure 3-2).

Copper - The background concentration limit for copper is 58 mg/kg. The median value of copper in soils under the LEP is 190 mg/kg, 110 mg/kg for soils beneath the UEP, 41 mg/kg for soils beneath FEPs 1-4 and 44/mg/kg beneath the Thumb Pond (Figure 3-3).

Iron - The background concentration limit for iron is 19,502 mg/kg. The median value of soils underlying the LEP is 25,000 mg/kg, 32,000 mg/kg for soils under the UEP, 26,000 mg/kg for soils beneath FEPs 1-4, and 17,000 mg/kg for soils beneath the Thumb Pond (Figure 3-4).

Mercury - The background concentration limit for mercury is 0.031 mg/kg. The median value of mercury in soils under the UEP is 0.085 mg/kg, and 0.19 mg/kg for soils under the Thumb Pond

(Figure 3-5). The median values of mercury in soils under the LEP and FEPs 1-4 are unknown because of the large number of mercury results reported as below laboratory detection limits. The average value for mercury under the LEP is 0.08 mg/kg.

Molybdenum - The background concentration limit for molybdenum is 1.7 mg/kg. The median value of molybdenum in soils under the LEP is 3.1 mg/kg, 3.7 mg/kg for soils under the UEP, 1.2 mg/kg for soils under the FEPs, and 1.6 for soils under the Thumb Pond (Figure 3-6).

Selenium - The background concentration limit for selenium is 0.8 mg/kg. The median value of selenium under the UEP is 1.2 mg/kg, 0.84 mg/kg in soils under the LEP, and 7.9 mg/kg in soils under the Thumb Pond (Figure 3-8). Selenium in soils beneath the FEPs was not detected.

Thallium - The background concentration limit for thallium is 0.61 mg/kg. The median value of thallium is 0.55 mg/kg in soils beneath the LEP, 1.7 mg/kg in soils beneath the UEP and 17 mg/kg in soils beneath the Thumb Pond (Figure 3-9). The average thallium concentration in soils beneath the FEPs is 0.7 mg/kg.

Uranium - The background concentration limit for uranium is 2.9 mg/kg. The median value of uranium in soils underlying the LEP is 8.32 mg/kg, 7.08 mg/kg in soils beneath the UEP, 3.95 mg/kg in soils beneath FEPs 1-4, and 30.4 mg/kg in soils beneath the Thumb Pond (Figure 3-10).

Groundwater Impacts

In general, as described in Section 4.0 and illustrated in Figures 4-1 through 4-23, shallow groundwater beneath the Pond areas exhibits chemical concentrations that exceed MCLs and preliminary background values for sulfate and uranium (Table 6-1 in the *Second-Step Hydrogeologic Framework Assessment Data Summary Report*; Brown and Caldwell, 2008b). Based on groundwater data collected to date from monitor wells located on the Site, and at off-Site locations (summarized in the *2008 Annual Groundwater Monitoring Report* dated February 19, 2009; Brown and Caldwell, 2009b), the shallow hydrostratigraphic zone of the alluvial aquifer beneath the Ponds, particularly the UEP, exhibits the highest observed concentrations of chemicals within the boundaries of the Site.

Arimetco Mining Period

Given that the groundwater chemistry beneath the UEP appears to include the signature of Arimetco heap fluids, and that the Arimetco Phase IV – VLT Heap Leach Pad and Pond (monitor well MW-5 area) are located immediately southwest of the UEP, it appears as if the VLT Heap and Pond facilities may have sourced chemicals to underlying soils and subjacent shallow groundwater. As described in the *Second-Step Hydrogeologic Framework Assessment Data Summary Report* (Brown and Caldwell, 2008b), determining the impacts from the VLT Heap and solution pond requires further investigations.

Post-Mining Period (to the Present)

The 1980 aerial photo (Figure 9-1; approximately two years after Anaconda operations ceased) indicates that: 1) the Sulfide Tailings, the Thumb Pond, and the FEPs were dry on the surface; and 2) the LEP and the northernmost portion of the UEP retained standing water (for the LEP, the extent of standing water was greater than the extent of the 'wet' areas shown in Figure 2-5). Conceptually, drying of the surface of the topographically higher portions of the LEP has continued, and the 'wet' areas have a maximum extent similar to the geometry represented in Figure 2-5. Because of the occurrence of seasonal 'wet' areas within the LEP, the hydraulic properties of wet vs. dry Pond sediments and underlying soils will differ.

The conceptual model for the Ponds under current conditions is illustrated in Figures 3-1 (material profiles and soil moisture content and saturation conditions for Pond solids and subjacent alluvial soils, with only one profile shown for the LEP) and 9-2 (updated on the basis of observed and modeled physical and chemical characteristics). Direct precipitation as rain or snow, or surface water run-on, will either directly infiltrate through the pond solids (primarily composed of precipitates from process solutions) or create standing water. Standing water in the LEP will remain on the surface until the water percolates or is evaporated. Standing water in the LEP 'wet' areas may persist during the fall, winter and spring when precipitation rates are high and evaporation rates are low. Pond sediments in the LEP 'wet' areas remain saturated throughout the year. Standing water does not occur in the UEP, FEPs or Thumb Pond.

Soil moisture will migrate either upward to the atmosphere or downward to the water table as a result of ambient atmospheric conditions, hydraulic pressure gradients and material properties (e.g., grain size distribution, degree of saturation, osmotic flux limits in salt crusts, and unsaturated hydraulic conductivity). As shown in Figure 9-2, based on vadose zone modeling described in Section 7.0: 1) the Thumb Pond and UEP exhibit an upward vertical flux of soil moisture to the atmosphere (i.e., no flux of soil moisture toward groundwater); and 2) the 'wet' areas of the LEP and FEPs 1-4 exhibit a downward flux of soil moisture toward the water table.

Model results for the dry (peripheral) portions of the LEP indicate: 1) a net evaporative flux to the atmosphere during the majority of the simulation period, resulting from lower precipitation rates; and 2) a downward flux of soil moisture during the latter third of the simulation period, resulting from wetter climate conditions. The estimated flux rates for the Ponds with a simulated downward migration of soil moisture to the water table are 3.2 and 0.3 centimeters per year (cm/year) for the 'wet' areas of the LEP and FEPs 1-4, respectively, based on cumulative flux rates for the 15-year simulation period.

The estimated flux rates described in Section 7.0, when integrated over the acreage values for these Ponds, result in the following annual estimated volumes of water that could potentially migrate to groundwater beneath the Ponds:

- Approximately 0.31 acre-feet per year (ac ft/yr) for the LEP 'dry' areas, based on an estimated flux rate of 0.0012 m/yr and an area of 79.5 acres, equivalent to 0.19 gpm;
- Approximately 1.13 ac ft/yr for the LEP 'wet' areas, based on an estimate flux rate of 0.016 m/yr and an area of 21.5 acres, equivalent to 0.70 gpm; and
- Approximately 0.15 ac ft/yr for FEP 1-4, based on an estimated flux rate of 0.0026 m/yr and an area of 17.8 acres, equivalent to 0.09 gpm.

The Pond sediment-soil profiles shown in Figure 3-1 represent the material properties at the time when the Ponds were sampled in October 2008, with some variations as described in Section 7.0. In addition to atmospheric conditions and material hydraulic properties, the direction and flux rate of soil moisture movement throughout the profiles can vary as a result of changes in the elevation of the water table. As presented in the hydrographs included in Appendix E of the *2008 Annual Groundwater Monitoring Report* (Brown and Caldwell, 2009b), the elevation of the water table responds to: 1) local seasonal fluctuations of up to four feet associated with groundwater irrigation pumping and the application of both surface and groundwater to the agricultural fields located to the east of the Ponds; and 2) longer-term climate trends that can result in multi-year upward and downward trends.

Figures 9-3 and 9-4, reproduced from Appendix E of the *2008 Annual Groundwater Monitoring Report*, illustrate the temporal response by the water table to seasonal influences in shallow zone groundwater monitor wells located between the agricultural fields and the Ponds and shallow zone wells located immediately northwest of the Ponds (specifically, well W5BB-S), respectively. The water table beneath the western portion of the Pond areas appears to fluctuate up to five feet in response to the seasonal build-up and dissipation of the groundwater mound and the effect of agricultural pumping (the eastern portion of the Pond areas exhibits less seasonal fluctuation). The long-term and seasonal variability of the water table elevation, and the monthly variability of evaporation and precipitation rates, can affect soil water responses in the vadose zone, as discussed in Section 7.0. The effect of a fluctuating water table boundary condition on potential vadose zone flux to groundwater cannot be quantitatively assessed at the present time because of lack of groundwater elevation data beneath the Ponds.

The vadose zone model simulations presented in Section 7.0 indicate: 1) the Thumb Pond and UEP are not current sources of chemicals to groundwater; and 2) the four FEPs and the LEP are potential sources of select chemicals to groundwater under existing conditions. These results should be considered preliminary because they are based on data from one borehole in the four FEPs (combined), data from one borehole in the Thumb Pond, three boreholes in the UEP, and three boreholes in the LEP.

As described in Section 5.0, select MWMP leachate chemical results (Table 5-1) are depicted in Figures 5-1 through 5-8 for the following metals and radiochemicals: arsenic, chromium, copper, iron, manganese, nickel, radium-226/228 and uranium. These chemicals are discussed below in the context of the Ponds (‘wet’ areas of the LEP and the four FEPs) with the potential to source chemicals to groundwater under current conditions, based on vadose zone simulations:

Arsenic - Arsenic (Figure 5-1) was not detected.

Chromium - Chromium (Figure 5-2) was detected in the OU4-LEP-01 sample ('wet' area in north cell of the LEP) and in the OU4-FEP-15 sample from the FEPs.

Copper - Copper (Figure 5-3) was detected in all three leachate samples from the LEP 'wet' areas and the FEP sample.

Iron - Iron (Figure 5-4) was detected in two of the three leachate samples from the LEP 'wet' areas and the FEP sample.

Manganese - Manganese (Figure 5-5) was detected in all three leachate samples from the LEP 'wet' areas and the FEP sample.

Nickel - Nickel (Figure 5-6) was detected in all three leachate samples from the LEP 'wet' areas and the FEP sample.

Uranium - Uranium (Figure 5-7) was detected in all three leachate samples from the LEP 'wet' areas and the FEP sample.

Radium-226/228 combined - was detected in two of the three leachate samples from the LEP 'wet' areas and the FEP sample.

The attenuation and release mechanisms that may be occurring within the vadose zone beneath the Ponds include: 1) sorption interactions with mineral or organic solids; 2) mineral precipitation and dissolution processes; 3) acid/base reactions; 4) redox reactions; and 5) complexation, in which the solubility of some chemicals can increase after forming a complex ion pair. The relative importance of each of these mechanisms in the soil profile underlying the Ponds is not quantifiable at the present time. However, if the Pond area soils are analogous to the soils in the Carson Desert (Welch and Lico, 1998), the same processes (i.e., evaporative concentration, redox and dissolution reactions and adsorption) may be controlling leachate chemistry and potential impacts to groundwater from the LEP and four FEPs.

An interpretation of past sources relative to existing groundwater conditions beneath the Ponds is beyond the scope of this RAC DSR. ARC anticipates that additional groundwater investigations associated with future remedial investigation work plans for the Evaporation Ponds and Sulfide Tailings (OU-4) and/or Site-Wide Groundwater (OU-1) will address the relationship between chemical sources and impacted groundwater beneath the Ponds.

SECTION 10.0
RECOMMENDATIONS

This section of the RAC DSR provides recommendations for the proposed removal actions for the Ponds and generalized supplemental soil and groundwater investigations in the Pond areas that may be performed under a future remedial investigation (RI) for the Evaporation Ponds and Sulfide Tailings Operable Unit (OU-4). Groundwater investigations may also be implemented under the Site-Wide Groundwater Operable Unit (OU-1).

Ponds Removal Action

The purpose of the removal action described in the AOC/SOW for the Ponds is to: 1) limit ponding of low pH, metalliferous water in the LEP; 2) limit the migration of dust from the UEP; and 3) improve the existing cap on the Thumb Pond. In addition, a small area (Sub-Area A) within the southern portion of the sulfide tailings will also be subject to the removal action under the AOC/SOW. As prescribed in the AOC/SOW, VLT materials be used from two borrow source areas located within the Oxide Tailings Area to fill and cap the Ponds and Sub-Area A based on the following rationale:

- proximity of the Oxide Tailings to the Pond areas, which will facilitate the construction schedule;
- past widespread use of VLT by Anaconda, Arimetco, NDEP and EPA from this source for interim response and removal actions on the Site (e.g., limiting fugitive dust from other pond and tailings source areas), and for the construction of berms and roads;
- limited leachability of chemicals from VLT materials, and the recognition that any potential leaching of constituents from the VLT will have little, if any, noticeable effect on soil chemistry and groundwater quality underlying the Ponds (previously impacted by past mining operations and, likely, by past agricultural operations);
- a preliminary assessment of VLT geotechnical properties indicates that VLT materials will allow soil moisture to be wicked into the atmosphere (the VLT grain size distribution curve from the existing Thumb Pond cap is provided in Appendix J); and
- radiometric surveys described in this DSR, and other surveys described in the *Radiological Data Compilation, Yerington Mine Site* (Brown and Caldwell, 2005b), indicate VLT gamma radiation levels that are considered background levels for the Site and off-Site areas, which will pose no human health risks to Site workers.

The estimated amount of VLT materials to be excavated and placed on the Ponds and Sub-Area A is approximately 644, 500 bank cubic yards (bcy), of which approximately 578,800 bcy will be used as cover materials and 65,700 bcy will be used as compacted road base. The LEP, UEP and Thumb Pond will require the majority of the VLT materials, which will be sourced from the North VLT Borrow Area. The anticipated 31,700 approximate bcy volume required to cover Sub-Area A will be excavated from the South VLT Borrow Area. VLT materials that currently exist as berms within the southern portion of the Sulfide Tailings Area will also be used to supplement materials from the South VLT Borrow Area to create or improve access roads, as appropriate. The following estimates of VLT materials will be used in the removal action:

- 265,000 bcy for the UEP;
- 243,000 bcy for the LEP;
- 39,000 bcy for the Thumb Pond; and
- 31,700 bcy for the Thumb Pond

Pursuant to the AOC/SOW, ARC will submit a *Draft Implementation Work Plan for Removal Action at the Evaporation Ponds* (Implementation Work Plan) that will contain an approximate 60 percent engineering design and associated information (e.g., updated schedule, supporting geotechnical information, and construction management and health and safety elements). The draft Implementation Work Plan will be submitted to EPA in early November 2009. As prescribed in the SOW, ARC will also submit interim and final reports to EPA that describe the construction and related activities for the removal action.

Subsequent Technical Investigations

ARC recommends that subsequent technical investigations for the Ponds be performed on the basis of the results presented in this RAC DSR and in accordance with DQOs developed as part of a future RI Work Plan for the Evaporation Ponds and Sulfide Tailings OU (OU-4), which would support a final remedy for the Ponds. Such investigations may include:

- Installation of groundwater monitor wells within the current footprint of the Ponds, and associated groundwater grab sampling and analysis (monitor wells in these areas may be installed as part of the OU-1 RI Work Plan for Site-wide groundwater).
- Performance (i.e., vadose zone) monitoring of Pond fill materials (VLT) and underlying Pond sediments and soils. Additional materials sampling and associated analysis of hydraulic properties, and vadose zone modeling, may also be performed.
- Assessment of human health and ecological risks associated with the Ponds.

ARC anticipates that the results of groundwater investigations in the area of the Ponds would be integrated with other Site-wide groundwater investigations. The future RI Work Plans for OU-4 and OU-1 will reflect this integration.

SECTION 11.0

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