-

The Oil Mining Company, Inc. (TomCo)

Utah Groundwater Discharge Permit Application

Holliday Block

Submitted by:

The Oil Mining Company, Inc.
TomCo Energy plc
50 Jermyn Street
London
SW1Y 6LX
United Kingdom

UK: +44 20 7097 1645
US: +1 801 833 0412

Deleted: 50 Jermyn Street¶
London¶
SW1Y 6LX¶
United Kingdom¶

To:
Utah Division of Water Quality
288 North 1460 West
Salt Lake City, UT 84114-4870

Prepared with the assistance of:
Lowham Walsh LLC / E & E, Inc.
7440 South Creek Road
Sandy, UT 84093

Date: December 3, 2014

TABLE OF CONTENTS

Tables

Figures

Appendices

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
AWAL	American West Analytical Laboratories
BAS	bentonite-amended soil
cm/sec	centimeters per second
CO2	carbon dioxide
CSS	Collection, Separation, and Storage
DOGM	Utah Division of Oil, Gas and Mining
DWQ	Utah Division of Water Quality
EPA	U.S. Environmental Protection Agency
EPS	Early Production System
gpm	gallons per minute
GPS	global positioning system
HELP	Hydrologic Evaluation of Landfill Performance
LMO	Notice of Intention to Conduct Large Mining Operations
MSE	mechanically stabilized earth
MW	Monitoring Well
NAICS	North American Industry Classification System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTNWS	Non-Transient Non-Community Water System
^{o}F	degrees Fahrenheit
pMC	percent modern carbon
psi	pounds per square inch

RLR	Red Leaf Resources
SDRI	sealed double ring infiltrometer
SIC	Standard Industrial Classification
SITLA	State of Utah School and Institutional Trust Lands Administration
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	semi-volatile organic compound
TomCo	The Oil Mining Company, Inc.
UAC	Utah Administrative Code
USGS	United States Geological Survey
VOC	volatile organic compounds

Certificates of Professional Engineers

This document was prepared by Lowham Walsh, LLC and Norwest Corp. utilizing design and processing information provided by Red Leaf Resources, Inc., and it is consistent with Red Leaf Resources' EPS capsule design. To fulfill the requirements of U.A.C. R317-6-6.3, this document was prepared under the direction, and bears the seals, of professional engineers as outlined on the following pages.

I, Thomas S. Norman, certify that the information presented in the following sections of this Utah Groundwater Discharge Permit Application for the Holliday Block submitted by The Oil Mining Company, Inc. (TomCo) are true and correct to the best of my knowledge and information.

PROFESSIONAL ENGINEER
12.5.14
No. 8656806
THOMAS S.
NORMAN
STATE OF UTAH

Section	Item	PE Review Date
0	Executive Summary	December 5, 2014
1	Administrative Information	December 5, 2014
2	Introduction	December 5, 2014
3	Background Information	December 5, 2014
4	Facility Classification and type	December 5, 2014
6	Issued and Pending Permits	December 5, 2014
7	Water Information	December 5, 2014
8	General Discharge information	December 5, 2014
9	Hydrology Report	December 5, 2014
11	Groundwater Discharge Control Plan	December 5, 2014
App C	Project Monitoring Wells and Coreholes	December 5, 2014
App D	Geophysical Log	December 5, 2014
App E	Monitor Well Laboratory Analytical Results	December 5, 2014
App F	Monitor Well Age Dating Calculations	December 5, 2014
App G	SPLP Leachate Analysis	December 5, 2014
App J	Monitoring Well Field Evaluation	December 5, 2014
App K	Geologic Evaluation of TomCo and Red Leaf Properties	December 5, 2014

Thomas Norman, P.E. – Utah P.E. No.8656806-2202

NORWEST CORPORATION

I, Craig J. Hawe, certify that all the information presented in the following sections of this Ground Water Discharge Permit Application are true and correct to the best of my knowledge and information.

Section	Item	PE Review Date
5.2	Early Production System Capsule	12/02/2014
Figure 5.1	EPS Site Plan	12/02/2014
Figure 5.4	EPS Capsule Life Cycle – Section for South to North	12/02/2014
Figure 5.5	EPS Capsule Life Cycle – Section for West to East	12/02/2014
Figure 5.7	Functional Equivalents to Base Case Design – Capsule Roof, Walls and Floor Details	12/02/2014
Figure 5.8	Tunnel and Bulkhead Sealing	12/02/2014
Section 10	Construction Quality Control Plan	12/02/2014
Appendix I	Additional EPS Information	12/02/2014

REGISTERED PROFESSIONAL ENGINEER
NO. 0871709110
CRAIG J. HAWE
STATE OF UTAH

12/2/14

Craig J. Hawe, P.S.E. – Utah P.E. No.175858-2203

NORWEST CORPORATION

I, Paul Kos, certify that all the information presented in the following sections of this Ground Water Discharge Permit Application are true and correct to the best of my knowledge and information.

Section	**Item**	**PE Review Date**
12	Reclamation and Closure Evaluation	December 3, 2014
App A	Early Production System Storm Water Drainage Plan	November 17, 2014
App H	Reclamation Cover Performance Modeling	December 3, 2014

Paul J. Kos, P.E. - Utah P.E. No. 8548614-2202

NORWEST
CORPORATION

Certificate of Engineer

I, Sekhar Bhattacharyya, went through all the information presented in the following sections of this Groundwater Discharge Permit Application and certify the contents as true and correct to the best of my understanding and information.

Section	**Item**	**PE Review Date**
Section 5.1	General Operation Description	12/2/2014
Section 5.3	Functionally Equivalent Alternatives to the BAS Containment and Confinement	12/2/2014
Section 5.4	Post Cooling Spent Shale Characterization	12/2/2014
Section 5.5	Capsule Basal Containment Monitoring	12/2/2014
Section 5.6	Reclamation	12/2/2014
Section 13	Compliance Monitoring Plan	12/2/2014

UTAH REGISTERED PROFESSIONAL ENGINEER
#8887624-2202
Sekhar Bhattacharyya

Sekhar
12-5-14

Sekhar Bhattacharyya, P.E. - Utah P.E. No. 8887624-2202

Executive Summary

This Utah Groundwater Discharge Permit Application (GWDPA) prepared by The Oil Mining Company, Inc. (TomCo) is for a single retort capsule, termed the Early Productions System (EPS) capsule. The EPS capsule will be a stand-alone capsule approximately three-fourths the size of a full scale commercial capsule. TomCo plans to simultaneously mine oil shale and construct the EPS for extracting oil on approximately 1,186 acres of land leased from the State of Utah School and Institutional Trust Lands Administration (SITLA; mineral lease ML-49571). TomCo has entered into a licensing agreement with Red Leaf Resources to use their EcoShale™ In-Capsule Technology, a proven method for extracting petroleum from oil shale. The EcoShale™ process involves placing ore in sealed capsules, heating the encapsulated ore, and extracting liquid hydrocarbons via a pipe and tank storage system. The capsules' design is intended to prevent impacts to groundwater and the surrounding ecosystem by utilizing an impermeable liner of bentonite amended soil (BAS). The EPS has been designed so that the functionality and effectiveness of its key components can be further evaluated and modified to maximize performance for future use in full scale operations. TomCo's EPS capsule design as presented in this GWDPA is consistent with Red Leaf Resources' EPS capsule design as presented in its Construction Permit, issued by Utah Division of Water Quality on May 30, 2014.

TomCo has conducted a number of studies in support of its future mining plans and this GWDPA. As part of site specific geologic and hydrology studies, TomCo drilled nine coreholes in 2010 into the Mahogany Zone of the Parachute Creek Member, which is the principal ore zone. The Parachute Creek and Douglas Creek Members of the Green River Formation are also significant geologic units at the project area; they control hydrology and consequently are important to site development. The Mahogany Zone has very low permeability. It is closest to the surface in the southern portion of TomCo's project area and deepest in the northeast corner. Corehole results found that the Mahogany Zone itself was very tight and did not appear to be water bearing, though several sandstone lenses above and below the Mahogany Zone were recognized in the cores. However, there did not appear to be a correlation between the apparent sandstones and the occurrence of groundwater.

In fall 2013, a groundwater investigation was conducted at the site to assess hydrologic conditions. The groundwater program consisted of three monitoring wells drilled and installed to depths of 200 feet below ground surface in the Parachute Creek Member at locations where groundwater shows occurred in coreholes. Additionally, one monitoring well was drilled and installed at a depth of 1,100 feet below ground surface in the Douglas Creek Member. The groundwater characterization program included packer production tests to determine well pumping productivities and groundwater samples to determine levels of metals, organics, and other constituents.

Productivity of the shallower wells screened in the Parachute Creek Member was very poor. Multiple production and packer tests were performed on the wells, and none were able to sustain production rates of 1 gallon per minute. By contrast, the deeper well drilled into the Douglas Creek Member produced water at a sustained rate of 20 gallons per minute at a depth of approximately 920 feet below ground surface.

Monitoring well water quality for wells screened in the Parachute Creek Member was poor compared to the deeper well screened in the Douglas Creek Member. A comparison of parameter concentrations between the shallower wells and the deep well shows a number of distinct differences, with constituent levels in water from the Parachute Creek Member exceeding a number of Utah Groundwater Quality standards, resulting in a Limited Use (Class III) classification. Water from the Douglas Creek Member did not exceed any water quality standards, and age dating of this water yielded potential ages between 7,600 and 15,200 years before present.

The main purpose of the GWDPA is to determine the potential impact of TomCo's project on groundwater at the site. Based on the above information and other studies described in this GWDPA, the likelihood of any contaminants impacting the Douglas Creek Aquifer from mining activity in the Mahogany Zone appears extremely remote. Geologic studies indicate significant vertical separation, 350 to 400 feet between the mining horizon and the Douglas Creek Aquifer. As evidenced by cuttings and borehole geophysics obtained from the monitoring well in the Douglas Creek Aquifer, sedimentary rocks between the two zones appear to be impermeable shales and marlstones. The impermeability of this layer is further supported by groundwater studies that, based on differences in constituent levels between wells screened in the Parachute and Douglas Creek Members, suggest that there is no hydrologic communication between these two zones. Equally as important as site geology, the EPS has been designed to minimize infiltration of water into the capsule, reduce the probability of spent shale coming into contact with outside water, and contain the entire retort process within the EPS, thereby substantially reducing the potential for groundwater and other ecological impacts. Spent shale leachate analyses were completed on three samples taken from Red Leaf Resources' preliminary test capsules, which processed ore that shares the same geological characteristics as found at the TomCo site (see **Appendix K**). Of the over 30 parameters tested that have groundwater standards associated with them, only antimony (Sb) showed levels that were slightly higher than groundwater standards. However, antimony levels naturally exceeded groundwater quality standards in samples taken from two of the four groundwater monitoring wells located within the TomCo project area (see **Section 9.3.2**). Likewise, Red Leaf Resources' Synthetic Precipitation Leaching Procedure extract had a pH of about 10, which was similar to the background pH measured at TomCo's monitoring wells (Red Leaf Resources 2013). However, similar tests will be run on spent shale from the TomCo EPS capsule to further evaluate this material when it becomes available for testing,

1 Administrative Information

Applicant Name, Mailing Address, Telephone Number, Contact Information, Designated Agent:

The Oil Mining Company, Inc.:
UK Address: 50 Jermyn St.
London, England SW1Y 6LX
United Kingdom
UK: +44 20 7097 1645
US: +1 801 833 0412

Authorized Utah Agent:

Ron Vance
1656 Reunion Ave. Suite 250
West Jordan, UT 84095
801-466-8802

Lead Consultant:

Lowham Walsh Engineering & Environmental Services
7440 S. Creek Rd. – Suite 400
Sandy, Utah 84093
1-801-561-1036

Facility Legal Location

The project area is located in Uintah County, Utah, in Township 12 South, Range 24 East, and includes the entirety of Section 13 and portions of Sections 11, 12, and 14. The Oil Mining Company, Inc. (TomCo) has leased approximately 1,186 acres (an area called the "Holliday

Block") from the State of Utah School and Institutional Trust Lands Administration (SITLA) as mineral lease ML-49571.

Owner and Operator Information

TomCo is the applicant, owner, and operator for the facility described in this application. TomCo is a Utah Incorporated Company and is 100 percent owned by TomCo Energy, plc. Further information may be found at: **http://www.tomcoenergy.uk.com//**

Facility and Contact Information

Holliday Block Mine Project
TomCo Energy, Plc
50 miles southeast of Vernal, UT
There is currently no staff on site.

2 Introduction

TomCo holds an oil shale mineral lease on 1,186 acres on SITLA (SITLA mineral lease ML-49571) lands in the Uinta Basin, Utah. TomCo plans to simultaneously mine oil shale and create an Early Production System (EPS) retort capsule for extracting oil at this site. TomCo has entered into a licensing agreement with Red Leaf Resources (RLR) to use its EcoShale™ In-Capsule Technology for this process. The EcoShale™ In-Capsule Technology uses heat to extract kerogen from oil shale as gases and liquids. As part of the extraction process, the shale will be encapsulated, left in place, and the disturbance area reclaimed, with no impact to surface or groundwater resources.

The project area is located in Uintah County, Utah, in Township 12 South, Range 24 East, and includes the entirety of Section 13 and portions of Sections 11, 12, and 14 (**Figure 2-1).** The project area is approximately 30 road miles south of Bonanza, Utah. It is accessed via State Route 45, the Dragon Road, and Kings Well Road.

While commercial-scale operations are expected to occur at this site in the future, this GWDPA is for a single EPS capsule only. The EPS capsule has been designed so that the functionality and effectiveness of its key components can be further evaluated and modified to maximize performance for future use in full scale operations. TomCo's design as presented in this GWDPA is consistent with Red Leaf Resources' final design as presented in its Construction Permit, issued by the Utah Division of Water Quality (DWQ) on May 30, 2014.

The general details of the EPS capsule are included in the GWDPA for reference purposes. The construction details are provided in the construction permit application, and the construction permit application is included as a reference. Any changes to the construction permit application will be considered part of this application. The Professional Engineering seal of this document pertains to the groundwater monitoring aspects of the GWDPA and not to the constructability and controls of the EPS Capsule.

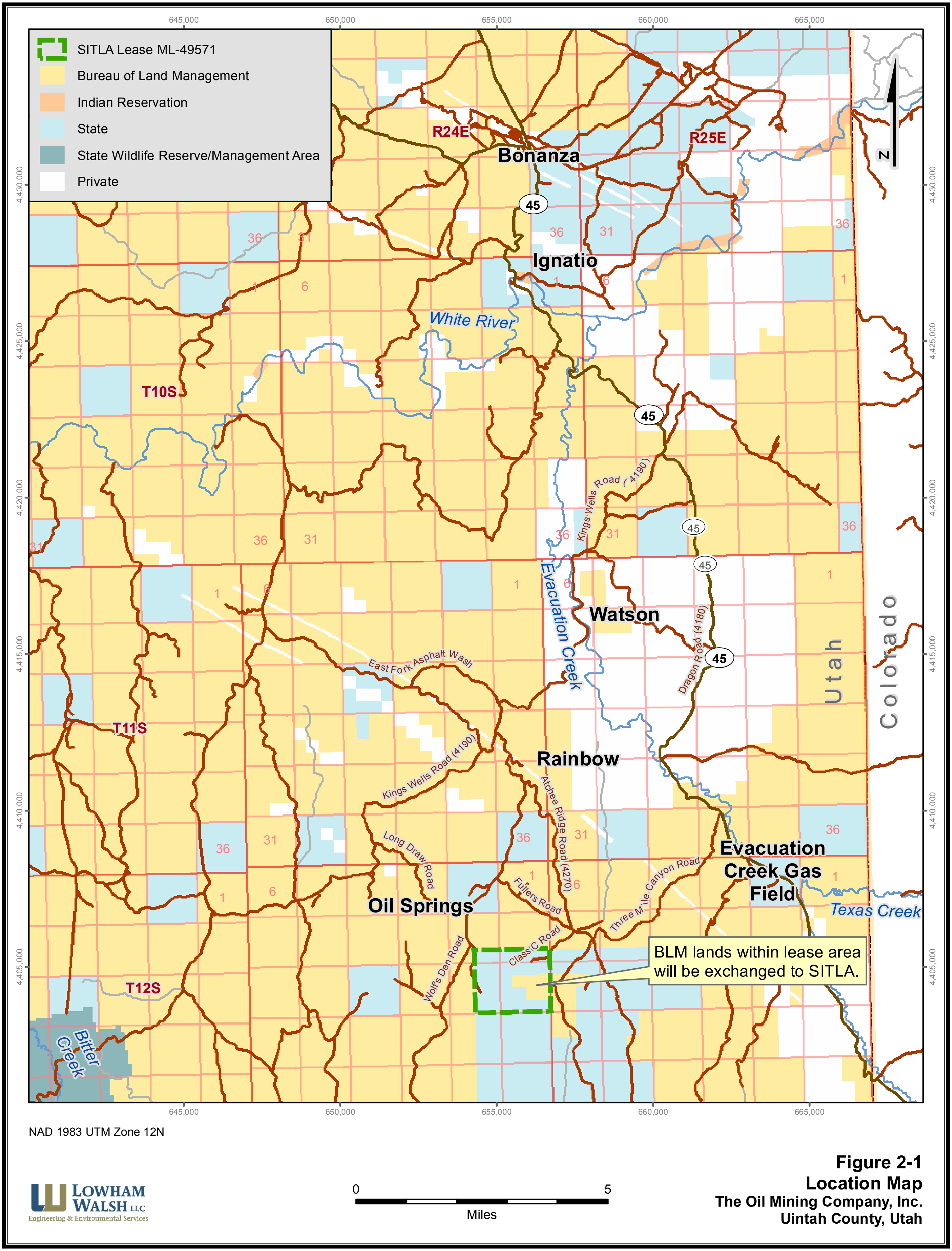


Figure 2-1
Location Map
The Oil Mining Company, Inc.
Uintah County, Utah

3 BACKGROUND INFORMATION

As noted above, TomCo has a contractual agreement with RLR to use this firm's technology in its mining and processing operation. In February 2007, RLR provisionally filed its first set of technology patent applications for the EcoShale™ In-Capsule Technology; this provisional filing was modified to a full patent application filing in February 2008. RLR has filed additional technology and development patent applications, including three U.S. two published patents and 13 other patents under development.

TomCo's agreement with RLR allows the company to receive updates to the technologies used at RLR's facility on Seep Ridge Road (the Southwest #1 Project, M/047/0120). RLR has been in continuous operation since 2008 testing capsules of the EcoShale™ In-Capsule Process through its Small Mining Operation, S/047/0102, and shares results of tests and studies with TomCo.

4 FACILITY CLASSIFICATION AND TYPE

4.1 Facility Classification

The mine will be a large mine operation, permitted by the Utah Division of Oil, Gas and Mining (DOGM).

4.2 Type of Facility

The facility will be an oil shale production operation to extract kerogen from mined oil shale ore. It will include equipment maintenance, laboratory support facilities, and ancillary facilities, as necessary.

4.3 SIC/NAICS Codes

The Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes that describe the proposed facility are 1311 (SIC) and 211111 (NAICS) for petroleum extraction, production, and oil shale mining and beneficiating.

4.4 Project Facility Life

The initial life of mining operations for EPS capsule construction, operation, and reclamation is two years.

5 TOMCO OIL SHALE MINE AND OPERATION DESCRIPTION

In support of developing full-scale mining and oil-production operations, the phase of the project covered by this GWDPA is for a single EPS capsule. It will be approximately 75 percent of the size of the full commercial scale capsules. The location of the EPS capsule and related facilities is shown on **Figure 5-1**.

5.1 General Operation Description

The EcoShale™ In-Capsule Technology uses heat to extract kerogen from oil shale deposits to produce crude oil. The operation is designed to maximize resource recovery and accommodate construction of "capsules" designed for low temperature heating of the shale to extract the hydrocarbons as gases and liquids. All mined materials are utilized completely and play a role in the technology for capsule construction, hydrocarbon extraction, and reclamation.

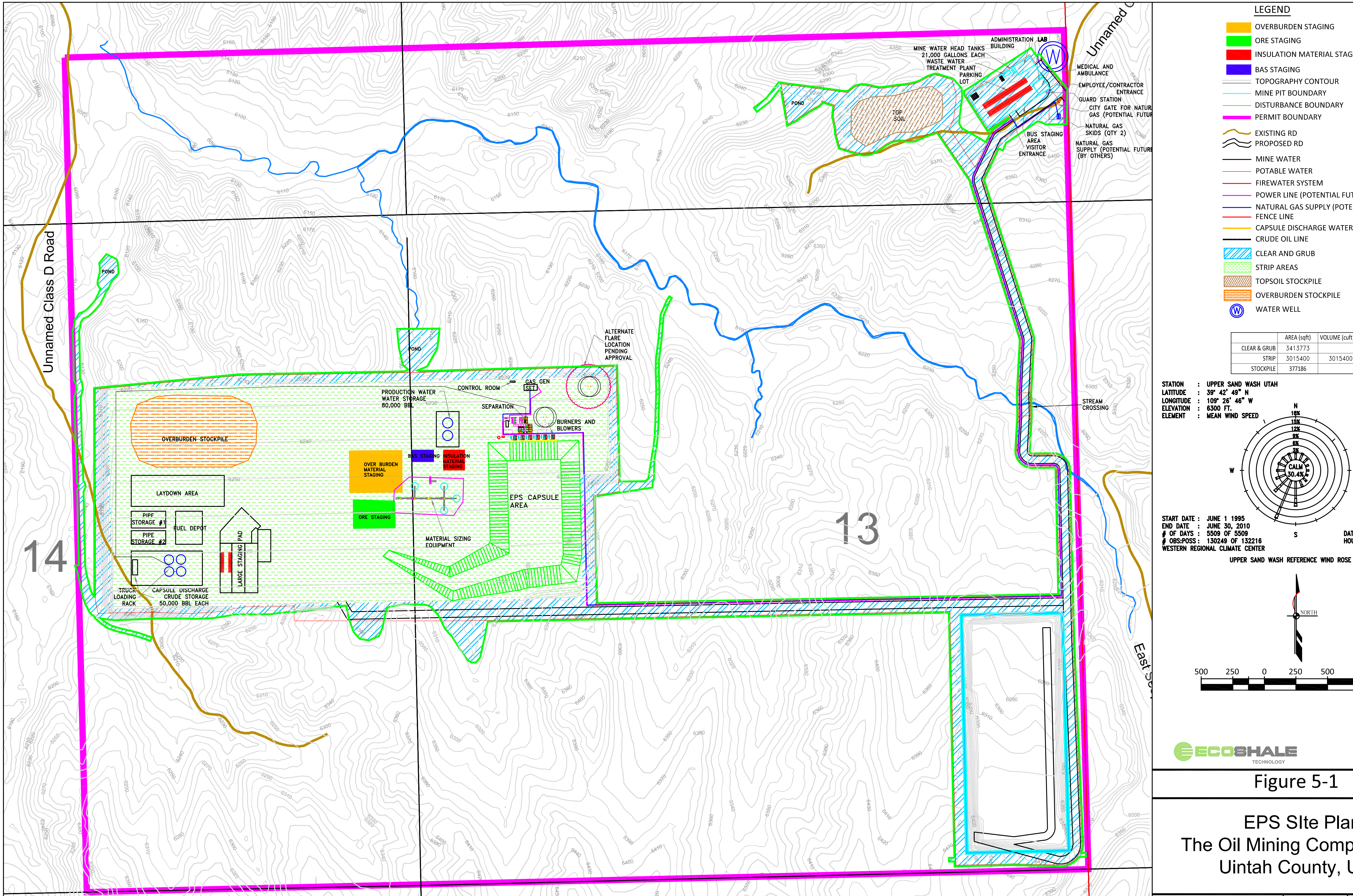
Mining will be required to produce materials necessary to create the EPS capsule. The mining sequence will consist of the following operations:

- Construction of sediment control measures;
- Land clearing (where required);
- Soil removal and stockpiling;
- Pre-stripping of unconsolidated overburden (when required);
- Drilling and blasting of overburden;
- Overburden removal;
- Overburden loading, hauling, and screening;

- Drilling and blasting of ore and interburden;
- Ore and interburden loading, hauling, and screening;
- Selective use of screened materials in construction of capsule;
- Heating and oil recovery;
- Final grading; and
- Soil placement and revegetation.

Mining will take place in Section 13, T12S R24E. The mine pit will be located in the southeast 1/4 Section 13, while the capsule will be placed in the west 1/2 Section 13 and the east 1/2 Section 14, T12S, R24E. Topsoil will be salvaged and carefully stockpiled from all areas to be disturbed and will be used during the reclamation phase. **Figure 5-1** shows where disturbance will occur and where major construction components will be located. **Figure 5-2** shows cross-sections of the capsules and of the topography pre-construction, during EPS testing, and after reclamation.

The watershed in which the project area is located is shown in **Figure 5-3**. A water management plan has been developed to manage potential surface water inflows and outflows (**Appendix A**). Two clean water collection and diversion ditches will be installed prior to any development to divert upland runoff around the project area. This system will be designed to carry flows from a 100-year, 24-hour storm event. Water intercepted by mining-related disturbance will be managed by storing water on site, using berms and sumps to provide source control and limit the migration of any pollutants around the site. If high flows occur, water will be directed to engineered ditches and ponds, where it will be stored and be used for BAS production and dust control, or will be stored until it evaporates. These ditches have been designed to carry runoff flows resulting from a 10-year, 24-hour event, as explained further in the Drainage Design Plan (Norwest 2014), attached as **Appendix A**. The ditch and sump locations are shown on **Figure A** of the Drainage Design Plan. TomCo plans to use water collected in the sumps for its operations to supplement other water resources at the site. TomCo maintains a water lease option agreement for 1,000 acre feet of surface water with the Uintah Water Conservancy District for this purpose.



NOT FOR CONSTRUCTION

C:\PROJECTS\228-7 TomCo Support\GWDP Application\Nov 2014\Figure 5-1 EPS Site Plan_jds_rev01.dwg

THIS IS AN "ANSI D" SIZE DRAWING. IF PRINTED AT ANY OTHER SIZE THIS DRAWING IS NOT TO SCALE.

LEGEND

- OVERBURDEN STAGING
- ORE STAGING
- INSULATION MATERIAL STAGING
- BAS STAGING
- TOPOGRAPHY CONTOUR
- MINE PIT BOUNDARY
- DISTURBANCE BOUNDARY
- PERMIT BOUNDARY
- EXISTING RD
- PROPOSED RD
- MINE WATER
- POTABLE WATER
- FIREWATER SYSTEM
- POWER LINE (POTENTIAL FUTURE)
- NATURAL GAS SUPPLY (POTENTIAL FUTURE)
- FENCE LINE
- CAPSULE DISCHARGE WATER
- CRUDE OIL LINE
- CLEAR AND GRUB
- STRIP AREAS
- TOPSOIL STOCKPILE
- OVERBURDEN STOCKPILE
- WATER WELL

	AREA (sqft)	VOLUME (cuft)
CLEAR & GRUB	3413773	
STRIP	3015400	3015400
STOCKPILE	377186	

STATION : UPPER SAND WASH UTAH
LATITUDE : 39° 42' 49" N
LONGITUDE : 109° 26' 46" W
ELEVATION : 6300 FT.
ELEMENT : MEAN WIND SPEED

START DATE : JUNE 1 1995
END DATE : JUNE 30, 2010
OF DAYS : 5509 OF 5509
OBS/POSS : 130249 OF 132216
WESTERN REGIONAL CLIMATE CENTER

SUB-INTERVAL WINDOWS

	START	END
DATE:	JAN. 01	DEC. 31
HOUR:	00	23

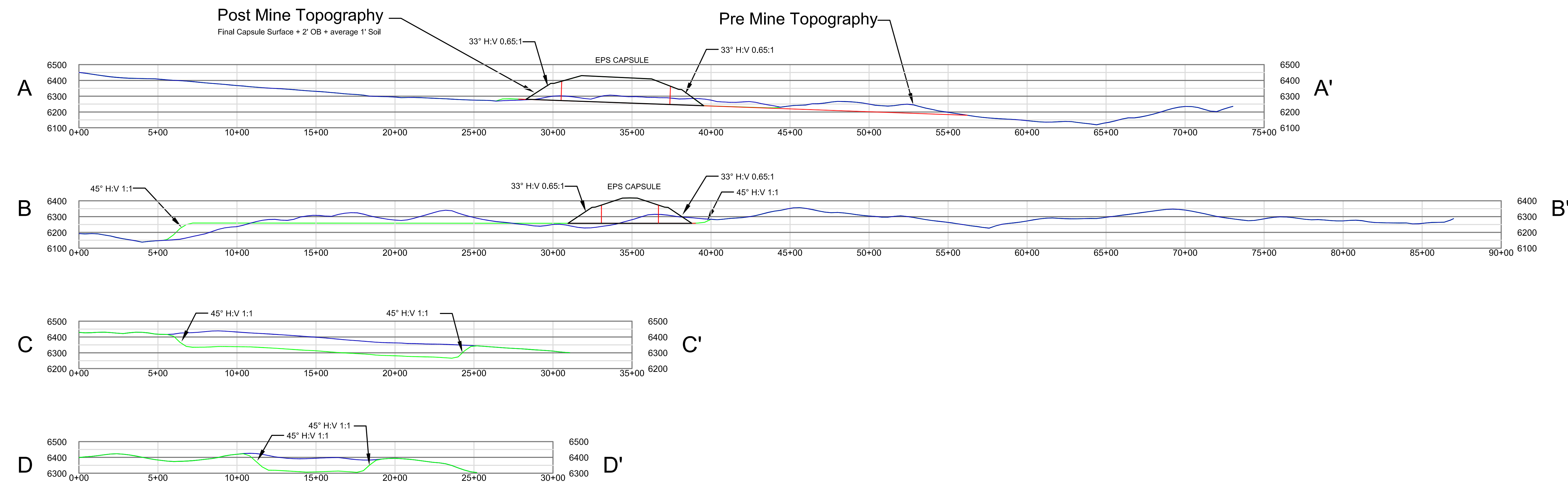
UPPER SAND WASH REFERENCE WIND ROSE

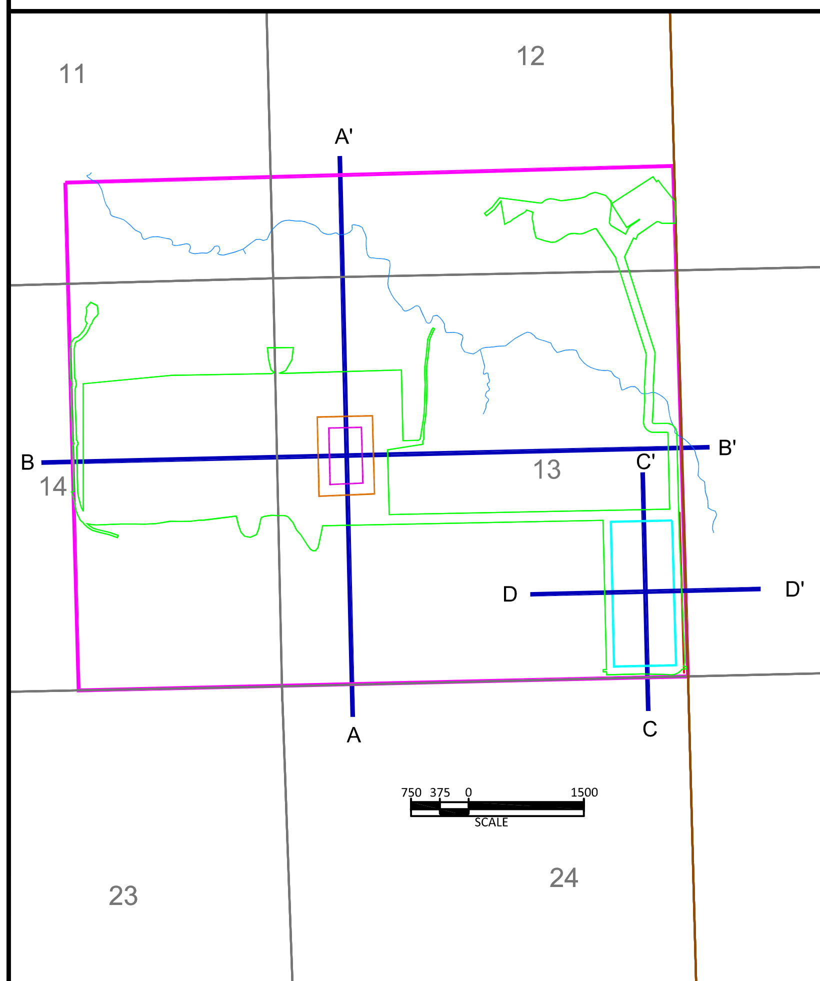
ECOSHALE TECHNOLOGY

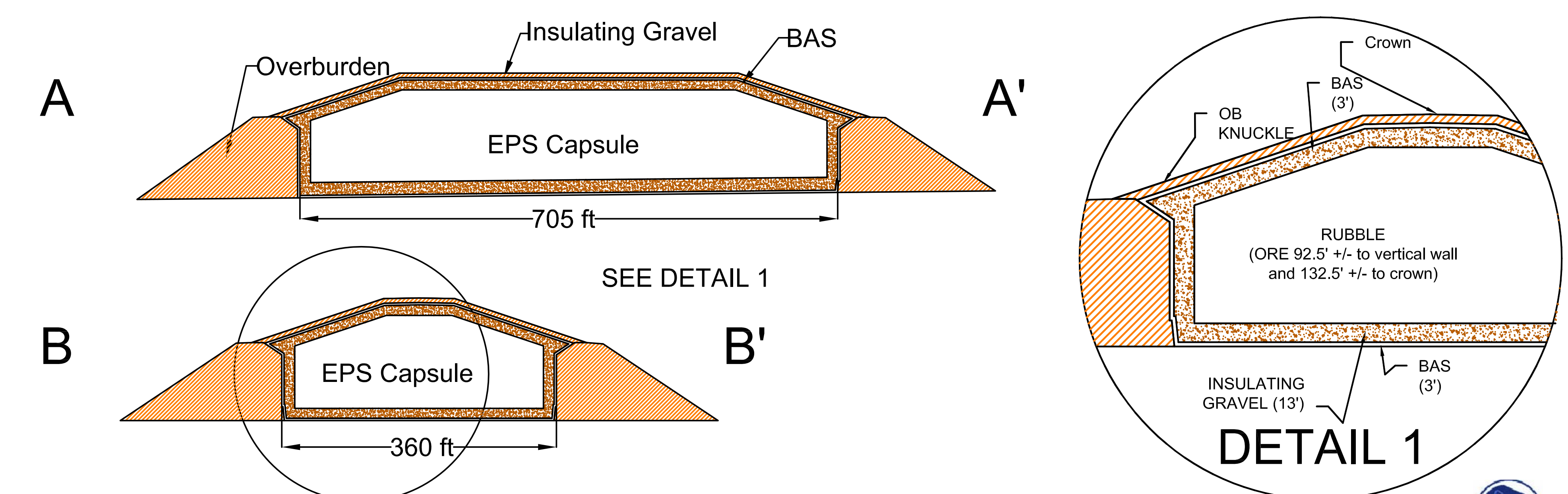
Figure 5-1

EPS SIte Plan
The Oil Mining Company, Inc.
Uintah County, Utah

DATE: 11/26/2014
FILE: TomCo PMT Sections.dwg
SCALE: AS NOTED
NORWEST CORPORATION







LEGEND

- EPS Capsule Crest Boundary
- EPS Capsule Toe Boundary
- The Oil Mining Company Lease Boundary
- Mine Pit Boundary
- EPS Disturbance Boundary
- Cross Section Line

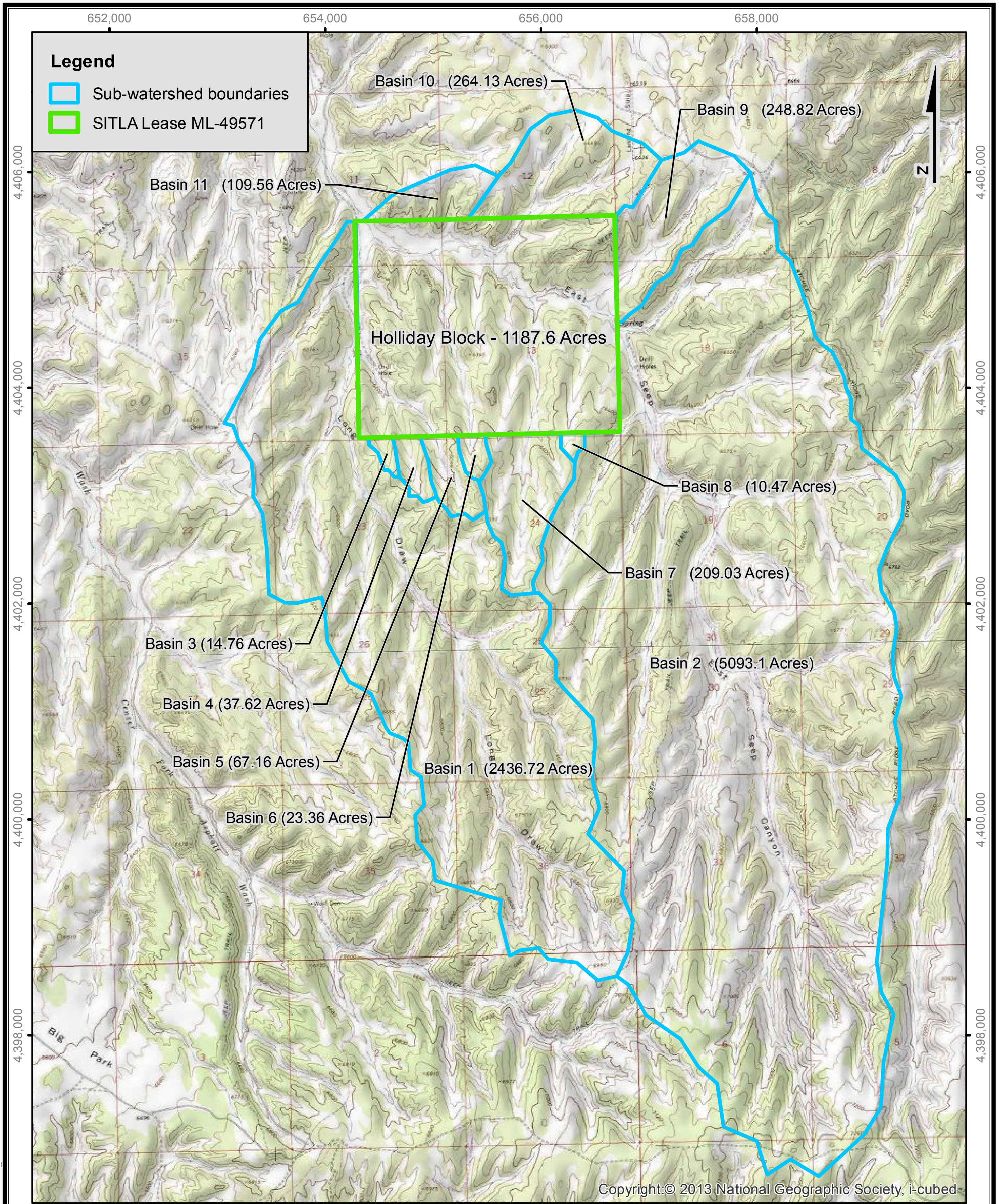
N

NOT FOR CONSTRUCTION

FIGURE 5-2

Post Mine Topography Cross-Sections
(Stacked Capsules)
The Oil Mining Company, Inc.
Uintah County, Utah

DATE: 11/06/2014	SCALE:	NORWEST CORPORATION
FILE: Tomco PMT Section.dwg	NOTED	



U:\Projects\LO000080_TomCoLMO\OMC_Watersheds.mxd 07 Feb 2014

NAD 1983 UTM Zone 12N
USGS Topographic Base

LOWHAM WALSH LLC
Engineering & Environmental Services

0 4,000
Feet

Figure 5-3
Watersheds
The Oil Mining Company, Inc.
Uintah County, Utah

5.2 Early Production System Capsule

This section describes the design of the EPS capsule to be used for this project. The portion of this description that consists of proprietary information is provided in **Appendix I** and is clearly marked confidential business information. TomCo requests that **Appendix I** in its entirety be maintained as confidential applicant material in accordance with the DWQ's rules and policies. **Appendix I** is provided under separate cover.

Deleted: Utah Division of Water Quality's (

Deleted:)

Ore material and a portion of the overburden needed to construct the EPS capsule will be excavated from a pit to be located in the southeast corner of the project area. Additional overburden needed to complete capsule construction and construct a work surface for associated activities will be excavated from the EPS capsule pad area located in the western half of the project area **(Figure 5-1).** The EPS capsule location will slope approximately 3 degrees to the north toward the Collection, Separation, and Storage (CSS) plant.

When first constructed, the EPS capsule will be approximately 360 feet wide, 705 feet long, and 115 feet high at the capsule edge and approximately 167 feet high at the top of the capsule crown. **Figures 5-4 and 5-5** show cross-sections of the capsule, looking east and north, respectively. The EPS capsule will be buttressed on all four sides by engineered fill in an "overburden backing wall," as explained in more detail in **Section 5.2.2.**

Deleted: 385

Deleted: 695

Deleted: 109

Deleted: 170

The EPS capsule's key components are designed to standards believed necessary to confirm proofs of concept for the full scale commercial capsules. These standards are intended to enable observation, measurement, and assessment of key design concepts and components during the EPS project phase. Data obtained during EPS operation will be applied to the final design of the commercial scale capsules. Key EPS concepts and components include the following:

- Bedding materials for piping;
- Pipe sizing and spacing;
- Insulation effectiveness;
- Design effects on fluid and gas recovery;

- Bulkhead design, including bentonite-amended soil (BAS) penetrations for heating and product recovery piping, heat delivery, and product recovery manifold effectiveness;
- BAS thickness;
- Construction procedures;
- Capsule dimensions; and
- Capsule containment effectiveness, especially roof performance during capsule settling.

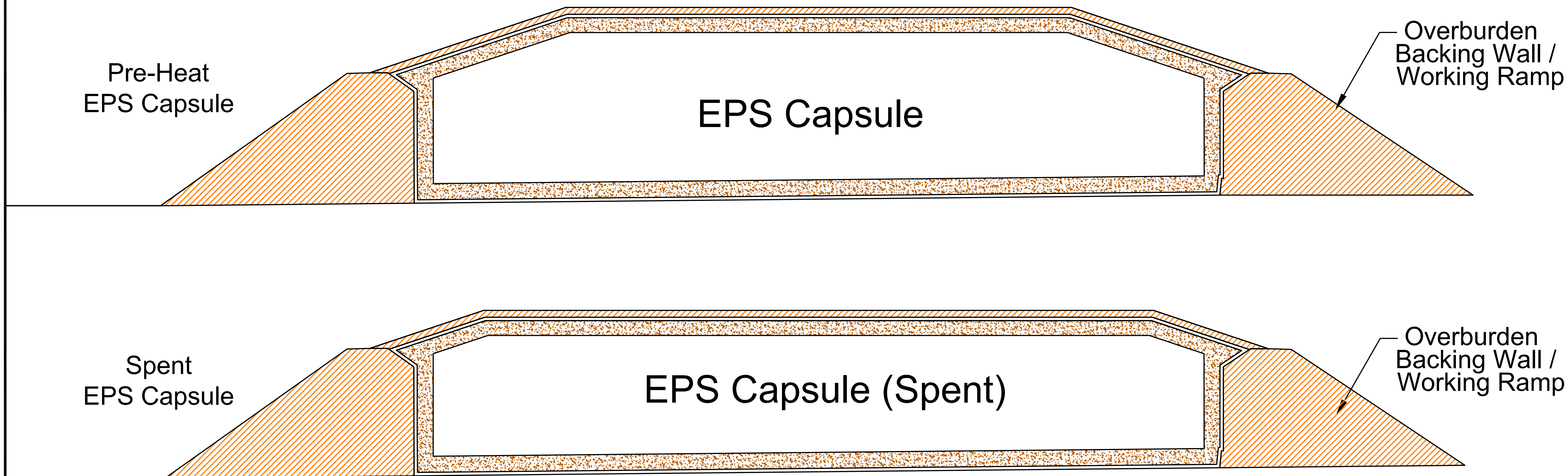
5.2.1 Capsule Floor and Walls

The capsule floor will be constructed with 3 feet of compacted BAS covered by 13 feet of gravel (2 x 3/8 inches crushed shale) with an oil collection pan embedded within the gravel. The BAS is designed to prevent impacts to groundwater and the surrounding ecosystem. Inside the BAS layer is a 13-foot-thick rind of coarse-sized material or gravel, which serves as insulation inside the BAS barrier to conserve heat and protect the BAS from thermal breakdown (**Figure 5-5)**. The floor of the mining horizon dips to the north at 3 degrees to allow oil to flow towards the low point of the capsule, where it will be collected. The land in the area where the EPS capsule is to be constructed has been pre-stripped to a flat horizon (east to west), dips to the north at 3 degrees, and will serve as the base upon which the capsule will be constructed.

Some of the overburden shale material deemed to be non-ore- or non-oil-bearing rock will be blasted to create fines and gravel. Rock that has a size up to 3/8 inches is classified as “fines,” and “gravel” is defined as shale between 3/8 and 2 inches diameter. Fines are used to make BAS, which involves using a special size fraction of materials mixed with bentonite and appropriate quantities of water in a pug mill (or similar equipment) to produce a bentonite sealing material for placement in the capsules. The saturated hydraulic conductivity of the BAS layer will be 1.0 x 10^{-7} centimeters per second (cm/sec) or less. A 3-foot layer of BAS will surround the capsule top, bottom, sides, and ends.

Deleted: Shale

The blended BAS mixture will be moisture conditioned to a water content between optimum and +4 percent and will be placed in lifts of loose material no greater than 18 inches in thickness at 95 percent compaction. The BAS Quality Control Plan presented in **Section 10**, below, describes the procedure to be used to develop installation and compaction practices based on performance evaluation of BAS test fills. Among other things, the lift thicknesses of loose BAS placed for compaction will be reduced if test results support this. Alternative methods for BAS placement may be used (see **Section 5.3**).



SECTION OF EPS CAPSULE
FROM NORTH TO SOUTH
(LOOKING EAST)

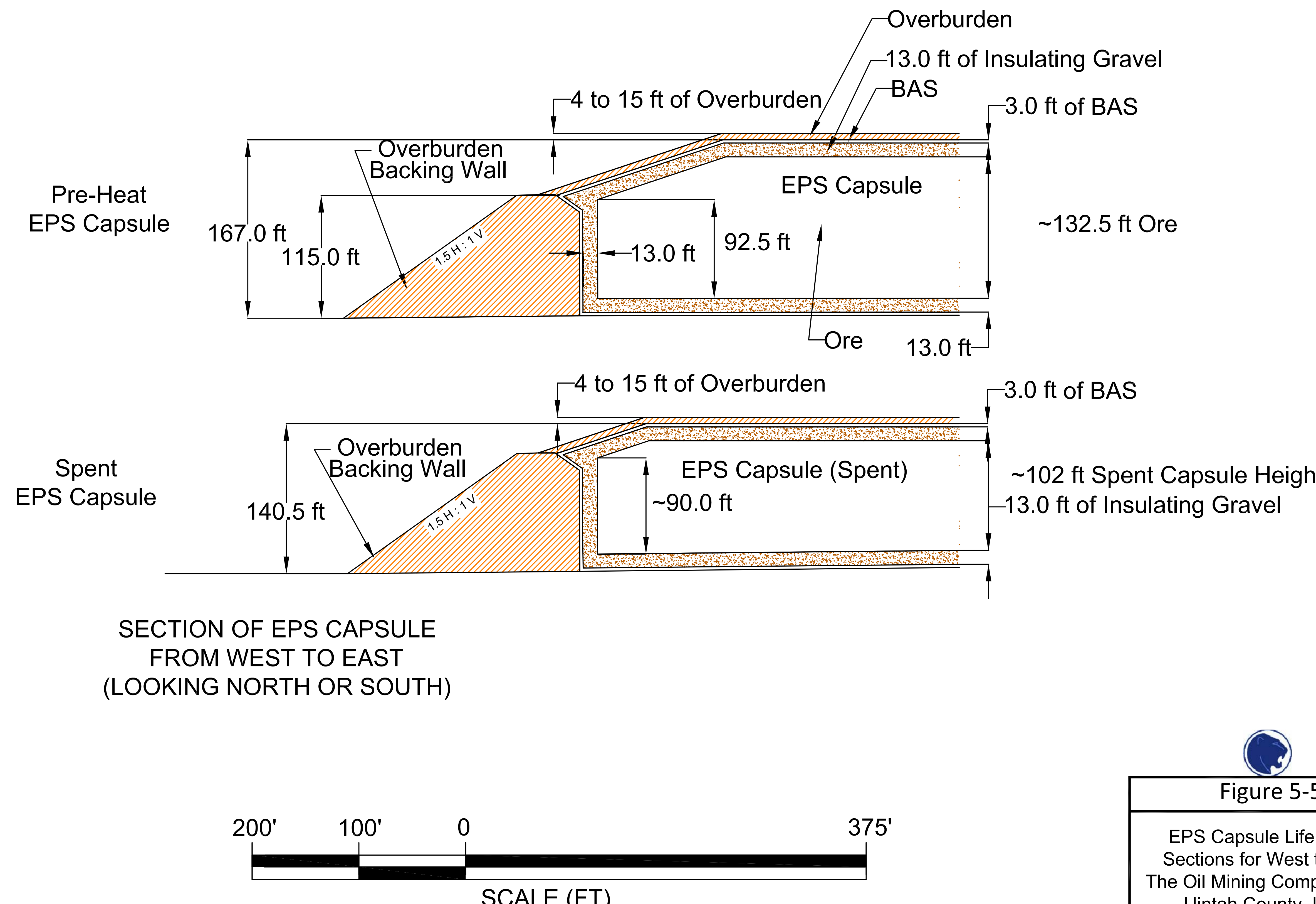
DIMENSIONS SHOWN ON FIGURE 5-5

NOT FOR CONSTRUCTION

FIGURE 5-4

EPS Capsule Life Cycle
Sections for South to North
The Oil Mining Company, Inc.
Uintah County, Utah

DATE: 11/06/2014
FILE: Tomco PMT Sections.dwg
SCALE: NOTED
NORWEST CORPORATION



NOT FOR CONSTRUCTION

Figure 5-5

EPS Capsule Life Cycle
Sections for West to East
The Oil Mining Company, Inc.
Uintah County, Utah

DATE: 11/06/2014 | SCALE: NOTED | NORWEST CORPORATION
FILE: Tomco PMT Sections.dwg

Gravel will be placed between the ore and BAS as insulation to protect the BAS from the higher temperatures that will be distributed through the ore.

Construction of the floor of the capsule begins with creating the required positive drainage profile, using dozers. Next, the BAS layer will be placed with trucks delivering the BAS and road graders or dozers spreading this material across the entire capsule floor. Traditional roller or sheep foot compactors will run over the BAS to compact it.

Following placement of the BAS, the first layer of gravel will be placed on the surface of the BAS with trucks and graders. The first gravel layer will be placed to create the final grade required for the oil drainage path through and out of the capsule.

The oil collection pan is the next component of the floor to be built. The oil collection pan will be constructed from steel sheets. The panels of the oil collection pan will be laid across the floor of the capsule with lapping joints to develop an integrated surface for the oil to flow across. The oil collection panels will be placed like roof shingles, with the upstream lap higher than the downstream sheet. The oil collection pan steel sheets shall be installed with a minimum of 4 inches of overlap. The specified overlap shall be maintained throughout backfilling. Steel specifications are provided in **Appendix B**, and a design specification showing overlap detail is included in the Confidential section of the TomCo Construction Permit application. The pan will slope to the north at an angle of approximately 3 degrees to a collection drain trough. Forklifts will be used to place the pans. Mine personnel will handle the non-galvanized carbon steel gauge sheets directly to ensure proper lapping. The pans will direct oil into a channel or formed pan, which will connect to a pipe and, through a sealed conduit, conduct petroleum liquids to the product collection manifold at the north end of the capsule.

Deleted: Steel specifications are provided in Appendix B.

Deleted: each

After a row of pans and collection channels are placed, a second gravel layer will be placed on top of the oil collection pan to protect the pan by distributing the load from continued equipment traffic. The beginning of the BAS side walls develops as the gravel floor advances vertically. The BAS wall will be 3 feet thick and will be placed using mobile equipment.

As the BAS wall progresses above the gravel floor, the gravel wall will begin to develop. Gravel will also encapsulate the ore. Gravel will insulate the BAS from the heat used to retort the oil shale. To minimize degradation, scrapers will not routinely drive on the rubble material.

Construction of vertical walls requires the placement of backing material with bottom-up construction or with layered stacking. Layered stacking is required for the perimeter backing wall to provide sufficient safety factor for construction and to establish compaction to support the vertical walls.

5.2.2 Placing Ore, Progressing the Walls, and Laying Heating Pipes

Above the bottom insulation layer, approximately 132.5 feet of ore will be placed within the cell in lifts at the same time the side walls, end walls and insulation layers are built (**Figure 5-5**). The ore will be placed with standard articulated haul trucks and dozers. BAS will be placed using portable forms, as depicted in **Figure 5-6**. The forms enable the placement of BAS as a discrete wall without possible effects from the adjacent gravel during placement. After a course of BAS has been placed and gravel has been placed against the forms, the forms will be removed and used again for the ongoing wall construction, leaving a smooth outer BAS wall in contact with the porous gravel.

Deleted: 138

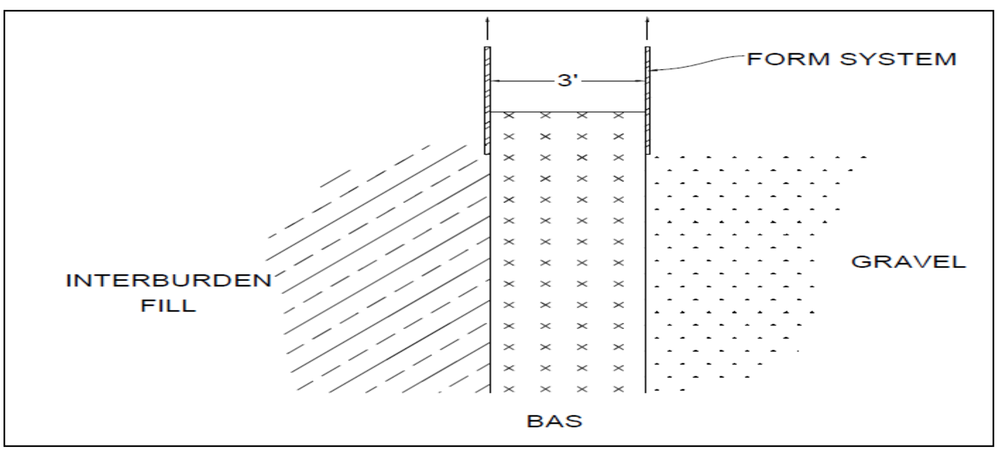


Figure 5-6 BAS Wall Progression with Forms

The outer wall of the EPS capsule will be created from BAS and gravel. All four walls are internally vertical. The north wall is where all the system equipment will tie into the capsule. Six layers of heating pipes will be placed along the length of the capsule as the ore placement continues until the level of ore in the capsule has reached the required thickness. Pipes will be milled on site using a mobile pipe rolling mill or alternative vendors, supply chains, and/or pipe manufacturing. Pipes will be corrugated. Typical specification for the steel to be used in pipe milling is provided in **Appendix** B. Placement of rubble will continue while the pipes are placed. Layering of ore, bedding, and placement of pipes and instrumentation will continue until the capsule is full. At the north end of each capsule, a bulkhead and manifold system will contain the piping to distribute heated air to the capsule and recover liquid and gas products from the in-capsule collection pipes for storage and water separation prior to transport.

Initially, the capsule will be heated to approximately the boiling point of water and held at that temperature until steam production diminishes. This step is completed prior to increasing the heat to pyrolysis temperatures. The heating pipes heat the ore to a maximum temperature of approximately 725 degrees Fahrenheit (^{o}F) and, through pyrolysis, liberate liquid and gaseous components of kerogen.

5.2.3 Capsule Pipe Wall or Floor Penetrations

The heating pipes will be connected to the blowers and heaters just beyond the boundaries of the capsule's northern wall. To keep the BAS seal functioning, the BAS needs to be protected from heat that is introduced into the capsules from the heating pipes. Proprietary fabrications have been designed and will be installed to enable BAS protection from heating. The penetrations will be through the floor for the EPS capsule.

A vent stack located above the bulkhead is intended to provide natural ventilation of hot air from the vicinity of the bulkhead floor penetrations to facilitate cooling in the tunnels.

5.2.4 Access Ramp

A pad and access ramp will be constructed along the south end of the capsule. The pad and the access ramp will be constructed using traditional methods for earth structures that utilize haul trucks, graders, and compactors.

5.2.5 Capsule Roof Finishing

The east and west margins of the capsule surface will be constructed of sloped gravel and earthen materials (**Figures 5-4 and 5-5**). The slope enables the upper BAS layer to remain intact and keep the capsule sealed when it settles following heating. Finishing the capsule margins with slopes at the angle of repose will reduce the amount of backing material needed for the top part of the capsule. Ore will be placed to the required depth, after which 13 feet of gravel will be placed over the ore. After the BAS is placed, additional haul trucks and graders will cover the BAS with run of mine interburden/overburden material to a depth of 4 to 15 feet.

5.2.6 Material Handling Equipment

The material handling equipment will be used to size and sort the materials for capsule construction. The equipment will consist of a designed system of screens, conveyors, and crushers that will size the mined material. Separate equipment streams will be used to handle ore and overburden/interburden. Off-spec ore and overburden/interburden will be sized and sorted as necessary to produce construction fill, insulating gravel, and the sized fines for the BAS.

Deleted: gravel

5.2.7 Capsule Consolidation

After capsule heating and oil recovery, the oil shale is expected to lose its strength, resulting in significant capsule settlement (consolidation). The EPS capsule will be constructed to a total height of up to 167 feet; however, following consolidation, the capsules will be reduced to a height as low as 140 feet. Recent data review has led RLR's engineers to believe that consolidation is likely to be approximately 25 percent. Some of the consolidation will occur during capsule construction as the ore is placed within the capsule, but this will not affect the final covering of BAS.

Deleted: 170

Deleted: 135

Information used to predict capsule deformation includes material properties of gravel insulation, shale, and BAS. Material properties were determined by RLR from laboratory testing that included laboratory reactor retorting of oil shale samples, reactor heat/compression testing of the shale, BAS permeability testing, and evaluating the conditions found during RLR's pilot run, 2012 site constructability testing, and geotechnical work done by outside laboratories. These data were compared to published and unpublished information on the behavior of consolidating spent oil shale based on work done in Colorado in the late 1970s. From this comparative work on capsule design, it is known that a sufficient thickness of earthen cover above the covering BAS layer is needed to maintain the BAS in compression. The thickness required to do so will be evaluated in the design, construction, and operation of the EPS.

5.2.8 BAS Integrity on Consolidation: Knuckle

One purpose of the sloped upper edges of the capsule is to prevent excessive shear of the BAS as consolidation occurs. Previous studies found that excessive shear occurred where vertical BAS walls joined a horizontal upper BAS layer and would not remain intact. However, the BAS in the sloped capsule roof must remain under compression as capsule consolidation occurs. The side slopes are therefore finished with the addition of earthen fill to create a knuckle. This knuckle design can be used for various capsule heights, with the depth of the knuckle related to the level of expected subsidence. **Figure 5-2** depicts the knuckle construction. The extra fill placed over both the sloped wall and the adjoining roof surface completes the knuckle that maintains compressive stress on the BAS and gravel layers as settlement of the heated capsule occurs and the adjacent unheated capsule remains at its constructed height.

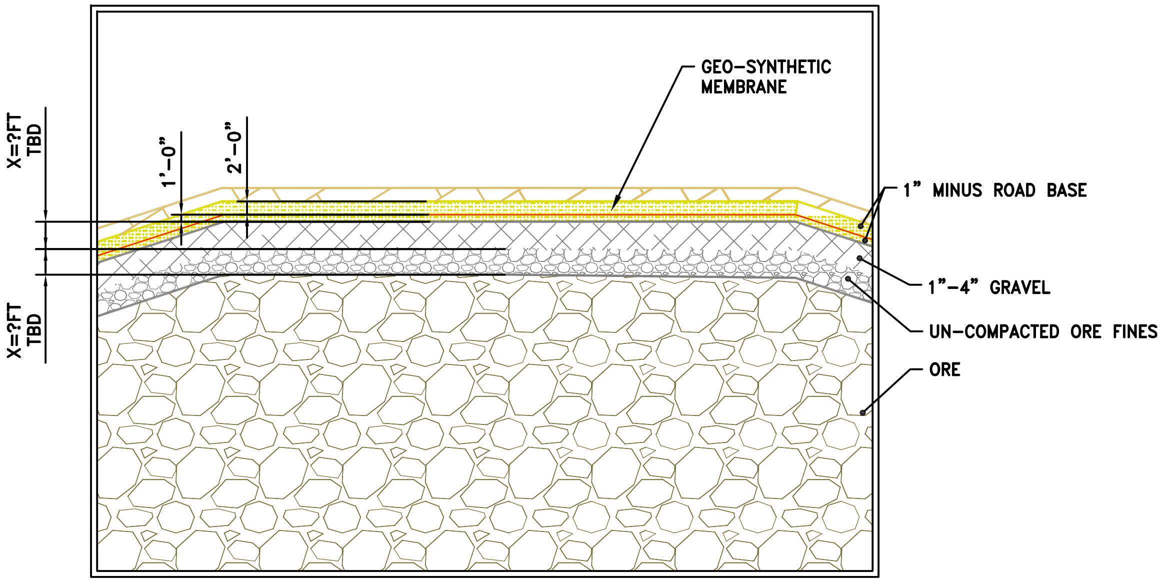
Deleted: 3

Consolidation in the EPS capsule will be monitored carefully and assessed after cooling to determine if the BAS has maintained its plasticity and remained intact. If the integrity of the BAS has been affected, it will be repaired.

5.3 Functionally Equivalent Alternatives to the BAS Containment and Confinement

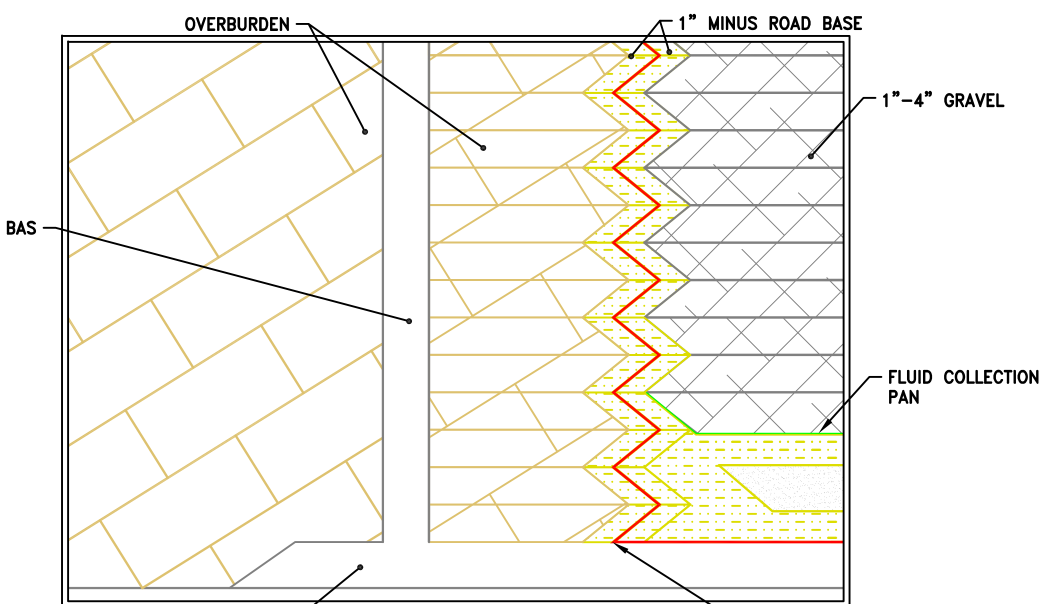
The base case for EPS includes an outer 3-foot rind of BAS surrounding the insulated ore retorting zone. Functionally equivalent alternatives to the base case BAS encapsulation are being considered for the bottom, side, and cover BAS layers. The purpose of evaluating these alternatives is to optimize functionality, constructability, and costs.

The environmental functions of the BAS are containment of process gases and liquids, prevention of infiltration of meteoric water, and containment of any meteoric water that may, despite all precautions, find its way into the capsule. To serve the water quality protection functions, all BAS layers or their functional equivalents must be able to maintain their uniform low permeability throughout capsule construction, heating, hydrocarbon recovery, and cooling. To be considered functionally equivalent for environmental purposes, the BAS alternatives must have a permeability of $\leq 1 \times 10^{-7}$ cm/sec. **Figure 5-7** is a schematic drawing illustrating the functional alternatives described in this section. If an alternative design is selected, the application will be modified and submitted to the DWQ for review and approval.



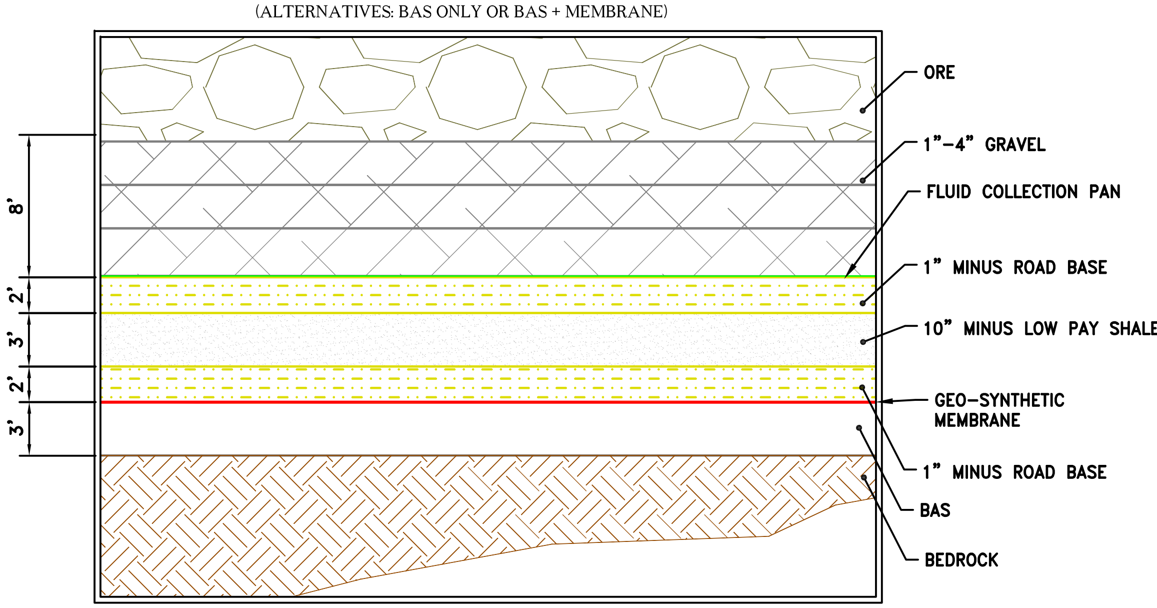
ROOF DETAILS

(MEMBRANE ALTERNATIVES [WITH BAS TO BE PLACED AFTER CAPSULE SETTLEMENT AND COOLING])



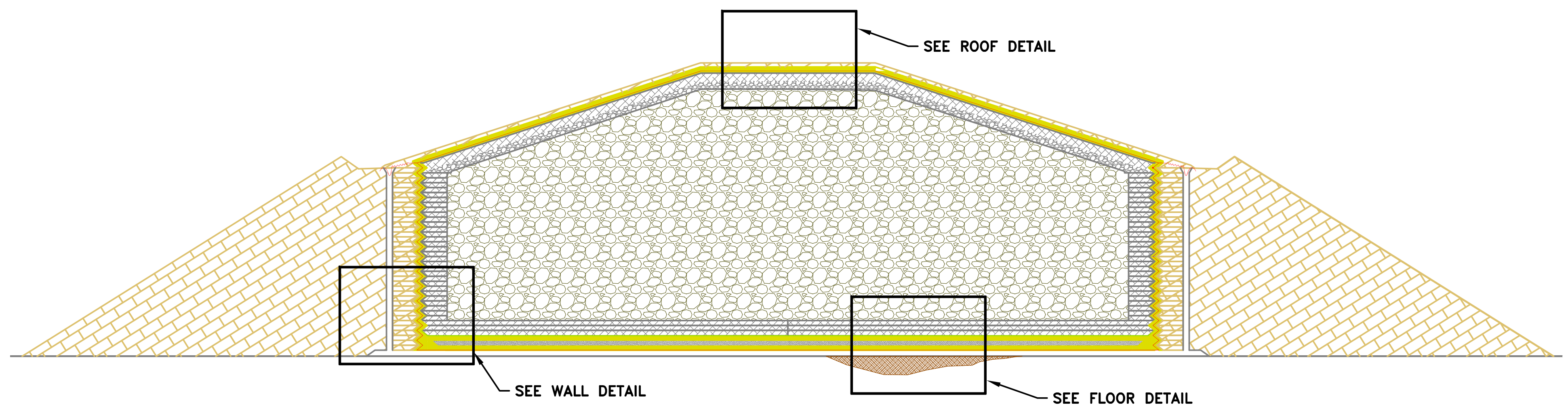
WALL DETAILS

(ALTERNATIVES: BAS ONLY OR BAS + MEMBRANE)



FLOOR DETAILS

(ALTERNATIVES: BAS ONLY OR BAS + MEMBRANE)



MEMBRANE ROOF CAPSULE

ALTERNATE DESIGN - MEMBRANE ROOF (WITH BAS TO BE PLACED AFTER CAPSULE SETTLEMENT AND COOLING)

NOTE:
1. FLOOR DETAIL THICKNESSES SUBJECT TO CHANGE FOR FINAL DESIGN.
2. ROOF DETAIL "TBD" DIMENSIONS ARE TO BE CONFIRMED.

THIS IS AN "ANSI D" SIZE DRAWING. IF PRINTED AT ANY OTHER SIZE THIS DRAWING IS NOT TO SCALE.

NOT FOR CONSTRUCTION

PRELIMINARY

ECOSHALE TECHNOLOGY

FIGURE 5-7

EPS Capsule Construction Engineering
Functional Equivalents to Base Case Design
Capsule Roof, Walls, and Floor Details
The Oil Mining Company, Inc.
Uintah County, Utah

DATE: 11/26/2014
FILE: Floor_Roof_Wall Options.dwg
SCALE: NTS

NORWEST CORPORATION

The following alternatives are being considered. Note that all of these functionally equivalent alternatives remain under review; consideration and preliminary designs by RLR engineers and TomCo may or may not employ any of these alternatives.

- The upper or cover BAS layer may be installed after capsule cooling and settlement as a 3-foot-thick BAS cap with permeability of ≤ 1 x 10-7 cm/sec. During operations, a membrane cover sealed to the BAS side wall's integrated flexible membrane will serve to confine gas and liquid product while preventing infiltration of meteoric water in the event that capsule operations were unexpectedly interrupted.
- An alternative ("hybrid") BAS cover concept would be a combination of a BAS layer with a permeability of ≤ 1 x 10-7 cm/sec and a flexible membrane.
- The basal BAS layer will have 3 feet of BAS compacted in lifts, with a permeability of 1 x 10-7 cm/sec. No changes in the basal BAS are under consideration for this project; however, a flexible membrane liner may be incorporated to ensure recoverability of product and to ensure that liquid product is not lost to the BAS.

5.4 Post Cooling Spent Shale Characterization

Following retorting and cooling of the EPS capsule to below 100 °F, but not more than two years after the cessation of capsule heating, TomCo will drill into the EPS capsule and obtain spent shale material, including material from the upper and lower 30 feet of spent shale. This procedure will be carried out as follows:

- Samples from these zones will be obtained from three to five EPS footprint locations.
- Prior to drilling, TomCo will solicit input from the DWQ regarding location selection and the number of locations to be drilled.
- Samples will be analyzed utilizing the Synthetic Precipitation Leaching Procedure (SPLP) for a suite of organic and inorganic analytes developed in cooperation

with the DWQ. TomCo will submit a report outlining an evaluation of these results to the DWQ within 60 days of receiving the results of sample analyses.

5.5 Capsule Basal Containment Monitoring

Monitoring and sampling for detection of any discharge from the capsule will be conducted at three different zones located within, below, and adjacent to the EPS capsule. TomCo will be able to monitor these zones from a monitoring location established at the base of the backfill/mechanically stabilized earth (MSE) wall on the north (downgradient) side of the capsule. From the monitoring location, the three zones will be checked on a regular basis, further described below, to detect potential leaks, and to evaluate EPS capsule performance. These three zones are:

- Collection Pan
- Lower Containment (BAS) Layer
- Bedrock Under Capsule Edge

These systems are shown in the Construction Permit in Confidential Drawing **RL-EPS-W-0004** and are described below. These monitoring locations are located downgradient of the capsule and outside the backfill/MSE wall.

Collection Pan: A collection pan covers the floor of the EPS capsule and is designed to collect and convey oil produced during ore processing. A trough, formed between the collection pan and the bulkhead, is located near the north (downgradient) end of the capsule. A system of sealed pipes will be used during operations to collect hydrocarbons from the trough via gravity flow for delivery to the base of the backfill/MSE wall on the north side of the capsule. During production, hydrocarbons will be routed from the exit point at the north side of the capsule to tanks to be processed for sale. The trough in the collection pan is sized to adequately contain at least two weeks of liquid hydrocarbons at full production rates. Fluid levels in the trough can be monitored from outside the capsule via a float valve system. An electronic alarm will be installed to alert workers if an overflow occurs. A system is in place to unclog pipes, should this occur, to prevent overflow of the trough.

After the heating and cooling process is complete, this system will continue to be used to monitor and evaluate liquids that reach the monitoring station, if produced in measurable quantities. All but one of the pipes leading from the collection pan trough will be capped. The remaining pipe will remain in place to be used for monitoring. An engineered monitoring port will be installed with a valved fitting and sealed to the monitoring station to prevent leakage from the pipe system. A system is in place to unclog pipes, should this occur.

Lower Containment Layer: A second monitoring system will be constructed should fluids bypass the floor pan either during or after processing. Piping will be placed across the north (downgradient) end of the capsule to capture fluids that reach the top of the lower BAS layer. Because of the slope of the capsule, fluids reaching this area flow to the north end of the capsule. Captured fluids would flow via gravity to a monitoring location at the north end of the capsule where they can be captured and evaluated if produced in measurable quantities. An engineered monitoring port will be installed with a valved fitting and sealed to the backfill/MSE wall to prevent leakage from the pipe system. A system will be in place to unclog pipes, should this occur, to prevent hydrocarbon build-up in this location of the capsule.

Bedrock Under Capsule Edge: A third monitoring system will be constructed should fluids pass through the BAS base liner. A perforated drain system, similar to a french drain, will be constructed between the bedrock foundation and the outside edge of the BAS containment layer on the east, west, and north sides of the capsule to collect liquids. These fluids would flow via gravity to the monitoring location, where they can be captured and evaluated if produced in measurable quantities. An engineered monitoring port will be installed with a valved fitting and sealed to the backfill/MSE wall to prevent leakage from the pipe system. A system is in place to unclog pipes, should this occur.

Monitoring Frequency: The EcoShale™ capsule's liquid product collection system and leak detection system will be checked at the monitoring locations during heating, cooling, and product recovery phases on a weekly basis. Sixty days after heating pipes are turned off, monitoring for liquids will shift to a monthly basis. If liquids are detected, samples will be collected and analyzed for the groundwater quality parameters described below. The volume of liquid produced will be recorded. Presence of liquids will trigger resumption of weekly monitoring until four consecutive weeks have passed without additional liquids accumulation, at which time sampling will revert to monthly.

After six months have passed without additional liquid accumulation, monitoring will take place on a bi-annual basis for the remainder of the permit term.

Monitoring Parameters: Within 90 days of completion of construction of the EPS capsule, TomCo will submit a sampling analysis plan. If any liquid is found in quantities large enough to obtain a sample for analysis, TomCo will sample and analyze this liquid for the following parameters: temperature, pH, TDS, total phosphorus, arsenic, nitrate, boron, selenium, benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEXN), TPH-GRO, TPH-DRO, and Total Recoverable Petroleum Hydrocarbons (TRPH).

Results from these analyses from semi-annual sampling will be reported to DWQ within 90 days of sampling. If sufficient liquid for sampling is not available, a monitoring report will be submitted within 30 days following the sampling event. An annual report of volumes removed from the monitoring points, the periods when fluids were observed, and the results of any sample analysis will be provided to the DWQ annually. The report will be submitted by March 1 for the previous year.

Liquid hydrocarbons draining from the metal collection pan will not be discharged to the environment. TomCo will remove all hydrocarbons from the site while they flow from capsule drains. Water discharges from the pan will be contained until a disposal method is approved by DWQ. The analyses outlined above will help DWQ determine appropriate disposal methods.

5.6 Reclamation

After the heaters have been removed from the EPS, a cooling period will be allowed. After cooling and settlement is completed, the EPS capsule will be ready for regrading and further mine development if the project moves forward, or final reclamation if the project terminates after the EPS capsule is completed.

Further mine development involves construction of additional capsules to be constructed adjacent to the EPS capsule, according to the DOGM Notice of Intention to Conduct Large

Deleted: ,

Deleted: TomCo will notify DWQ within 60 days of when heating pipes were shut down. Beginning six months after shutdown of EPS capsule retorting operations and continuing semi-annually for the term of the permit, TomCo will monitor drainage from the metal collection pan, the top of the lower BAS liner, and the six channels that lead to the liner penetration bulkheads semi-annually for water or liquid hydrocarbons discharging from the capsule. ¶
After production from the capsule is complete, the pipes from the collection pan trench (tunnel) will be separated from the product collection tank. All but one of the six pipes will be capped inside the piping trench. The remaining product pipe will remain in place and be used for monitoring. Any liquids reaching the collection trench will flow to the single remaining collection pipe and then to the monitoring point at the distal end of the trench (**Figure 5-8**).¶
The presence of liquid build-up on the top of the BAS near the collection drain trough for the steel floor pan will be monitored. As shown on **Figure 5-8**, a monitoring port will be installed in the concrete slab covering each collection trench in the area adjacent to the heating pipes. A valved fitting will be installed and sealed in the slab roof of the trench during capsule construction. After the capsule has cooled sufficiently, the fittings will be cleaned, the valve removed, and a pipe attached to a roof fitting in a selected trench. The pipe will extend to the monitoring point at the distal end of the trench. Any liquids that might enter the monitoring trench itself would, if present in significant quantities, flow along the sloping trench floor toward the distal end of the trench where the monitoring point will be located. The monitoring point will consist of a sump installed in the trench floor. The capsule floor and product collection trough pipe will extend to the monitoring sump and be fitted with ...

Deleted: ¶

Deleted: drainage

Deleted: for

Deleted: as long as

Deleted: ------------Page Break------------ ¶

Deleted: Figure 5-8 EPS Capsule Construction Engineering Tunnel and Bulkhead Sealing Tunnel and Capsule Section¶

Deleted: ------------Page Break------------ ¶

Mining Operations (LMO) M/047/0120 submitted January 3, 2014, and preliminarily approved on October 10, 2014. Mine development is described in the DOGM permit application in Section 106.2. A 5-year mine plan with reclamation cost calculations is included in Section R647-4-113. No mining will take place under this LMO until a reclamation surety instrument based on these calculations is accepted by the DOGM.

Deleted: 040

TomCo will submit a revised GWDPA to the DWQ incorporating the findings from this EPS capsule project, and will not begin construction of subsequent capsules until the DWQ has approved the revised plan.

Deleted:

The following is a summary of the reclamation plan as described in the LMO

The EPS final pit depth is approximately 95 feet. If further mine development does not occur, the site will be reclaimed. Final grading to achieve acceptable surface contours for positive drainage will be conducted, where necessary, using overburden material not used in capsule construction. This is expected to include both run of mine and overburden material. The latter may also be used as supplemental plant growth material if its chemical characteristics are suitable. Salvaged soil will then be used to establish vegetative cover for the final graded capsule.

The final top surface of the EPS will be regraded to reduce runoff onto the side slopes and minimize erosion potential by excavating small areas with a small dozer to create a shallow, concave surface to collect precipitation, encourage establishment of more mesic vegetation communities, and reduce run-off. The excavated surfaces will be constructed such that these small areas are surficial and no deeper than 1 foot or wider than 3 feet in diameter. These microsite features are truly surficial and are not perceptible on the scale of the post-mining topography map. Given the limited precipitation and high evapotranspiration rates for the Uinta Basin, puddling of moisture is not anticipated to last for extended periods. This is because, in addition to the 3-foot BAS layer, the EPS capsule will be topped with 4 to 15 feet of overburden to account for uneven deformation after heating, and 6 to 12 inches of soil. By managing the top surface of the capsule in this manner, run-off will be limited, as will resultant erosion.

Pit endwalls and the final highwall will be regraded and stabilized by sloping back the walls or backfilling material against them to achieve a slope angle of 45 degrees, in compliance with

DOGM rules and to minimize potential safety hazards. All disturbed areas will be left in a stable configuration and planted with a seed mix dominated by native species suited to the topography and physical characteristics of the site.

The residual hydrocarbon in the capsules following retorting is coke (RLR 2010), which is a gray, hard, porous, insoluble solid that consists of fused mineral matter and fixed carbon. Due to capsule design and system operation, a minimal amount of the product generated during pyrolysis may not be recoverable and may remain within the capsules after extraction.

6 ISSUED AND PENDING PERMITS

6.1 Permit History

TomCo obtained Exploration Permit EXP 047/0061 in support of corehole drilling in 2010 and amended this same permit in 2013 to allow monitor well drilling.

6.2 Pending and Future Permits

An LMO was filed with the DOGM on January 10, 2014 and was provisionally approved on October 10, 2014.

The project area is located in "Indian Country," and most federal permits for this area are therefore under the jurisdiction of the U.S. Environmental Protection Agency (EPA).

Nationwide permits for storm water discharge under the federal National Pollutant Discharge Elimination System (NPDES) will be obtained from EPA Region 8 for construction of the facility. Oil shale facilities are exempt from NPDES permits during operations. Prior to construction activities, a Storm Water Pollution Prevention Plan will be prepared and updated to remain current. Plans will be available on site prior to commencement of construction or mining activities.

At this time, TomCo does not anticipate affecting waters of the U.S.; therefore, an application for a permit under section 404 of the federal Clean Water Act for the dredging and filling will not be necessary.

TomCo will operate as a minor source emitter in continuous operations, beginning with blower testing in 2014. TomCo will register as such in accordance with newly promulgated EPA air regulations for operation in Indian Country. Prior to registration, the facilities have not been subject to implementation of a minor source permitting program.

The project may have a Non-Transient Non-Community Water System (NTNWS). The engineering plans and specifications for an NTNWS must be approved prior to construction by the Executive Secretary of the Utah Division of Drinking Water.

Sanitary waste water is and will be, upon commencement of the proposed operations, collected and removed from the site by a licensed contractor. Solid waste will be collected and taken to a municipal or commercial landfill.

7 WATER INFORMATION

7.1 Well and Spring Identification

Oil and gas wells and water rights within a 1-mile radius of the project area are shown in **Figure 7-1** and listed in **Tables 7-1 and 7-2**. The United States Geological Survey (USGS) National Hydrography Dataset was used to identify any mapped springs in the general vicinity; there were no springs in TomCo's project area and one spring within a half mile of the site's boundary (USGS 2013). The records of the Utah Division of Water Rights were used to identify wells and springs in the area. There were no springs having a recorded water right, either within the project area or within a mile of the project area. No drinking water wells within a mile radius of the project area were identified. The water rights records search identified one existing water right within the project boundary (Water Right # 49-1111). The water right is owned by the BLM and is a point-to-point right for surface watering of livestock from Long Draw Wash. The point-to-point diversion is defined as "directly on stream from a point at N 660 feet E 660 feet from the

SW corner, Section 25, Township 12S, Range 24E to a point at S 660 feet from the NW corner, Section 14, Township 12S Range 24 East." According to the DWQ's records, the claim under this Water Right Number has not yet been established in accordance with statute and its validity is in question.

In addition to the water sources identified from public information sources, a seep and spring inventory for the project area and 0.5-mile buffer was completed in fall 2013. The inventory area and locations of springs, seeps, and possible seeps identified during the inventory are discussed in **Section 9.5.1**, below, as are the water sources identified in public records and referenced above. None of the seeps and springs identified in the survey has an associated water right.

7.2 Surface Water Body Identification

No bodies of surface water have been identified within a 1-mile radius of the mine operation.

7.3 Drainage Identification

TomCo's project area is crossed by numerous small ephemeral drainages typical of high-desert landscapes and does not contain any perennial surface water sources. Most of the smaller drainages lack an Ordinary High Water Mark and are not considered jurisdictional by the U.S. Army Corps of Engineers (Epic Engineering 2013). One main intermittent drainage traverses the northern third of the project area from east to west, with four tributary drainages feeding in from the south. The main drainage was determined in a field evaluation to be a Water of the U.S. by the U.S. Army Corps of Engineers in May 2013. Portions of two of the tributary drainages were also determined to be Waters of the U.S. The location and extent of this Water of the U.S. is shown on **Figure 7-1**.

7.4 Well-head Protection Area Identification

No well-head protection areas have been identified within a 0.5-mile radius of the mine operation.

7.5 Drinking Water Source Identification

No drinking water sources within a 0.5-mile radius of the mine operation have been identified in the project area. No drinking water sources subject to the protection of Utah Administrative Code (UAC) 309-600 have been identified within a 1-mile radius of the mine operation.

7.6 Well Logs

The only active wells found within the project's boundaries are owned by TomCo. Well logs from these wells and area hydrogeology are discussed in **Section 9**.

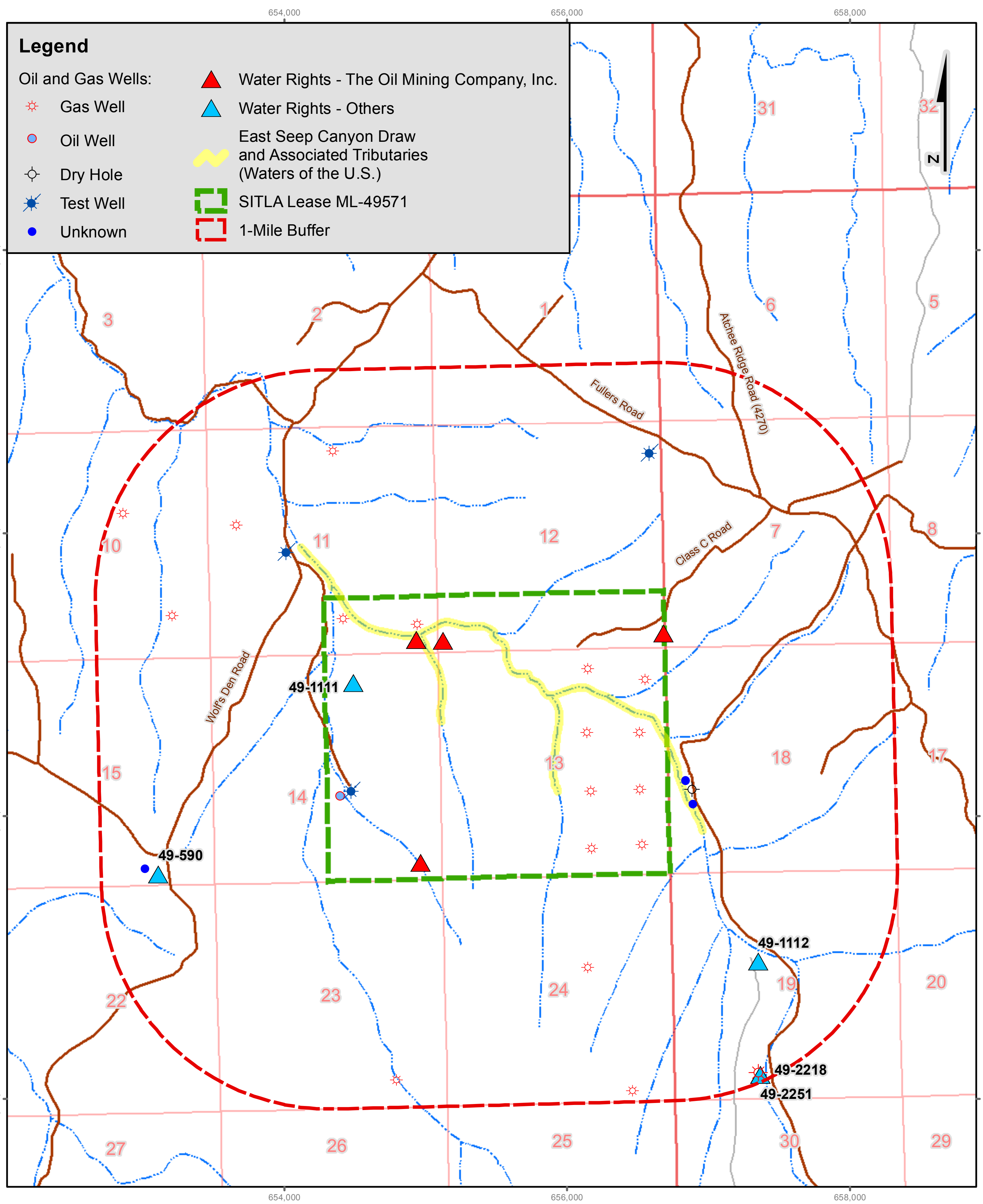
Table 7-1 Water Rights within, and within One Mile of, the TomCo Project Area

Township	Range	Section	Water Rights Number	Owner	Acre Feet	Well Type	Status
12S	24E	SE 11	1349006M00	TomCo	0.00	Underground	APPLAPP
12S	24E	SE 11	1349007M00	TomCo	0.00	Underground	APPLAPP
12S	24E	SE 14	1349007M00	TomCo	0.00	Underground	APPLAPP
12S	24E	SW 12	1349007M00	TomCo	0.00	Underground	APPLAPP
12S	24E	SE 12	1349007M00	TomCo	0.00	Underground	APPLAPP
12S	24E	NE 14	49-1111	BLM	0.00	Point to Point	PAC
12S	25E	SW 19	49-1112	BLM	0.00	Point to Point	PAC
12S	24E	SW 15	49-590	BLM	0.25	Surface	PAC
12S	25E	SW 19	49-2218	Medallion Exploration	20.00	Underground	TEMPEXP
12S	25E	SW 19	49-2251	Medallion Exploration	20.00	Underground	TEMPEXP

Key:
APPLAPP Application to Appropriate Approved
BLM Bureau of Land Management
PAC Pending Adjudication Claim
TEMPEXP Temporary Application for One Year, Expired
TomCo The Oil Mining Company, Inc.

Table 7-2 Oil and Gas Wells within, and within One Mile of, the TomCo Project Area

Township	Range	Section	API Number	Well Type	Status	Operator
12S	24E	SWSE 15	43-047-10263-00-00	Unknown	Plugged and Abandoned	Continental Oil Company
12S	24E	NWSE 14	43-047-11137-00-00	Oil	Plugged and Abandoned	Sky-High Oil Company
12S	24E	SWNE 10	43-047-31056-00-00	Gas	Abandoned	Texas Oil and Gas
12S	24E	SWNW 11	43-047-32557-00-00	Gas	Plugged and Abandoned	XTO Energy Inc.
12S	24E	SESE 10	43-047-32681-00-00	Gas	Plugged and Abandoned	XTO Energy Inc.
12S	24E	SESE 24	43-047-33172-00-00	Gas	Abandoned	Lone Mtn. Production Co.
12S	24E	NWNE 11	43-047-33183-00-00	Gas	Abandoned	Lone Mtn. Production Co.
12S	24E	SESE 11	43-047-36625-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SWSE 11	43-047-36626-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	NWNE 13	43-047-36627-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	NENE 13	43-047-36628-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SESE 13	43-047-36629-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SWSE 13	43-047-36630-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SWNE 13	43-047-36631-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SENE 13	43-047-36632-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	NESE 13	43-047-36633-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	NWSE 13	43-047-36634-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	NWSE 14	43-047-37799-00-00	Test	Plugged and Abandoned	Continental Oil Company
12S	24E	NENE 12	43-047-37800-00-00	Test	Plugged and Abandoned	Continental Oil Company
12S	24E	NESW 11	43-047-37801-00-00	Test	Plugged and Abandoned	Continental Oil Company
12S	24E	SWNE 24	43-047-38484-00-00	Gas	Abandoned	Enduring Resources LLC
12S	24E	SWSE 23	43-047-38652-00-00	Gas	Abandoned	Enduring Resources LLC
12S	25E	NWSW 18	43-047-11157-00-00	Dry Hole	Plugged and Abandoned	Medallion Exploration
12S	25E	NWSW 18	43-047-20480-00-00	Unknown	Plugged and Abandoned	Continental Oil Company
12S	25E	NWSW 18	43-047-20482-00-00	Unknown	Plugged and Abandoned	Continental Oil Company
12S	25E	NWSW 18	43-047-20484-00-00	Unknown	Plugged and Abandoned	Continental Oil Company
12S	25E	SESW 19	43-047-32660-00-00	Gas	Shut-In	Medallion Exploration



NAD 1983 UTM Zone 12N

0 1
Miles

LOWHAM WALSH LLC
Engineering & Environmental Services

Figure 7-1
Water Rights and
Oil and Gas Wells
The Oil Mining Company, Inc.
Uintah County, Utah

U:\Projects\LO000080_TomCoLMO\OMC_OGWells_WaterRts.mxd 24 Nov 2014

8 General Discharge Identification

8.1 Discharge Point Identification

TomCo's mine operation is designed to be a zero-discharge facility. There are no point discharges from the operation, and the facility is conservatively designed. Containment of all product liquids and gases is ensured through secondary containment of all tanks and clay seals 3-feet thick surrounding the capsule.

8.2 Planned Discharges

As noted above, TomCo's mine operation is designed to be a zero-discharge facility. There is no planned discharge of water or other liquid. The capsule design prevents storm water from contacting waste materials. During construction and production, storm water will be managed on site with ponds and sumps as outlined in the Surface Water Monitoring Plan located in **Appendix A**. Water collected in these sumps may be used for dust suppression.

Deleted: C

Deleted: Storm

Deleted: and

Deleted: as part of the project's water supply

8.3 Potential Discharges

Because TomCo's mine operation is designed to be a zero-discharge facility, there is no potential for discharge of non-storm-water-induced water or other liquids from the operations.

8.4 Means of Discharge

The capsules are designed to prevent both infiltration of water and discharge of fluids. The capsules are conservatively designed, and the cover material is engineered as a low permeability cap that will be covered with a pre-determined thickness of earthen borrow, graded, covered with salvaged topsoil, and revegetated, negating the necessity of post-closure care after revegetative cover has been established.

Stockpiles of mined ore are not potential sources of contamination, as most storm water is directed away from the site, with the exception of any storm water (direct precipitation) that comes in contact with the ore. This storm water will be utilized or contained on site until it evaporates. Following the commencement of capsule construction, ore will be mined and placed

Deleted: coming

Deleted: to

in the open capsule, and storm water diverted away from the EPS capsule and managed on site to prevent discharge of contact water.

No underground storage tanks or buried lines are planned for the project. Materials such as processed oil and other fuels or oil-related materials will be stored in tanks constructed of compatible material meeting all applicable requirements and will have secondary containment. Pipes and plumbing associated with storage will be visually observable or have leak detection technology.

8.5 Flows, Sources of Pollution, and Treatment Technology

All surface flows—which would include storm water with incidental contact to disturbed areas and, in the unlikely event that a spill were to occur, hydrocarbons—will be contained in both primary containment (within bermed areas around tanks, or within the bermed EPS capsule area or mine area shown on Figure 5-1) and secondary containment (within Pond 8, as shown in **Appendix A, Figure A**). No treatment of waste water or waste solid is required, as there is no generation of associated waste streams. Solid materials will be fully encapsulated. Storm water will be collected for beneficial use.

8.6 Discharge Effluent Characteristics

TomCo's mine operation is designed to be a zero-discharge facility. There is no planned discharge water or other liquid from the operation.

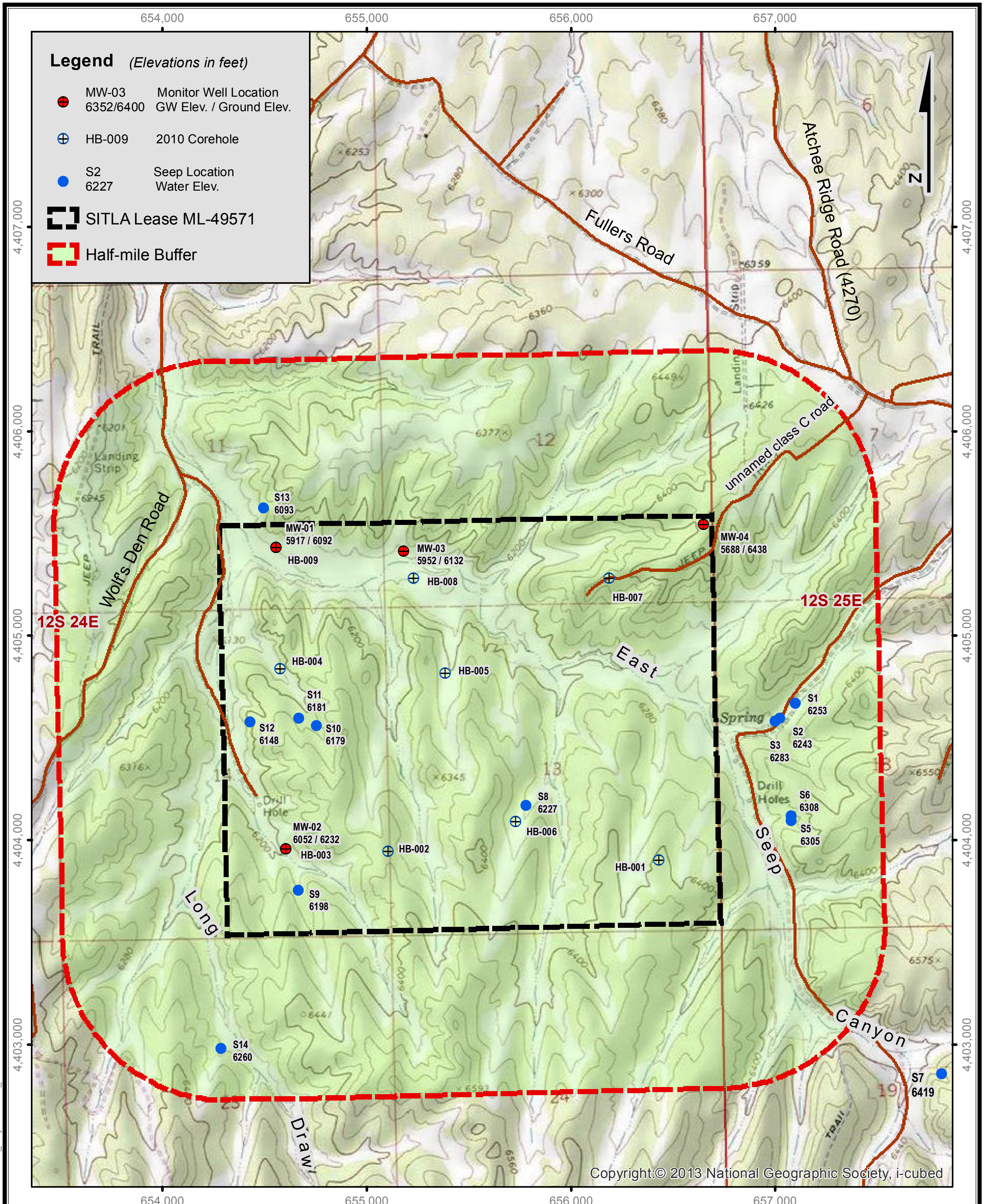
9 HYDROLOGY REPORT

9.1 Introduction

9.1.1 Regional Geology and Landform

TomCo's project area is located in the Uinta Basin section of the Colorado Plateau physiographic province (Stokes 1986). This physiographic province is also known as the Colorado Plateau's Level III Eco region (Woods et al. 2001). The project area is shown in **Figure 9-1**.

The Uinta Basin is a structural depression with Eocene fluvial and lacustrine sedimentary rocks exposed at the surface. The project area is located in the southern part of the basin and is underlain by north-dipping middle Eocene strata. The region is characterized by a dissected plateau with strong relief (Stokes 1986). Elevations in the basin range from under 5,000 feet in the basin center near the Green and White Rivers and above 8,000 feet at the southern basin margins. Incised tributaries of the two rivers flow northward as ephemeral, intermittent, and perennial streams providing the framework for rapid runoff throughout the southern portion of the basin.



NAD 1983 UTM Zone 12N
USGS Topographic Base

LOWHAM WALSH LLC
Engineering & Environmental Services

0 3,000
Feet

Figure 9-1
Project Area Features
The Oil Mining Company, Inc.
Uintah County, Utah

U:\Projects\LO000080_TomCo\LMO\OMC_ProjectFeature_4.mxd 04 Feb 2014

The southern Uinta Basin is underlain almost entirely by the Green River Formation, which is composed of two members: the Parachute Creek Member and the underlying Douglas Creek Member. The Parachute Creek Member is characterized by the presence of oil shale throughout its thickness. The Mahogany Zone is a 100-foot-plus interval in the upper third of the unit that represents the horizon with the highest concentration of kerogen and is the zone to be mined by TomCo.

Table 9-1 shows a summary of the Hot Rod Oil Government Chorney B-NCT-1 oil well to the southwest of the TomCo project area. This well, the nearest to the project area, was used by Sprinkel (2009) to develop the “Interim Geologic Map of the Seep Ridge 30’x60’ Quadrangle.” This map shows only the upper portions of the log, from the surface through the regional Mesa Verde Aquifer to the Dakota Sandstone. It places the Douglas Creek Member of the Green River Formation at 1,100 feet below ground surface (bgs) and shows the relative location of the Mahogany Zone within the Green River Formation. The Douglas Creek Member potentially contains the uppermost aquifer in the Green River Formation in the eastern Uinta Basin. The distance between the base of the Mahogany Zone and the top of the Douglas Creek Member is about 600 feet.

Table 9-1 Selected Oil and Gas Well Near the Project Area

Well ID & Location	Formations	Geologic Unit Symbol	Top (feet bgs	Thickness (feet)
Hot Rod Oil Government Chorney B-NCT-1				
SE1/4SW1/4 Sec23, T13S, R22E API: 4304730115 Surface: 6,624 feet’ AMSL	Parachute Creek Member, Green River Formation	Tgp	0	1,120
	Mahogany oil-shale zone, Green River Formation		415	
	Douglas Cr Member, Green River Formation	Tgd	1,120	995
	Green River-Wasatch Formations transition zone	Tg-Tw	2,115	185
	Wasatch Formation	Tw	2,300	1,765
	Upper Mesaverde Group	Kmv	4,065	1,390
	Sego Sandstone of Mesaverde Group	Kmv	5,455	515

Table 9-1 Selected Oil and Gas Well Near the Project Area

Well ID & Location	Formations	Geologic Unit Symbol	Top (feet bgs	Thickness (feet)
	Buck Tongue of Mancos Shale	Kmv	5,970	100
	Castlegate Sandstone of Mesaverde Group	Kmv	6,070	280
	Mancos Shale	Kms	6,350	3,505
	Frontier Formation	Kfd	9,855	335
	Mowry Shale	Kfd	10,190	30
	Dakota Sandstone	Kfd	10,220	40

Source: Sprinkel 2009
Key:
AMSL above mean sea level
bgs below ground surface
ID Identifier

The Hot Rod well shown in **Table 9-1** penetrated substantial thicknesses of the Parachute Creek Member. The well penetrated 1,120 feet of the Parachute Creek Member, which represents a fairly complete section of this sedimentary unit (Vanden Berg 2008).

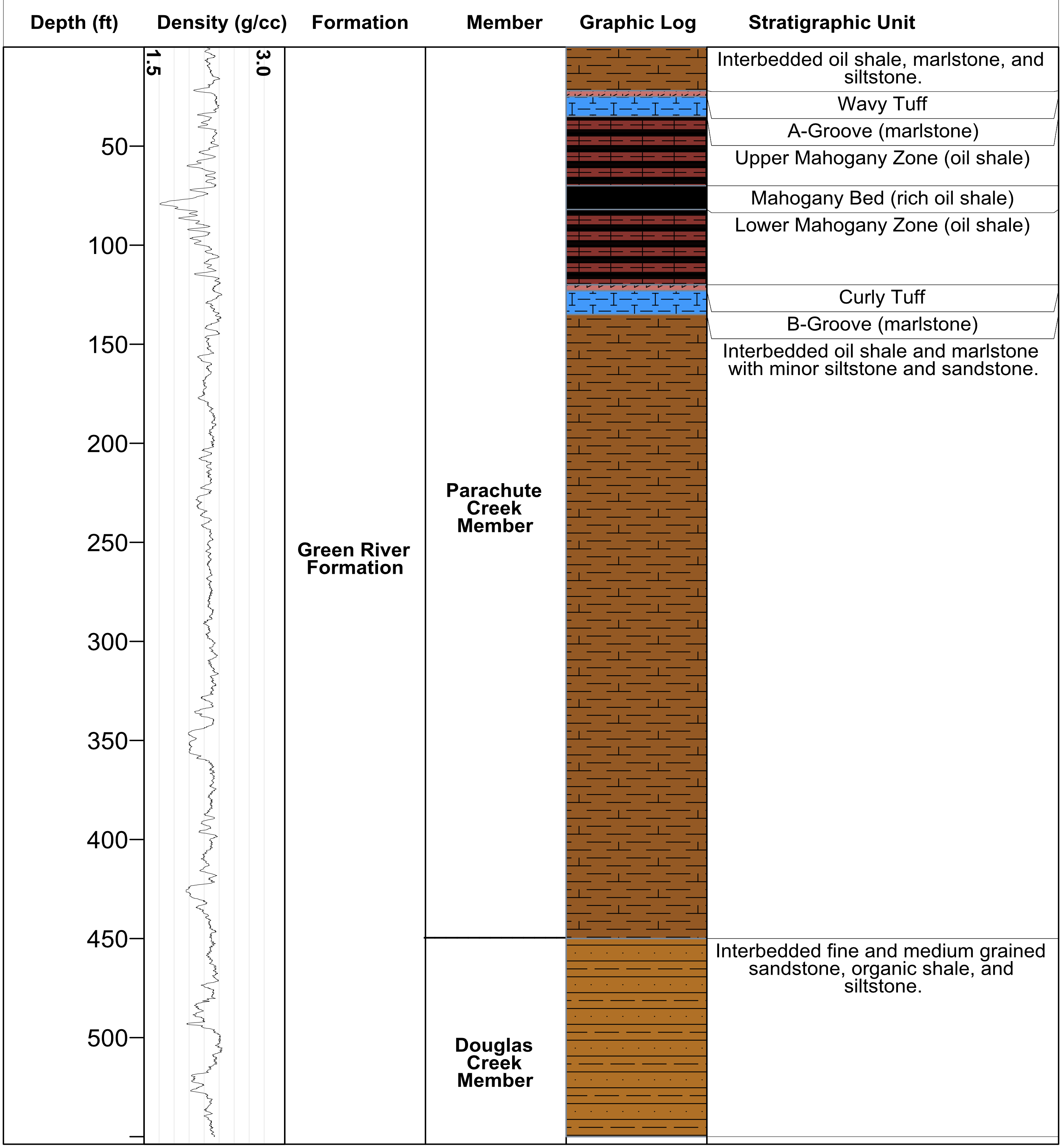
Key stratigraphic markers, the Wavy and Curly Tuffs, are located within the Mahogany Zone. The tuffs, which resulted from volcanic eruptions, are recognized throughout the Green River Basin. Two other units, which are less well recognizable, are the A Groove and the B Groove. Their relationship to the Mahogany Zone can be seen in the type Stratigraphic Column for the Site (**Figure 9-2**). The Mahogany Bed, the principal ore zone for this project area, is located approximately 400 feet above the top of the Parachute Creek Member. Throughout its thickness, the Parachute Creek member is kerogen-rich and is commonly described as oil shale (Vanden Berg 2008).

The Parachute Creek Member is closest to the surface in the project area. In some parts of the project area, it is overlain by a mantle of soils. The Parachute Creek Member outcrops in the southeast portion of the project area and in several small canyons across the site. The Douglas Creek Member begins at the base of the Parachute Creek Member and, depending on the elevation across the project area, ranges from 400 to 700 feet bgs.

Figure 9-2

Type Stratigraphic Column

The Oil Mining Company, Inc.
Uintah County, Utah



The Parachute Creek Member is known to be carbonate-rich and more kerogen rich in the center of the Uinta Basin to the northwest, where deeper water levels persisted throughout the period over which the sediments that formed the Parachute Creek Member were deposited. In the center of the basin, oil shale is present in significant quantities (measured in gallons per ton) throughout the 1,100-foot thickness of the member. To the east and south, toward the Douglas Creek Arch and Uncompahgre Uplift, respectively, deposition of terrigenous clastic sediments increased, forming silty and sandy marlstones and locally siltstone and sandstone horizons. Deposition of carbonate rocks and organic matter occurred when water levels in the lake in which the Green River Formation was deposited (termed Lake Uinta) were high and deep-water; anoxic conditions prevailed. Fluctuations in lake depth over time nearer the basin margins resulted in greater quantities of clastic sediments when lake levels dropped, and more carbonate and organic matter deposition occurred with higher lake levels and deeper water conditions (Keiglin 1977; Pipiringos 1978).

9.2 Project Area Geology

9.2.1. Introduction

The Mahogany Zone is the primary ore-bearing zone, and therefore the primary zone of interest in the project area. It is located within the Parachute Creek Member at the base of the Upper Green River Formation and is of Eocene Age. The Mahogany Zone is bounded on two sides by volcanic tuffs, the Wavy Tuff and the Curly Tuff, that have been age dated at 48.7 million years and 49.3 million years, respectively (Birgenheier et al. 2013). The approximate thickness of the zone in the project area is 85 feet. Tests previously performed on the Mahogany Zone in other areas of the Green River Basin indicate that it will produce up to 30 gallons of oil per ton (Wallace 2012). Within the Mahogany bed itself, which is about 8 feet thick in the project area, production may be as high as 50 gallons per ton (Vanden Berg 2008).

9.2.2. Conceptual Site Model

Prior to the initiation of field studies in September 2013, a conceptual site model was developed for this project and submitted as part of the *Groundwater Monitoring Plan TomCo Mine Site Uinta County Utah* (Lowham Walsh 2013). This conceptual site model is presented below.

In eastern Utah, the Green River Formation contains two significant members that are important to site hydrology and the development of the Holliday Block. These are the Parachute Creek Member, which comprises the Upper and Middle Green River Formation, and the Douglas Creek Member, which comprises the Middle and Lower Green River Formation (Birgenheier 2013). The Parachute Creek Member outcrops on the project area and contains the Mahogany Zone, which is the ore bearing zone for this project. The Parachute Creek Member is of very low permeability and would be classified as shale or a dolomitic/calcareous marlstone. Coarser sandstone and siltstone beds have been identified above and below the Mahogany Zone. Some of these could have sufficient permeability to hold groundwater, although their aerial extent is discontinuous due to their alluvial origin, and they likely do not hold sufficient groundwater to be classified as aquifers. Beneath the Mahogany Zone, the Parachute Creek Member is made up of organic shales and leaner shales that are not as productive as the Mahogany Zone. The thickness of the lower Parachute Creek Member has not been measured in the project area, but it is anticipated to be 400 to 600 feet before grading into the Douglas Creek Member. Sediments from the Douglas Creek Member, which are classified as a fluvial deltaic facies, resulted during a period when the size of the Green River lake system had decreased and deltas prograded across the western fringe of the basin. A number of sand-based fluvial channels were deposited during this period. These sandstones have sufficient permeability and aerial and vertical extent to be classified as aquifers in some areas. Recent wells drilled into the Douglas Creek Member at the adjacent Enefit and RLR properties were both completed at depths of 900 to 1,000 feet bgs and produce groundwater in the range of tens of gallons per minute (gpm).

In 2010, TomCo drilled nine coreholes across the project area to determine the thickness and depth of the Mahogany Zone. The depth of penetration of the coreholes ranged between 116 to 304 feet bgs. In general, the Mahogany Zone is closest to the surface in the southern portion of the PA, particularly in the southeast, and deepest in the northeast corner where the 304-foot-deep corehole was located. The Mahogany Zone itself was very tight and did not appear to be water bearing. However, a number of sandstones below the Mahogany Zone were recognized in the cores. For the most part, these sandstones were fine grained, poorly sorted, or filled with tar (i.e., tar sand) and were not classified as aquifer media. Three of the coreholes actually had “shows” of groundwater, suggesting that they could contain limited water bearing zones. Support for this contention comes from similar work that RLR has performed within the Mahogany Zone. RLR installed a number of nested wells above and below the Mahogany Zone. Wells were installed at six locations, with one well screened above the Mahogany Zone and the other screened below the Mahogany Zone. The monitoring zones were all screened in zones that visually appeared to be sandstones or siltstones and could have sufficient permeability to be water bearing. The permeability of these zones was measured with rising head slug tests. The results all came back in the range of clay, i.e., 10^{-7} cm/sec. Some of the wells had such low permeability that the groundwater had not recovered to pre-test levels after one week. In May 2013, a site visit to the Holliday Block was performed by Mark Novak and Woody Campbell of DWQ and Mike Vanden Berg of the USGS. The purpose of the site visit was to investigate the stratigraphy of the Mahogany Zone to determine if any permeable zones may exist in strata above and below the Mahogany Zone that could transport groundwater in the site area. Of particular concern were sandstones beneath the Mahogany Zone that could transmit groundwater. The team observed a spring on the eastern portion of the site that may have resulted from a sandstone layer or from a secondary porosity that originated from fractured bedrock. They also observed sand beds below the Mahogany Bed in outcrops west of the site.

Deleted: Utah Geological Survey

The surveys and analyses conducted in the vicinity of the project suggest that the Douglas Creek Aquifer will not be impacted by mining activities. Groundwater may be stored in permeable sandstones beneath the Mahogany Zone. However, the depositional environments of these sandstones are likely discontinuous fluvial channels that would provide little or no potential for groundwater movement. They are generally described as sandstone lenses, implying that they are limited both vertically and horizontally. Because they are surrounded by impermeable shale, it is unlikely that groundwater in these lenses would be able to migrate. However, because they are located beneath the mining horizon, they could eventually accumulate trace levels of naturally occurring inorganics (metals) and hydrocarbons or that could be released during mining. The risk that impacted groundwater from these lenses may migrate downward into the Douglas Creek Aquifer is very low.

The Douglas Creek Member contains more massive sandstones than those observed in the younger Parachute Creek Member. The depositional system of the Douglas Creek Member is likely composed of multistoried channel sands of a delta that prograded out into the Green River

Basin during a period of time when the lake level was much lower. Groundwater is produced at higher rates in the Douglas Creek Member. The likelihood of any contaminants impacting the Douglas Creek Aquifer from mining activity in the Mahogany Zone seems extremely remote. At least a 400-foot section of mostly impermeable shale and marlstone separates the two formations. Even with occasional sand lenses and secondary porosity resulting from fractured bedrock, there is unlikely to be enough interconnectivity between the two formations for them to communicate hydrologically. Further, the Douglas Creek Aquifer has been recognized in the project area as confined, which provides additional support for the contention that it is hydrologically separate from the Parachute Creek Member.

The purpose of the conceptual site model is to determine site geology and hydrology (i.e., hydrogeology and surface hydrology) so that the mine can be developed without any adverse impacts to site hydrology in the project area. Initial valuable information for the project was developed during the drilling of nine coreholes by TomCo in 2010. One objective of TomCo's 2013 well drilling program was to build upon the 2010 TomCo study to fill data gaps so that the ultimate goals of protecting groundwater and developing the mine site can be achieved. The following critical key features were investigated to meet these objectives:

- The Parachute Creek Member is of very low permeability due to the fact that its sediments are fine grained silts and clays that are not capable of transmitting significant groundwater. In some portions of the project area, there may be discontinuous sands with the potential of having higher permeability. However, their discontinuity, along with the facts that they are very poorly sorted and/or have pore spaces infilled with tar, make them very unlikely to transmit significant amounts of groundwater. Groundwater Quality within the Parachute Creek Member is poor and there also appears to be very little groundwater in this formation. Of the nine coreholes drilled in the Parachute Creek Member in 2010, only three of those had "shows" of groundwater (see **Appendix C**). However, the three coreholes with groundwater shows were investigated to determine the hydraulic characteristics and groundwater quality of the Parachute Creek Member.

- A number low permeability zones beneath the B Groove of the Parachute Creek Member (R-6 Unit) provide hydraulic separation between the oil shales of the Parachute Creek Member and the deeper Douglas Creek Member.
- The Douglas Creek Aquifer is more permeable and can be classified as an aquifer. An additional monitoring well was drilled to determine the hydraulic characteristics and water quality of the Douglas Creek Member and the amount of hydraulic separation between the Douglas Creek and the Parachute Creek Member.

9.2.3 Drilling, Well Installation, and Groundwater Sampling

Four monitoring wells in the project area were drilled and completed by Himes Drilling Company of Grand Junction Colorado in September and October of 2013. Lowham Walsh provided oversight and directed the work effort. The location of coreholes drilled in 2010 and monitoring wells drilled in 2013, along with groundwater elevations, are shown in **Figure 9-1**.

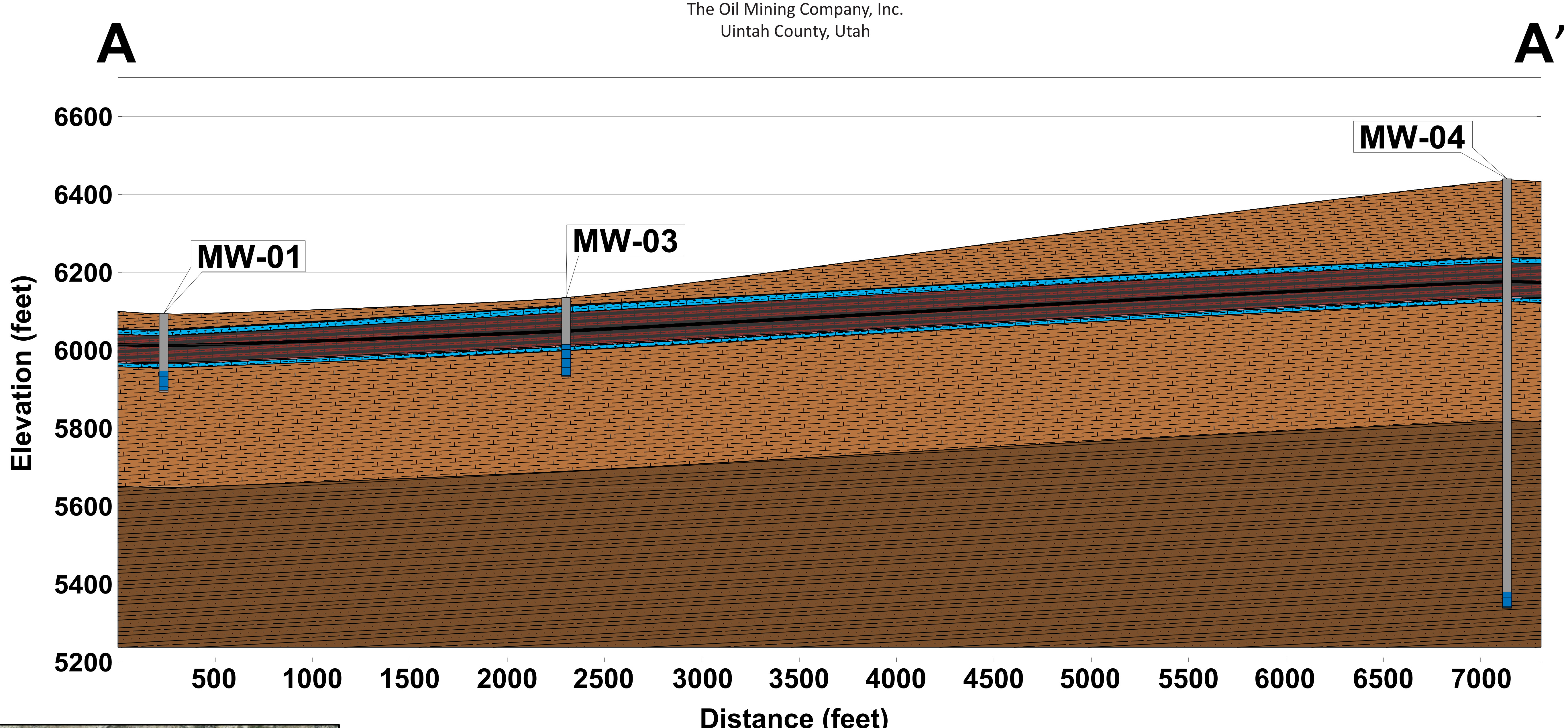
Screening-level groundwater samples were collected prior to well completion by using packer production tests. This provided in-field information that was used to determine the best monitoring zone in each well. Groundwater samples were also collected after the wells were completed and developed. The drilling method used on all boreholes was air rotary. Three intermediate boreholes were advanced to a total depth of 200 feet bgs and were completed in the Parachute Creek Member of the Green River Formation. Two-inch-diameter monitoring wells were installed into these three boreholes. One deep borehole was advanced to 1,100 feet bgs and was completed in the Douglas Creek Member of the Green River Formation. A 4-inch diameter monitoring well was installed in the Douglas Creek Member borehole.

Drill cuttings of subsurface lithologies encountered in the borehole were returned to the surface by the air rotary drilling system and were described in the field by a Lowham Walsh geologist. Boring logs and well diagrams of these monitoring wells are available in **Appendix C**. A type stratigraphic log of the site area is provided in **Figure 9-2**. Cross-sections of the geology of the project area are provided in **Figures 9-3 and 9-4**. Selected portions of the borehole geophysical logs are provided in **Figures 9-5 and 9-6**. The complete borehole geophysical log appears in **Appendix D**.

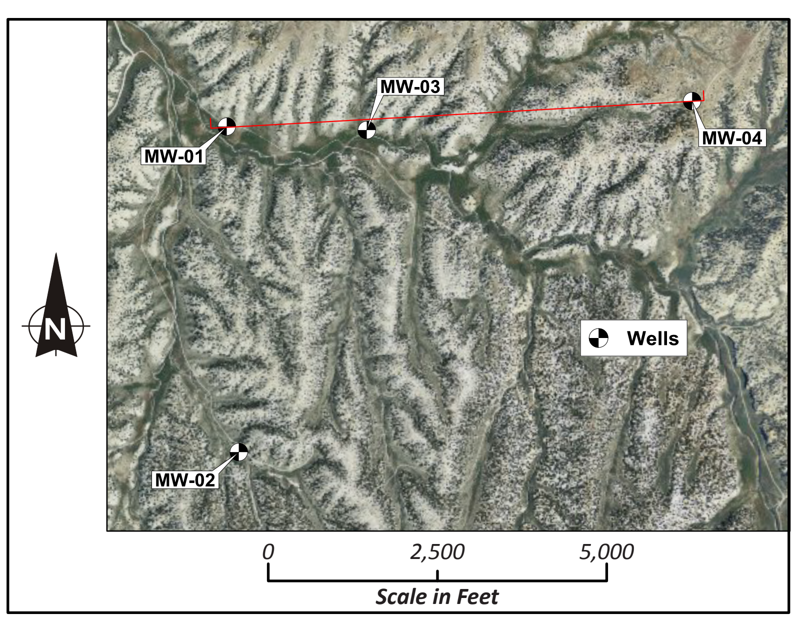
Figure 9-3

Cross Section A - A’

The Oil Mining Company, Inc.
Uintah County, Utah



Note: 2X vertical exageration.



Monitoring Wells

- Casing
- Screen

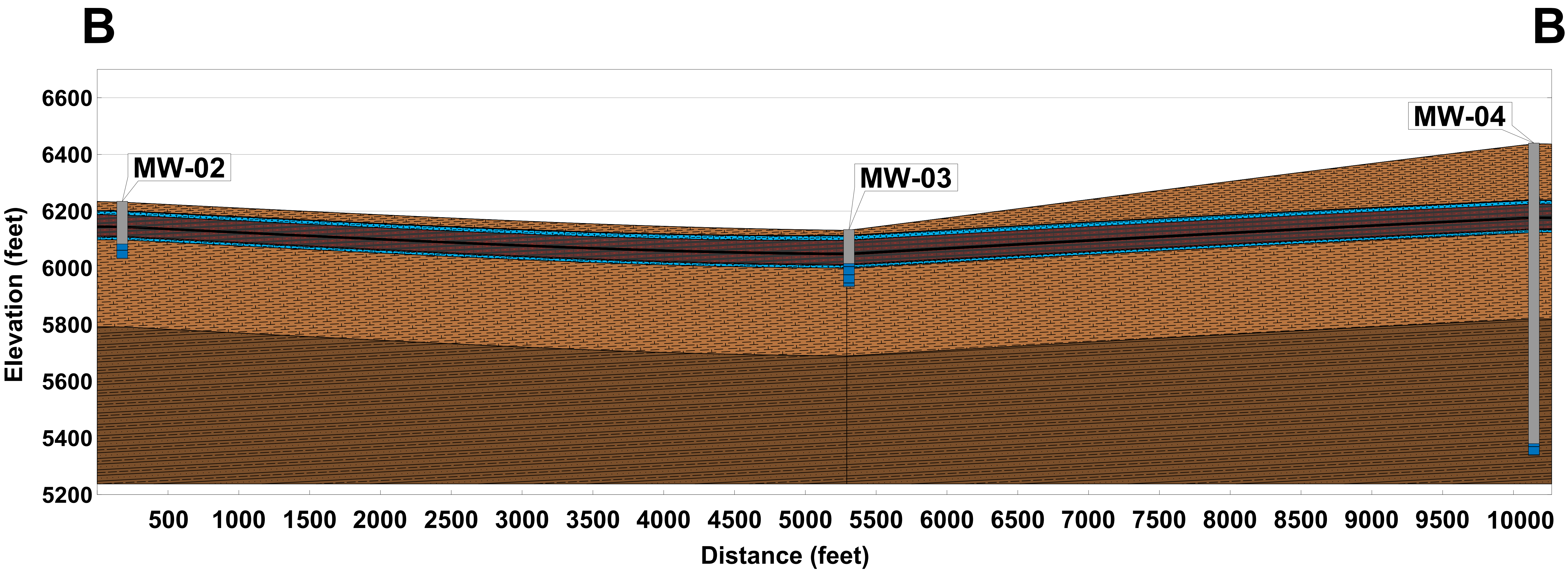
Stratigraphy

- Parachute Creek
- Mahogany Bed
- Wavy Tuff
- Curly Tuff
- A Groove
- B Groove
- Mahogany Zone
- Douglas Creek

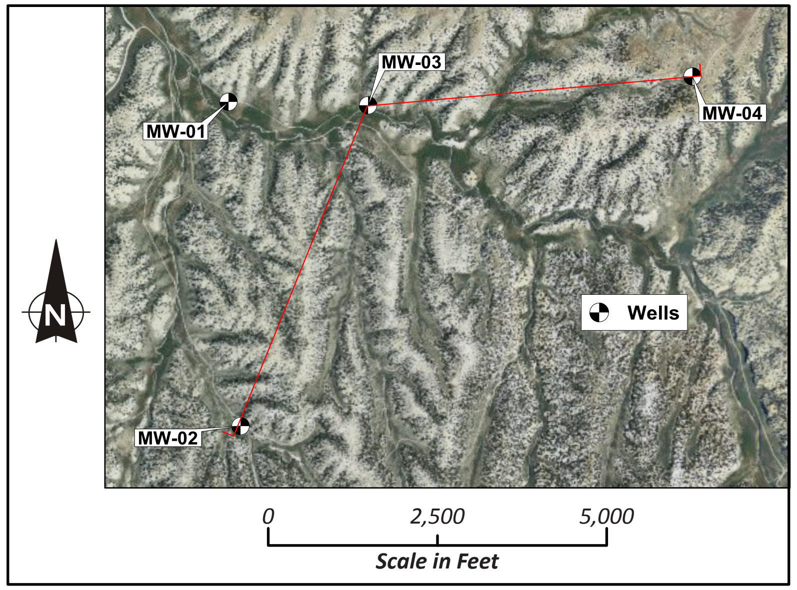
Figure 9-4

Cross Section B - B'

The Oil Mining Company, Inc.
Uintah County, Utah



Note: 2X vertical exageration.



Monitoring Wells

- Casing
- Screen

Stratigraphy

- Parachute Creek
- Wavy Tuff
- A Groove
- Mahogany Zone
- Mahogany Bed
- Curly Tuff
- B Groove
- Douglas Creek

Cross Section E-E'

Figure 9-4a

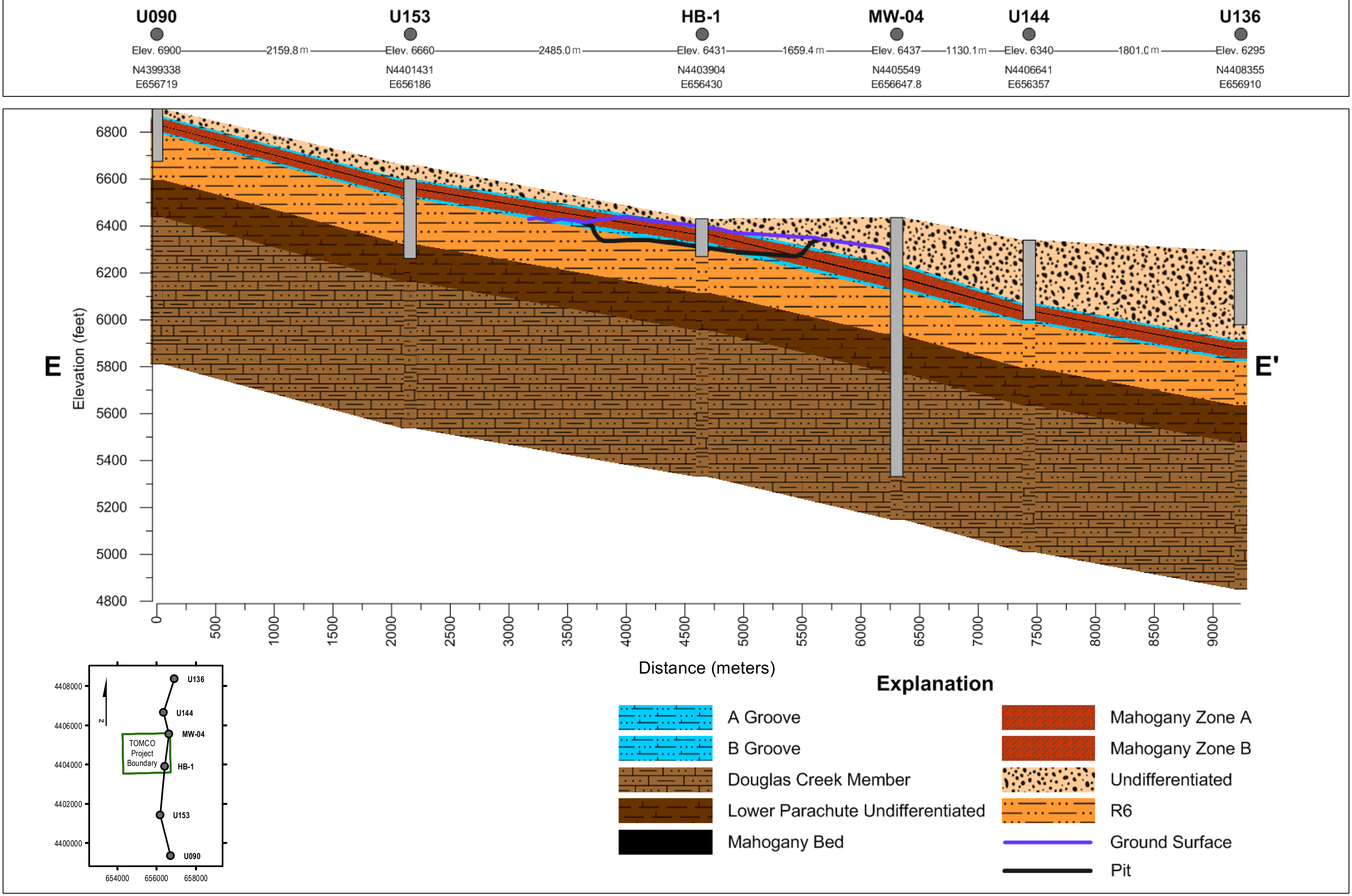
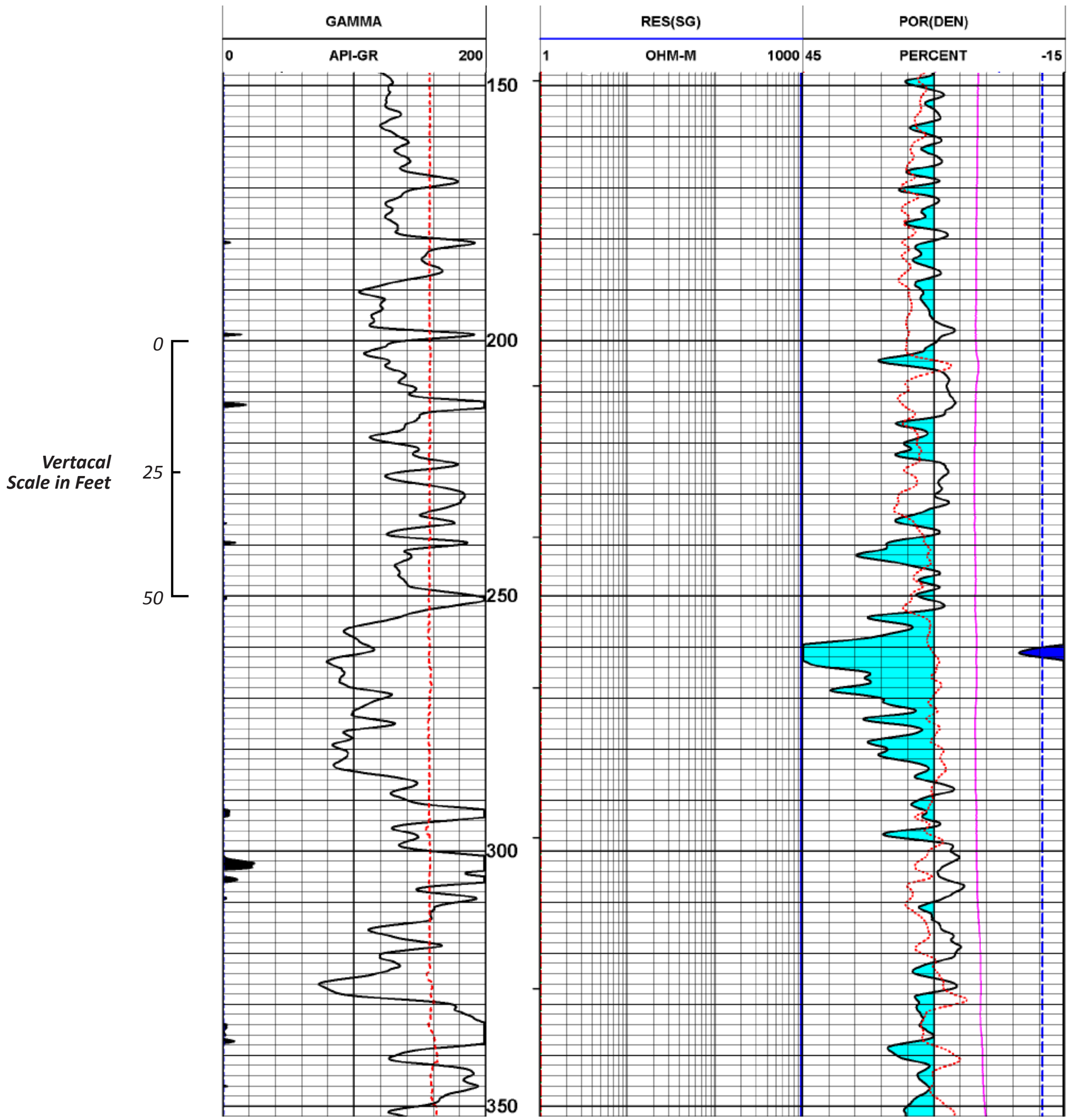


Figure 9-5
Selected Borehole Geophysics from the Mahogany Zone

The Oil Mining Company, Inc.
Uintah County, Utah



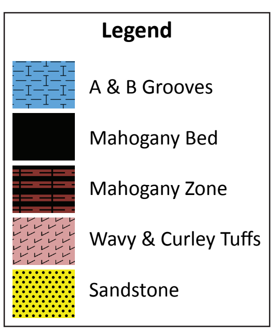
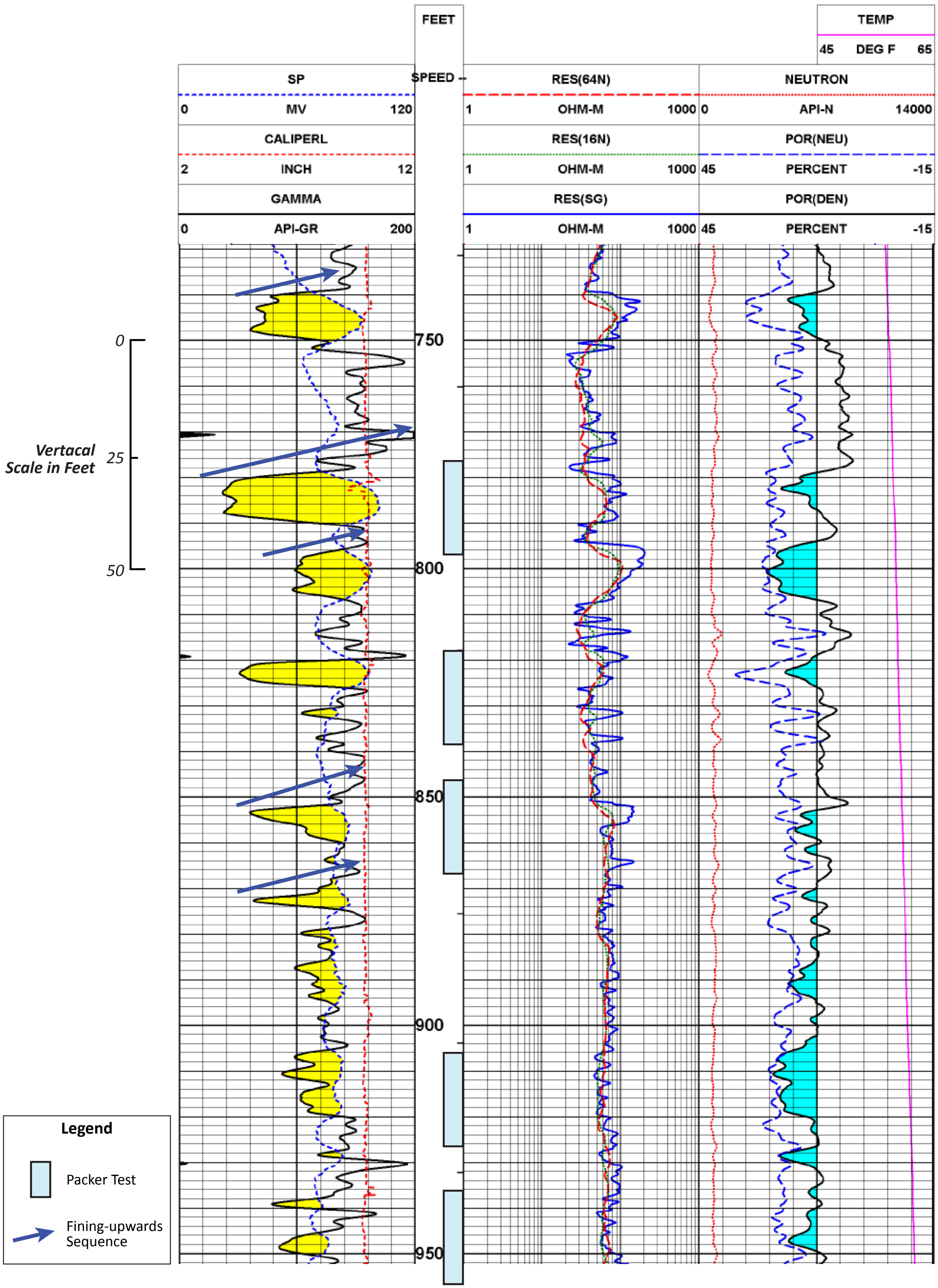


Figure 9-6
Selected Borehole Geophysics from the Douglas Creek Member

The Oil Mining Company, Inc.
Uintah County, Utah



Drilling, well installation, and groundwater sampling procedures for the monitoring wells were conducting as follows:

- Rig Type and Drilling Techniques
    - A Porta-Drill truck-mounted drill rig with an on-board air compressor was used to complete both the intermediate and deep wells. For the intermediate depth wells, a 10-inch drill bit was initially used to advance the boring from the surface to competent bedrock. Seven-inch steel casing was set and cemented in place at the following depths: Monitoring Well (MW)-01, 27 feet bgs; MW-02, 20 feet bgs; and MW-03, 14.3 feet bgs.
    - After the steel surface casing was set, each borehole was advanced to 200 feet bgs using the 6.25-inch bit. The borings were advanced dry until groundwater was encountered, after which a foaming agent suitable for drinking water well use was injected into the air stream to provide greater lift for groundwater and drill cuttings. After the boring was complete, the borehole was flushed with additional foam to clean the borehole of loose chips, then flushed with just air to clean the borehole of residual foam.
    - The deep borehole was created in a similar fashion except with larger diameter; a 14.75-inch drill bit was used to advance the boring from the surface to 20 feet bgs, then a 10.75-inch steel casing was set and cemented in place. From 20 to 1,100 feet bgs, the boring was advanced with an 8.75-inch drill bit with a Comp Air AC-3 750-cubic-feet/minute skid-mounted air compressor and foam injection after the initial encounter of groundwater. After the bit reached 1,100 feet bgs, the hole was cleaned with foam circulation, then air circulation.
- Packer Production Testing
    - Groundwater production tests were performed in each borehole in the form of dual packer production tests and open-borehole production tests. Packer testing was accomplished by inflating a top and bottom packer with nitrogen, isolating a zone of lithology, and pumping from the isolated

zone while measuring flow rate from the pump. Originally, three or four packer tests were planned in each borehole. The purpose of packer testing was to determine individual production of specific zones (e.g., sandstones) where there had been "shows" of groundwater during drilling. Successful packer tests were completed in MW-02 and MW-04. In MW-01 and MW-03, the amount of groundwater and degree of permeability were too low to sustain production down to the lowest possible rate, which is less than 0.5 gpm. As a result, open-borehole production tests were substituted for packer tests in an attempt to test the entire saturated section in the intermediate wells. Open borehole production tests were performed by pumping groundwater near the bottom of the borehole at differing rates depending on the amount of drawdown. Regardless of test type, drawdown in the three intermediate depth wells remained severe and production rates were very low. For MW-01, a production rate of 0.48 gpm was obtained in the open hole test. Drawdown was continuous, and the test was terminated at a drawdown of 36.2 feet. For MW-02, a successful packer test produced water at 1.33 gpm, but recovery rate was very slow. An open well test produced 0.95 gpm with 83.5 feet of drawdown, suggesting overall dewatering of the well. For MW-03, open borehole tests produced 0.53 gpm to 0.87 gpm, with a drawdown of 77.8 feet. Well MW-04, which penetrated and was screened in the Douglas Creek aquifer, showed higher production rates, reaching 20 gpm with a slowing drawdown of 30.85 feet. Further detail on well drawdown and production is provided in **Section 9.2.4**, below.

Where possible, water quality samples were collected during groundwater sampling.

- Borehole Geophysical Survey
  - A borehole geophysical survey was performed on the deep borehole (MW-04) by Century Wireline Services. Geophysical logs in the survey suite included: Spontaneous Potential; Gamma Ray; Caliper; Deep,

Deleted: In all but one

Deleted: well, drawdown in these wells

Deleted: were well below 1 gpm

Intermediate, and Shallow Resistivity; Density; and Neutron. Portions of the geophysical log that are representative of subsurface conditions are included in **Figures 9-5 and 9-6**. The entire log appears in **Appendix D**. The geophysical survey assisted with the interpretation of key stratigraphic units in the Parachute Creek and Douglas Creek Members.

- Well Completion
  - A monitoring well was installed in each borehole. The three intermediate depth monitoring wells were constructed of Schedule 80 PVC with a 2-foot sump and a 0.020-inch slotted Schedule 80 PVC screen. The deep monitoring well was constructed with carbon steel with a 2-foot sump and a 0.020-inch slotted carbon steel screen. Monitoring well identifiers, screen lengths, and total depths are listed in **Table 9-2**. Note that the initial screen intervals of the intermediate monitoring wells were planned to be 20 feet but were increased as the Parachute Creek Member proved to be very impermeable and would only produce groundwater at rates of less than 1 gpm.

Table 9-2 Site Monitoring Wells

Monitoring Well ID	Screened Interval (feet bgs)	Total Depth (feet bgs)
MW-01	148–198	200
MW-02	148–198	200
MW-03	117.3–197.3	200
MW-04	1,058–1,098	1,100

Key:
bgs below ground surface

  - Each monitoring well had the annular space filled with 6-9 Colorado Silica Sand across the screened interval, a transition zone of 10-20 Colorado Silica Sand, and a seal of hydrated bentonite pellets. For intermediate depth monitoring wells, bentonite chips were used as backfill for the remaining annular space, for the deep monitoring well bentonite grout was used. Complete well construction details are available in the boring logs, which are included in **Appendix C**.

- Well Development
  - All monitoring wells were developed via surging and air lifting. A plunger style surge block was used to surge the submerged screened interval, with the surge block moving up the interval in sections to ensure that the entire submerged screen was surged. Air lifting was then accomplished by placing a tremie pipe at the bottom of the well (within the sump) and forcing compressed air down the pipe to lift turbid water out. To further develop the intermediate wells, a second round of surging and air lifting was performed one week later, when the wells had had a chance to refill with available formation water. This second round of surging and airlifting was followed with pumping using a submersible pump placed at the bottom of the well to evacuate the remaining turbid water. Due to the low inflow rate of the installed wells, water quality stabilization criteria could not be used to determine well development.
  - In MW-04, air lifting was much more successful and could be operated continuously. Air lifting was conducted for 8 hours in this well until water quality criteria were deemed stabilized.

Monitoring wells were given one week to stabilize, after which groundwater samples were collected with a submersible pump for all four monitoring wells. An attempt was made to purge three well volumes from each well before sampling; however, the three intermediate depth wells did not have sufficient recharge to yield three well volumes. These three wells were sampled with the last water available before running dry. The deep well had sufficient recharge to purge three well volumes before sampling. During sampling, water quality field parameters were collected simultaneously.

9.2.4 Discussion

A type stratigraphic column of the project area is presented in in **Figure 9-2**. The type log depicts the common characteristics of the subsurface geology for the Parachute Creek and Douglas Creek Members that were observed in in the project area. It is based on the geologic features observed from the four monitoring wells and nine coreholes that have been drilled and completed. Three intermediate depth monitoring wells were drilled to 200 feet bgs, and all penetrated well into the Parachute Creek Member. One deep monitoring well was drilled to 1,100 feet through the Parachute Creek Member and an estimated 450 feet into the Douglas Creek Member. Boring logs for all wells and coreholes appear in **Appendix C**. The borehole geophysical log for MW-04 appears in **Appendix D**. The type log (**Figure 9-2**) provides the best overall representation of Green River Formation in the subsurface across the site. All of the principal stratigraphic units present across the project area in the Parachute Creek Member of the Green River Formation and also the Douglas Creek Member are present on the type log. These include:

- R-6 and R-8 of the Parachute Creek Member, which are composed of marlstones, shales, and siltstones;Mahogany Zone (R-7) and the Mahogany Bed. This formation is composed of more organic rich shales and is the mining horizon for this project;
- Wavy Tuff, a volcanic tuff from a volcanic eruption that affected the entire Green River Basin age dated at 48.7 million years before present;
- A Groove, composed of a dolomitic marlstone that is about 10 feet thick in the project area;
- B Groove, composed of a dolomitic marlstone that is about 10 feet thick in the project area;
- Curly Tuff, a volcanic tuff aged 49.3 million years before present; and
- Lower Parachute Creek strata, which is nearly 400 feet thick and eventually grades into the Douglas Creek Member.

The dominant lithologies of the borings were marlstone and shale. Sandstones were also identified above and below the B Groove in the Parachute Creek Member and in the lower portion of the Douglas Creek Member, although they were not a dominant lithology in these stratigraphic sections. Cross sections of site-wide stratigraphy sections appear on **Figures 9-3 and 9-4**.

These findings agree with the established literature that the Parachute Creek Member was deposited in a low-energy lacustrine environment and is thus composed primarily of fine-grained sediments (Holmes and Kimball 1987). The TomCo site is on the southeast fringe of the Green River Basin in Utah. The deepest portion of the basin lies to the north of the project area and trends east-southeast and west-northwest. The Mahogany Zone stands out in all three intermediate borings as a zone of increased kerogen content, with sections of the Mahogany Zone appearing oil productive in the borehole. During installation of several of the borings, cuttings were returned to the surface with a distinct order of petroleum hydrocarbons. The section producing the most abundant oil is interpreted as the Mahogany Bed and is recognized in the geophysical log in MW-04 from 258 to 264 feet bgs (**Figure 9-5**). The Mahogany Zone is encountered at 25 to 110 feet bgs in MW-01, at 45 to 120 feet bgs in MW-02, and 35 to 120 feet bgs in MW-03. The Mahogany Zone can be seen at the surface in outcrops, particularly in the southeast portion of the project area (Vanden Berg 2014; Lowham Walsh 2014). It occurs as beds of kerogen that are deposited in very fine layers as seasonal varves, interbedded with marlstones and shale, and occasional stringers of siltstone.

During the site visit conducted by the DWQ and Utah Geological Survey on May 21, 2013, the team observed apparent sandstones in outcrops of the Parachute Creek Member. These sandstones appeared to outcrop both above and below the B Groove and could be considered more permeable than the shales and marlstones. Several sandstone beds were identified in cuttings returned to the surface during drilling of the borings through the Parachute Creek Member. For the most part, the cuttings appeared to be in the range of siltstones and fine-grained sandstones. The sandstones can also be seen in the cores drilled in 2010 appearing immediately beneath the B Groove. When examined in cores, these sandstones beds appear to have very little primary porosity and permeability, due either to very poor sorting, resulting in a mixture of mud and sand, or later injection of tar into the primary sand matrix. These zones appear to have very low permeability based on the fact that of the three borings, only one produced a very slight amount of groundwater during drilling and subsequent packer tests. All four borings were subjected to packer production testing to measure sustained groundwater production rates. The results of these tests are fully discussed in **Section 9.3.2.1** of this permit application.

MW-04 was drilled to a depth of 1,100 feet bgs. This well was of significant value to project area studies in that it provided a complete stratigraphic section of the entire area of interest. The objectives for drilling MW-04 to this depth were:

- To provide a means of monitoring for the Douglas Creek Aquifer;
- To acquire a complete section of the of the Parachute Creek and the Douglas Creek Members of the Green River Formation;
- To assess the amount of stratigraphic separation between the Parachute Creek and the Douglas Creek Members; and
- To determine the potential for groundwater use during mine site development and subsequent operations.

During drilling, this well was logged by the on-site geologist (see **Appendix C**). Prior to well completion, a borehole geophysics survey of the entire well was also completed (see **Appendix D**), including: Spontaneous Potential; Gamma Ray; Caliper; Deep, Intermediate and Shallow Resistivity; Density, and Neutron logs. The following major stratigraphic features were observed on the borehole geophysical log:

- Wavy and Curly Tuff;
- A Groove; B Groove;
- Mahogany Zone (R-7);
- Mahogany Bed;
- Transition to the Douglas Creek Member; and
- Fining upward sequences (i.e., deposition of subsequently finer grain sizes—sand, silt, clay—moving upward through the sandstone bed) in the Douglas Creek Member, representing fluvial systems that were being deposited as the delta prograded out into the Green River Basin (see **Figures 9-5 and 9-6**).

MW-04 is located in the northeast corner of the project area. The surface elevation of the well location is 6,438 feet above sea level. The average elevation of the three wells located in the East

Seep Canyon is about 6,152 feet above mean sea level. Thus, there is significantly more section in the R-8 unit of the Parachute Creek Member in MW-04. For instance, the top of the Mahogany Bed is recognized in MW-04 at a depth of 258 feet bgs. In MW-01, MW-02, and MW-03, the Mahogany Bed is generally in the range of 50 to 80 feet bgs. **Figure 9-5** is an annotated section of the geophysical log for MW-04 from 200 to 400 feet bgs. The log is annotated with all the important stratigraphic features in the Mahogany Zone interval, including the Wavy Tuff, A Groove, Upper and Lower Mahogany Zone, Mahogany Bed, Curly Tuff, and B Groove. The top of the Mahogany Zone begins at about 213 feet bgs. The Mahogany Bed itself appears from 258 to 265 feet, and the base of the Mahogany Zone appears at about 300 feet.

The Douglas Creek Member appears with the first prominent sandstone bed at about 664 feet bgs. The contact between the Douglas Creek and Parachute Creek Members often does not stand out sharply in the drilling returns and outcrops, and previous mapping of the two units suggests that the contact between them is gradational (Keighin 1977; Pipiringos 1978). This is consistent with observations made during logging of MW-04. While the first prominent sandstone is noted at 664 feet bgs, several less prominent and perhaps finer grained sandstone beds are noted between 510 feet bgs and 588 feet bgs. Approximately 15 sandstones are noted in the Douglas Creek Section, with typical bed thicknesses of 8 to 12 feet. The vertical bed architecture of several of the sandstone beds appear to be fining upward sequences. Fining upward sequences are signature stratigraphic intervals for high sinuosity (meandering) rivers. This interpretation is consistent with the depositional environments recognized in the Douglas Creek Member, which consisted of periodic prograding deltaic events extending into the Green River basin.

The sandstone bed that appears beneath the base of the B Groove in some of the coreholes has also been recognized in outcrop in the site area. In MW-04, the sandstone bed appears to be also present beneath the B groove at a depth of 320 to 330 feet bgs. Low permeability rocks result in significant stratigraphic separation between the Douglas Creek and the Parachute Creek Members over the following intervals: 338 to 400 feet bgs, 420 to 508 feet bgs, 522 to 568 feet bgs, and 602 to 662 feet bgs. Significant stratigraphic separation of at least 256 feet exists between the R-6 zone of the Parachute Creek Member and the Douglas Creek Member. These rocks are likely a combination of calcareous mudstones and rich and lean shales. This amount of stratigraphic separation provides a significant barrier and isolates the Douglas Creek Member from the Parachute Creek Member. The importance of this separation is discussed further in **Section 9.3.2**.

9.3 Project Area Groundwater

9.3.1 Southern Uinta Basin Groundwater Setting

The State of Utah defines an aquifer as “a geologic formation, group of geologic formations or part of a geologic formation that contains sufficiently saturated permeable material to yield usable quantities of water to wells and springs” (UAC R317-6-1). The Utah State Water Plan (UDWR 1999) refers to the Mesa Verde Formation as the regional aquifer closest to the surface in the Project Area.

Groundwater underlies the lease area at depth (Freethy and Cordy 1991). Mesozoic-age rock underlies much of the upper Colorado River Basin, including the Uinta Basin. Several aquifers of regional extent are found within these rocks (Freethey and Cordy 1991). Groundwater associated with the Mesa Verde Group is the uppermost of these larger aquifers. Within the Uinta Basin, the saturated thickness associated with this aquifer often well exceeds 2,000 feet, but is buried quite deep (Freethey and Cordy 1991). Regionally, the direction of groundwater movement in this part of the Uinta Basin is toward the north and the White River. Water quality in the Mesa Verde and other regional aquifers ranges from relatively good to briny, with a range of 1,000 to 3,000 mg/L total dissolved solids expected in the aquifer underlying the project area (Price and Miller 1975).

State and federal publications (Price and Miller 1975; Sprinkel 2009) describe the Green River, Wasatch, and Mesa Verde Formations as intermixed strata of sandstone, shale, siltstone, and mudstone, with permeabilities ranging from very low to high. The Green River Formation is generally considered an aquiclude in the southern part of the Colorado River Basin, with low spring and well yields (Price and Miller 1975). In the central and northern parts of the basin, the Birds Nest Aquifer is located in the upper part of the Parachute Creek Member and is recharged from the area of Evacuation Creek to the east where the Birds Nest zone is partly exposed (BLM 2008).

The Utah Geological Survey has compiled information on surface and groundwater quality in the southeastern Uinta Basin in an Open-File Report (Wallace 2012). That report describes water quality and gross geology in selected wells, springs, and drill holes in the basin. In addition, 24 water quality samples from surface water bodies, springs, and wells were collected as part of the study; however, none were in the vicinity of the project area. Supplemental data for the study were provided by oil and gas companies and published sources.

A USGS Water-Resources Investigations report is of particular importance to this analysis (Holmes 1980). This report describes the results of groundwater test holes drilled by the USGS in the southeastern Uinta Basin from 1976 to 1978. The objective of the study was to evaluate the two recognized aquifers in the Green River Formation: the Birds Nest Aquifer in the Parachute Creek Member and the Douglas Creek Aquifer. A total of six wells were drilled; all reportedly penetrated some thickness of the Douglas Creek Member. Two of the six wells were completed in the south-central part of the basin. Test Hole 2 was drilled approximately 5 miles east of the project area on a small tributary of Bitter Creek, and Test Hole 3 was drilled approximately 7 miles to the northwest on Willow Creek. Each well encountered the Douglas Creek Member relatively near the ground surface.

After drilling through the Parachute Creek Member, Test Hole 2 was drilled to a depth of 1,290 feet and penetrated what Holmes (1980) described as intertonguing beds of the Douglas Creek and Wasatch Formations, beginning at a depth of 50 feet. Small quantities of water were encountered near the surface and at a depth of 400 feet. Significant water was encountered at a depth of 740 feet in what was described as the Douglas Creek Member. Discharge rates of up to 200 gpm were encountered as the hole was deepened. Based on geophysical logging, the water is inferred to be derived from sandstones. The well was cased to total depth and was un-cemented. Static water level was measured at 383 feet depth after completion of the well and prior to aquifer testing. The static water level observed indicates that the Douglas Creek Aquifer at this location is confined.

Test Hole 3 was drilled to a depth of 1,092 feet and penetrated alluvium to a depth of 190 feet, where it entered the Douglas Creek Member. After drilling through a 60-foot-thick tongue of the Wasatch Formation, the well bottomed in the Douglas Creek Member. The upper 250 feet of the hole was cased to eliminate caving. Measured discharge rate was variable and reached a maximum flow rate of 190 gpm at 550 feet. Again, based on geophysical logging, it appeared that sandstone was the dominant lithology in the well. The well was not cased and is open from 250 to 1,092 feet. No aquifer tests were conducted. Static water level was 11 feet bgs after completion, again indicating that the Douglas Creek Aquifer is confined in this area.

The following section discusses regional groundwater conditions and their relationship to TomCo's project area.

9.3.2 Project Area Groundwater Investigation

9.3.2.1 Hydrogeology

The geological and hydrogeological study developed for the TomCo site was based on the conceptual site model that was developed for the project area, as discussed in **Section 9.2.2**. Several other investigations provided background for the development of the conceptual site model. These include the 2010 corehole investigation that was performed in the project area and hydrogeological studies that were performed on the Red Leaf site, which is approximately 10 miles of project area. These studies, which both focused on the same subsurface rock formation—the Parachute Creek Member—as the study performed for the TomCo site, provided critical geologic and hydrogeologic information that was used to develop the conceptual site model and subsequent investigations for the project area in the fall of 2014. Studies performed at the RLR site demonstrated that the sedimentary rocks that make up the Parachute Creek Member—principally, shales, mudstones, and marlstones—did not have sufficient porosity and permeability to contain or transmit significant amounts of groundwater (RLR 2013). In 2010, nine coreholes were drilled across the project area. All cores were drilled well below the B Groove, so they tested important strata above and below the Mahogany Zone, which is the primary ore zone for this project. The cores were entirely void of groundwater, except for three—Coreholes HB-003, HB-008, and HB-009—which had groundwater shows in the Mahogany Zone. Minor sandstone beds, some filled with tar, were also recognized both above and below the Mahogany zone. The vast majority of the cored stratigraphic section comprised shales, mudstones, and marlstones.

From this preliminary work at the TomCo site, and supporting studies at the RLR site, the conceptual site model discussed previously was developed to provide an understanding of site hydrology so that the TomCo mining project may be developed in a manner that protects groundwater and surface water resources. The conceptual site model is characterized by the following key aspects:

- Sedimentary rocks within the Mahogany Zone are made up of primarily shales, siltstones, and marlstones that have very low permeabilities. For the most part, these rocks are incapable of storing and transmitting significant amounts of groundwater. The groundwater quality from these zones is anticipated to also be poor due to the fact that the rock matrices contain hydrocarbons.

- Sandstones, while being a minor part of the entire Mahogany Zone section, may have the ability to transmit more significant amounts groundwater. However, the sandstones at the TomCo site have limited permeability due to poor sorting or the presence of tar or oil; i.e., tar sands.
- The Douglas Creek Member was deposited at a time when deltas were prograding out into the Green River Basin. In some cases, this resulted in fluvial systems that were larger and more numerous than those present during the period of deposition, when sediments from the Parachute Creek Member were deposited. Douglas Creek sandstones resulting from these fluvial processes have the potential to be better sorted, resulting in better porosity and permeability. Thus, the Douglas Creek Member is recognized as an aquifer that must be protected.
- A significant impermeable section beneath the Parachute Creek Member exists and is expected to result in hydraulic separation between the Parachute Creek Member and the Douglas Creek Member.

Discussion

Three monitoring wells (MW-01, MW-02, and MW-03) were drilled into the Parachute Creek Member. These wells were installed at corehole locations HB-003, HB-008, and HB-009, where there were previous shows of groundwater during coring. One monitoring well, MW-04, was installed in the northeast corner, and cross-gradient of the project area (**Figure 9-1**). This well was drilled to 1,100 feet bgs into the Douglas Creek Member. Packer production tests were performed on all wells. In addition, groundwater samples were also collected to assess water quality. The overall hydraulic gradient for groundwater in the Parachute Creek was 0.032 feet to the north or northwest. The gradient for the Douglas Creek Member could not be measured; however, regionally, the gradient for the Douglas Creek Aquifer is towards the White River, to the north (Holmes and Kimball 1987).

During packer testing, sparse amounts of groundwater were produced from the intermediate monitoring wells. Ten packer tests were performed in the intermediate wells: three in MW-01, four in MW-02, and three in MW-03. In general, insufficient water was produced from any of the tests to indicate that any of the zones had sustainable production. The results of the tests are presented in **Table 9-3**. The specific advantage of packer testing is that a specific interval, in this case a 20-foot interval, can be tested. For instance, a sandstone within the Mahogany Zone beneath the B Groove can be targeted. The packers are inflatable, and they are filled with nitrogen to a pressure that exceeds the hydrostatic head in the borehole. Water is then produced out of the zone, and a specific sustainable production rate will be determined. In particular, this made sense for the tests conducted in the Green River Formation in the project area because a number of sand lenses were observed within the Mahogany Zone and immediately below the B Groove. Specifically, the tests would determine if the sandstone lenses are productive and could be a valuable groundwater resource.

Of the 10 packer tests, five were depth-specific tests, and five were open bore hole. The results of all the tests are summarized below:

- MW-01: No groundwater was produced in either of the two depth-specific packer tests on MW-01. A production rate of 0.48 gpm was obtained in the open hole test. Drawdown was continuous, and the test was terminated at a drawdown of 36.2 feet.

- MW-02: This well was by far the most successful set of packer tests conducted in the intermediate wells, even though both tests appeared unsustainable. One depth-specific test at 175.5 to 191.3 feet bgs (nearly at the total depth of the well) produced water at a rate of 1.33 gpm. The recovery of the zone was very slow, producing an average recharge rate of 0.18 feet per minute. An open well production test was performed in MW-02 about 0.5 hours after the completion of the packer test. The production rate from the open hole test was 0.95 gpm, which is significantly below the production rate for the specific packer test from this well. Drawdown from the open hole production test on MW 02 was extreme, 83.5

feet, suggesting that the productivity zone of the entire well was rapidly decreasing.

- MW-03: Three tests, one packer and two open hole production, were performed on MW-03. The packer test was conducted in sandstone at 165 to 185 feet bgs. It produced water at a rate of 0.51 gpm, with a drawdown of 39.5 feet bgs. Two open borehole tests were then performed approximately two weeks apart. The first test produced at a rate of 0.53 gpm; however, there was absolutely no recovery in the borehole, indicating that the storage of groundwater in the rock formation was very low. In the second test, the rate was actually increased to 0.87 gpm. The drawdown of 77.8 feet was severe.

In summary, the results of these hydraulic tests indicate that the occurrence of groundwater in the Parachute Creek Member is remote and is not sufficiently productive to be classified as an aquifer. This conclusion is strongly supported by the fact that of the nine coreholes drilled across the site in 2010, only three had shows of groundwater. In other words, the corehole work indicated that two-thirds of the coreholes did not contain any groundwater in the Parachute Creek Member. Of the three coreholes that did show groundwater, the subsequent productivity test results were very poor. While the productive zones seem to suggest that there is some permeability to transmit groundwater in the Parachute Creek Member, the rate of production and the excessive drawdown of all the tests indicate that that there is very little groundwater storage in any of these zones. The cores of the Parachute Creek Member do show some fine to medium grained sandstones; however, they are either very poorly sorted (i.e., the rock matrix is sand supported by mud), or they have been impregnated with tar and have become impermeable as a result.

In contrast to the Parachute Creek Member, the Douglas Creek Member provides a groundwater resource that can be classified as an aquifer, as the packer tests indicate. Six tests were attempted on the Douglas Creek Member. Tests that produced significant amounts of groundwater included one open borehole test that was run in the form of a step drawdown test and one packer production test. Four other packer production tests were attempted; all failed to produce groundwater. The step drawdown test was performed over a period of 2 hours on the open borehole, and the well was pumped near the total depth of the well at progressively increasing production rates of 2, 3, 5, 10, and 20 gpm over the test period (**Table 9-2**). In each step, the static water level stabilized or nearly stabilized. The duration of the last step at 20 gpm was 0.5 hours. The total drawdown of the entire step drawdown test, including the last step, was 30.85 feet. It is likely that this last step would have also stabilized, as the rate of drawdown decreased to 1 foot per 5 minutes before the test was terminated.

A second packer production test was performed in sandstone between 906 and 927 feet bgs. This zone was also productive, yielding groundwater at a rate of up to 10 gpm. The test was conducted for 1 hour. Four other tests were attempted in sandstones with strong Gamma Ray and Spontaneous Potential signatures and density porosities of at least 15 percent. Three of these tests were in shallower zones uphole from the successful test at 906 feet bgs. The tests were conducted at 936 to 957 feet bgs, 846 to 867 feet bgs, 818 to 839 feet bgs, and 776 to 797 feet bgs. Surprisingly, no groundwater was produced in any of these tests. These results are especially unexpected considering that all of these zones looked like they should be at least as productive as the successful test based on the log analysis that was performed using the borehole geophysical log. The likely explanation for this phenomenon is that the non-productive sandstones are actually tar sands and all pore spaces are actually filled with tar. This is a common phenomenon in the upper portion of the Douglas Creek (Vanden Berg 2014). Subjective support for this conclusion is provided by observations made by the driller, who asserted that more significant water production began between 900 and 1,100 bgs, suggesting that the Douglas Creek sandstones were not productive at shallower depths.

The static water level of the Douglas Creek Formation in MW-04 was measured at 720 bgs during the borehole geophysical survey. It is likely that the Douglas Creek Formation is confined or semi-confined in the site area, for two reasons. First, the primary productive zones for the Douglas Creek Formation are below 900 feet. However, water is present at 720 feet, suggesting that the water level rose to that elevation while drilling through the section in the lower part of the borehole. Second, there are substantial shale and marlstone sections in the lower portion of the Parachute Creek Member and upper Douglas Creek Member. These intervals are present at 338 to 400 feet bgs, 420 to 508 feet bgs, 522 to 568 feet bgs, and 602 to 662 feet bgs. This results in 256 feet of impermeable strata between the Mahogany Zone and the top of the Douglas Creek

Member. Based on the results of the packer testing, there is likely another 300 feet of low permeability strata at the top of the Douglas Creek Member prior to the productive sands being encountered below 900 feet. In conclusion, a great length of low permeability section exists between the Douglas Creek Member and the Mahogany Zone. This length of section isolates the Douglas Creek Aquifer from any occurrences of groundwater in the Mahogany Zone. They are two separate hydrological systems.

Table 9-3 Packer Test Summary

Location	Test No.	Date	Time	Depth to GW	Test Depth	Rate	Feet Draw-down	Comments
MW-01	PT-01	9/20/2013	15:30	158.5	67.5–82.5	No water produced		
MW-01	PT-02	9/21/2013	10:40	157.2	172.5–188.5	No water produced		
MW-01	Open borehole	10/5/2013	12:34	162.5	199.2[a]	0.48 gpm[b]	36.2	No measurable recharge
MW-02	PT-04	9/23/2013	11:30	93.8	175.5–191.3	0.72 gpm[b]	68.0	
MW-02	Open borehole	9/23/2013	14:01	106.1	161.8[a]	0.27 gpm[b]	4.0	Unstable recharge observed post-test
MW-02	PT-11	10/7/2013	8:40	77.3	165–186	1.33 gpm		Recharge 0.18 ft/min
MW-02	Open borehole	10/7/2013	12:58	114.3	195[a]	0.95 gpm	83.5	Recharge 0.69 ft/min
MW-03	PT-03	9/21/2013	16:25	123.0	175.5–191.3	0.51 gpm[b]	39.5	
MW-03	Open borehole	9/22/2013	8:50	147.7	162.5[a]	0.53 gpm[b]	14.1	No measurable recharge.
MW-03	Open borehole	10/6/2013	10:40	121.2	194.2[a]	0.87 gpm[b]	77.8	Recharge 0.0625 ft/min
MW-04	Open borehole	10/2/2013	10:49	741.4[c]	1090[a]	2.0 gpm	1.85	Stepdown test
MW-04	Open borehole	10/2/2013	11:25	747.1	1090[a]	3.0 gpm	7.9	Stepdown test
MW-04	Open borehole	10/2/2013	11:58	757.6	1090[a]	5.26 gpm	5.3	Stepdown test
MW-04	Open borehole	10/2/2013	12:33	769.05	1090[a]	9.52 gpm	10.05	Stepdown test
MW-04	Open borehole	10/2/2013	13:16	793.3	1090[a]	20 gpm	30.85	
MW-04	PT-05	10/2/2013	15:25	748.5	906–927	10 gpm		

Table 9-3 Packer Test Summary

Location	Test No.	Date	Time	Depth to GW	Test Depth	Rate	Feet Draw-down	Comments
MW-04	PT-06	10/3/2013	8:28	714.9	818–839	No water produced		
MW-04	PT-07	10/3/2013	9:57	723.3	846–867	No water produced		
MW-04	PT-08	10/3/2013	11:24	723.3	776–797	No water produced		
MW-04	PT-09	10/3/2013	13:00	724.4	936–957	No water produced		

Notes:
a For open borehole production tests the test depth is the depth to the inlet point on the submersible pump.
b The rate never stabilized as a sustainable yield was not produced. Rate shown is an average pumping rate for the duration of the test.
c Reflects initial static water level after pumping rate stabilized. Pre-test static water level was 712 feet bgs.

Key:
bgs below ground surface
ft/min feet per minute
gpm gallons per minute
GW groundwater

9.3.2.2 2014 Intermediate Depth Wells Stress Tests

To further characterize well drawdown and recharge in the proposed mining horizon, TomCo conducted three single well aquifer stress tests. These tests were conducted as simple pump and recovery tests on the three intermediate monitoring wells (200 feet bgs) installed in October 2013, with the objective to collect estimates of:

1. Total volume pumped (volume)
2. Well drawdown (length, feet)
3. Sustainable pump rate(s) (volume/time)
4. Rate of recovery (residual drawdown vs. time)

The workplan for these tests was predicated upon the ability of each well to sustain a constant pump rate at a quasi-stable value of drawdown. In practice however, identification of sustainable pump rates was complicated by the depth to water and the ability of the equipment to sustain constant rates at such depths. Therefore, each well was pumped at whatever rate the pump could sustain for as long as measurable drawdown was available or until the pump could not overcome the pressure differential at some increased value of drawdown.

Water level measurements obtained 12 days after initial well development in 2013 are presented in **Table 9-4** and compared to measurements made during October 2014, approximately one year later. As shown in **Table 9-4Error! Reference source not found.**, each well registered some amount of water level change after October 2013, probably reflecting the process of the well coming into equilibrium with the ambient head of the screened interval. The October 2014 water levels are therefore considered the best available representation of ambient conditions for the water-bearing zone in contact with the screen in each well.

Table 9-4 Water Level Measurements, 2013 versus 2014

Monitoring Well	Depth to water, October 2013 (ft bgs)[a]	Depth to water, October 2014 (ft bgs)	Water Level Change (feet)
MW-01	175.3	173.69	+1.61
MW-02	180.3	181.85	-1.55
MW-03	180.7	190.03	-9.33

Notes:
a. Water levels measured on 10/22/2103, 12 days after initial development was completed in each well.
Key:
ft bgs feet below ground surface

Each well was instrumented and tested over a two-day period, which included pump and transducer installation, overnight trend measurement, and pumping followed by at least a week of recovery. **Table 9-5** summarizes pertinent dates, times, durations and selected data associated with each test.

Table 9-5 Summary of Instrumentation Times, Test durations, Drawdown, and Recovery

WELL ID	Pump Installed	Test Start	Duration of Pumping (minutes)	Maximum Drawdown (feet)	Volume Pumped (gallons)	Recovery Duration (days)	Residual Drawdown (feet)
MW-01	1100 on 11/6/14	1105 on 11/7/2014	33.0	10.7	5.76	7.9	0.82
MW-02	1400 on 10/22/14	0930 on 10/23/14	78.24	11.42	6.8	8.1	9.24
MW-03	1530 on 10/22/14	12:52 on 10/23/14	8.1	7.41	3.14	8	1.16

Three 1.75-inch diameter Geotech GeoSub^{TM} stainless steel submersible pumps were specified for the testing in the monitoring wells. The transducer selected for testing was an In-Situ Troll 700TM, with a 30-pouns per square inch (psi) (69-foot) rating, which records pressure in psi, temperature in Celsius, and either depth below water level, or depth to water from a measurement point. In all cases, the transducer was set up to record depth to water below the top of the 2-inch PVC casing. The target depth for the bottom of the Geotech GeoSubTM stainless steel submersible pump was approximately equal to the bottom of the screen.

Depth to water was determined manually upon arriving at the site using an In-Situ Rugged 200TM electronic water level tape, referenced to the top of the 2-inch PVC well casing. Once depth to water was determined, the height of the static water column was calculated by subtracting the depth to water below ground surface (bgs) from the total depth of the well bgs.

After the instrumentation was installed in each well, the displaced volume of water was calculated. The corresponding increase in water level in the well was determined by dividing the displacement volume by the volume per foot for 2-inch casing (0.163 gallons per foot).

At the time the pump initialization phase was completed and the pumping began, the transducer log was started simultaneously with a stopwatch to record splits for discharge measurements. Discharge was calculated between time splits measured for 1 gallon of water captured in a graduated bucket. This resulted in average discharge values for the time split rather than instantaneous discharge measurements, which could have only been achieved through the use of a high precision low-flow meter, which was not available. Because it was known from observation that discharge decreased over time, discharge estimates were made and added to the log to augment the average discharge measurements during the data reduction to better fit the analytical models used in curve-fitting procedure.

Pumping periods for each well were analyzed by the method of Moench (1997) as implemented by the Aqtesolv™ well hydraulics analytical software program (Duffield 2007). Recovery periods were analyzed by the residual drawdown method derived from the Theis (1935) non-equilibrium equation as presented by Driscoll (1986). Analytical methods are described in greater detail in **Appendix K**, as are detailed pumping descriptions for each well.

MW-01 Test Summary

Two tests were attempted in MW-01 on November 7 2014. The first test was aborted due to poor pump performance (the pump failed to bring groundwater to the surface). The second test was completed successfully. A summary of settings and average discharge measurements made per gallon pumped is presented in **Table 9-6**. As noted in the table, water being pumped from the well was discolored, contained suspended fines, and had a hydrocarbon odor.

Table 9-6 MW-01 Pump Setting and Discharge Measurements

Time After Pumping Began (minutes)	Pumping Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement Start (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[a]	Comment
0	225	NA	NA	NA	NA	Pump started.
1	240	NA	NA	NA	NA	Power increase successful.
1.33	240	1:20	5:30	4.17	0.24	Water flowing at top of casing light grey with suspended fines. 1 gallon pumped.
5.5	240	5:30	10:00	4.5	0.22	Total 2 gallons pumped.
10.33	240	10:20	17:31	7.18	0.14	Total 3 gallons pumped.
17.52	240	17:31	27:00	9.48	0.11	Total 4 gallons pumped.
25:33	247	NA	NA	NA	NA	Power increase successful.

Table 9-6 MW-01 Pump Setting and Discharge Measurements

Time After Pumping Began (minutes)	Pumping Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement Start (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[a]	Comment
27	247	27:00	31:00	4	0.19	0.75 gallons produced in this time interval. Cumulative total 4.75 gallons pumped.
31	247	NA	NA	NA	NA	Water stopped flowing.
31.5	255	NA	NA	NA	NA	Power increase successful. No flow.
33.4	0	NA	NA	NA	NA	Pump shut down.

Notes
a. Average rate for the entire time of pumping 0.19 gpm calculated from time pumping started to when water stopped flowing, and considering the volume of the discharge tubing (1.01 gallons).
Key:
ft botc feet below top of casing
gpm gallons per minute
mm:ss minutes:seconds
NA not applicable

The recovery period was observed for approximately one hour before securing the well with the down-hole equipment intact and the transducer continuing to log the recovering water level. The MW-01 site was revisited after 7.9 days and the logging terminated, followed by removal of the test equipment.

The results from the testing conducted in MW-01 are presented in **Table 9-7, Figure 9-7, and Figure 9-8**. The average pumping rate for the total pumping time was 0.19 gpm.

Table 9-7 Summary of Results from MW-01

Analysis	Discharge Rate (gpm)[a]	Volume Pumped (gallons)	Duration of Test Period[b]	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	Variable	5.76	31 minutes	10.7	6E-03	2E-04
Theis Recovery	0.19	--	7.9 days	9.88	37	1.5

Notes:
a. Average rate for the entire time of pumping is 0.19 gpm calculated from time pumping started to when water stopped flowing, and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.01 gallons).
b. Pump was shut off after 33 minutes, but water stopped flowing at 31 minutes.
Key:
ft/day feet per day
ft^2/day square feet per day
gpm gallons per minute

A chart of drawdown in MW-01 computed for the period of record starting from when pumping began until the transducer was removed from the well is presented in **Figure 9-7**. Of note, despite being allowed to recharge for almost eight days, observed water levels did not fully recover and failed to reach pre-test levels.

Figure 9-8 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery in MW-01. Note that water level increased by 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing. **Figure 9-8** shows a standard water level response indicative of water contributed from the water bearing zone with a minimal amount of influence from casing storage. A flexure is apparent at about 60 minutes (about 25 minutes after pumping began), which reflects the increase in pump rate when the power setting was increased to 247.

The groundwater temperature response in MW-01 was somewhat different than the other wells. In the case of MW-01, the temperature displayed a relatively significant decrease in temperature as groundwater at ambient temperatures was initially drawn into the well screen. Only when drawdown decreased the amount of water in the well and the decrease in pumping rate slowed the intake of groundwater into the screen did the temperature begin to increase. After the cessation of pumping, the temperature spiked, reflecting the heat transferred to the relatively static column of water left in the well.

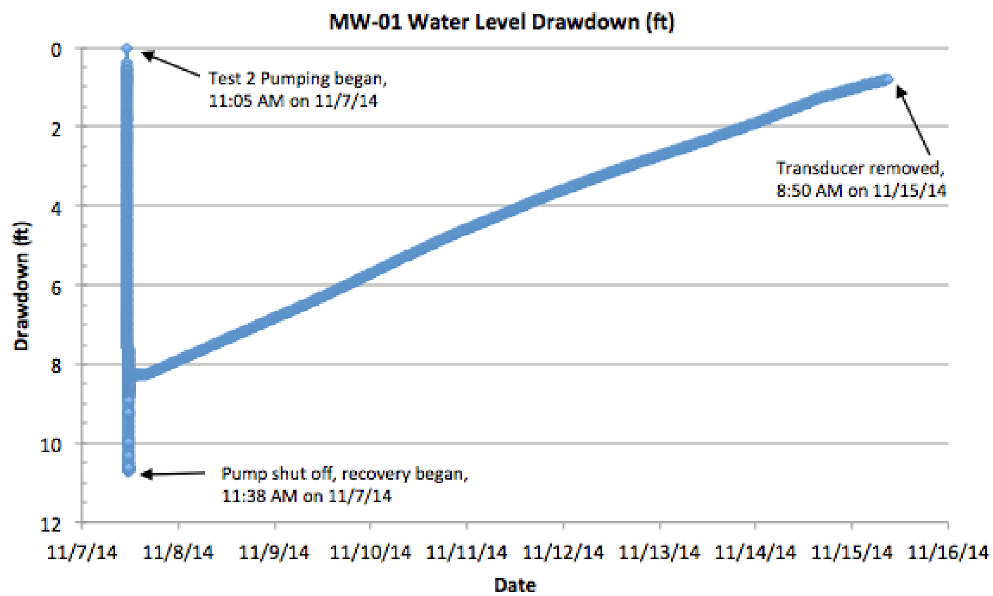


Figure 9-7 MW-01 Drawdown Computed for Pumping and Recovery Period of Record

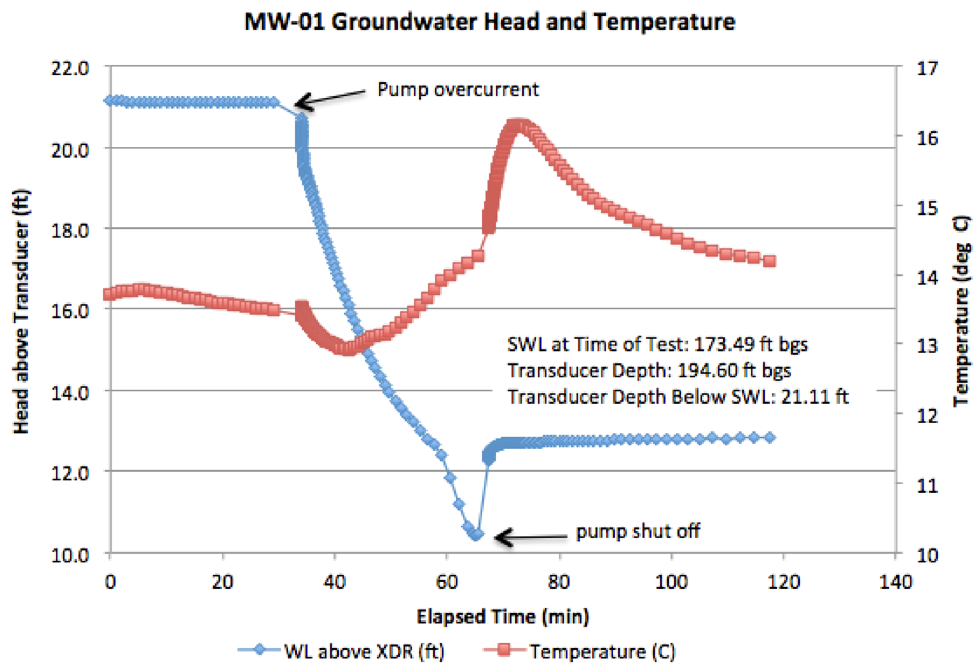


Figure 9-8 MW-01 Drawdown and Initial Recovery with Groundwater Temperature

MW-02 Test Summary

The aquifer test for MW-02 occurred on October 23, 2014. A summary of pump settings and average discharge measurements made per gallon pumped is presented in **Table 9-8**. As noted in the table, water being pumped from the well was grey, silty, and had a hydrocarbon odor. The water cleared somewhat as the pumping test progressed.

Table 9-8 MW-02 Pump Setting and Discharge Measurements

Time Since Pumping Began (minutes)	Pump Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average discharge (gpm)	Comment
0	100	NA	NA	NA	NA	No water.
10	125	NA	NA	NA	NA	No water, pump rate increase.
20	150	NA	NA	NA	NA	No water, pump rate increase.
25	175	NA	NA	NA	NA	No water, pump rate increase.
30	200	NA	NA	NA	NA	No water, pump rate increase.
35	225	NA	NA	NA	NA	No water, pump rate increase.
40.16	255	NA	NA	NA	NA	No water, pump rate increase.
40.8	255	40:58	44:13	3.25	0.31	Grey, silty; hydrocarbon odor.
44.1	255	44:13	48:19	4.1	0.25	Same
48.2	255	48.19	53:25	5.1	0.2	Same
60.23	255	60:23	70:19	9.93	0.1	Water clearing.
75.24	255	NA	NA	NA	NA	Down-hole water level up.
77.23	255	NA	NA	NA	NA	Air in tubing. No flow.
78.24	0	NA	NA	NA	0	Pump shut down.

Notes:
a. Average rate for the entire time of pumping 0.09 gpm considering the total volume pumped over the entire duration from pump start to absence of flow (77.5). This includes the volume of the discharge tubing, which filled to top if casing in the first minute of pumping (1.05 gallons). If the duration of pumping is assumed to be equal to when the pumping setting was set to the maximum value to when flow stopped (37.1 minutes), average discharge is 0.18 gpm.
b. A small amount of water may have been drawn into the tubing while pump failed to flow water.
Key:
gpm gallons per minute
mm:ss minutes:seconds
NA not applicable

The recovery period for MW-02 began 78.23 minutes after pumping initially began. Similar to what was observed in the other wells, the water level increased by about 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing. The recovery period was observed for approximately one hour before securing the well with the down-hole equipment intact and the transducer continuing to log the recovering water level. The

MW-02 site was revisited after eight days and the logging terminated followed by removal of the test equipment.

The results from the testing conducted in MW-02 are summarized in **Table 9-9, Figure 9-9**, and **Figure 9-10**. Two values for average rate were calculated. One was based on the total volume pumped from the well divided by the total time of pumping until no flow, yielding an average rate of 0.09 gpm for the pumping period. The second value was calculated assuming a total pumping duration represented by the time at which the pump setting was set to the maximum value of 255 to when water stopped flowing at top of casing (37 minutes), yielding an average rate of 0.18 gpm.

Table 9-9 Summary of Results from MW-02

Analysis	Discharge Rate (gpm)	Volume Pumped (gallons)	Duration of Test Period	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	Variable	6.8	77.2 minutes	11.59	1E-01	7E-04
Theis Recovery	0.09	--	8.1 days	2.35	1.2	7E-02
Theis Recovery	0.18	--	8.1 days	2.35	2.6	2E-01

Notes:
a. Average discharge rate of 0.09 gpm is calculated by assuming the duration is represented by the time pumping initially started to when water stopped flowing at top of casing (77.5 minutes), and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.05 gallons).
b. Average discharge rate 0.18 gpm is calculated by assuming the duration is represented by the time at which the pump setting was set to the to the maximum value of 255 to when water stopped flowing at top of casing (37 minutes), and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.05 gallons).
Key:
ft/day feet per day
ft^2/day square feet per day
gpm gallons per minute

The values of transmissivity obtained from the Theis recovery analysis are several orders of magnitude higher than the Moench analysis conducted in Aqtesolv™. It is also clear that the values are affected by the average discharge rate selected for input into the recovery analysis equation, with larger values of average discharge yielding higher values of transmissivity. Because of the subjectivity involved in selecting the appropriate portion of the curve to analyze, and the range in average discharge values, the transmissivity estimate obtained from the recovery analysis should receive much less weight. The value of 1.2 square feet per day (ft^2/day) (**Table 9-9**) should be regarded as the absolute upper end for transmissivity, and the estimate obtained from Aqtesolv™ as a more appropriate value.

A chart of drawdown in MW-02 computed for the period of record starting from when pumping began until the transducer was removed from the well is presented in **Figure 9-9**. Of note and as seen in the other two wells tested, MW-02 exhibited poor recovery over the test period, and water levels failed to reach those measured before testing began.

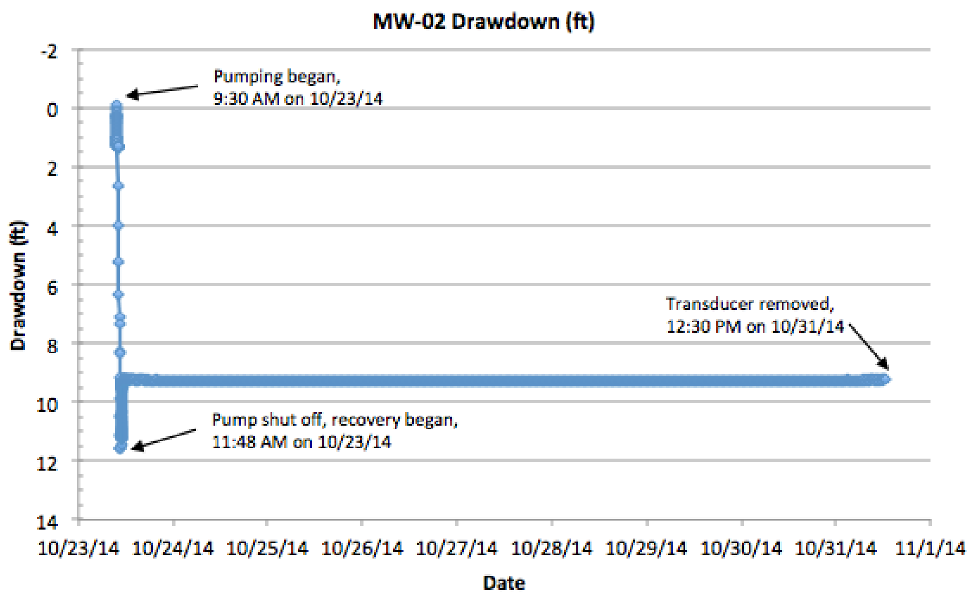


Figure 9-9 MW-02 Drawdown Computed for Pumping and Recovery Period of Record

Figure 9-10 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery. This figure shows the water level response to the 40-minute period of insufficient pump rates and the corresponding rise in water level temperature as the operation of the pump heated the stagnant water column. After flow is achieved at approximately 40.8 minutes, the water level begins to drop at a rate of about 0.6 feet per minute.

The down-hole water temperature then decreases as groundwater at ambient temperatures is drawn into the well screen. As the pump nears its capacity to lift, the water temperature begins to increase again as less water is drawn into the well.

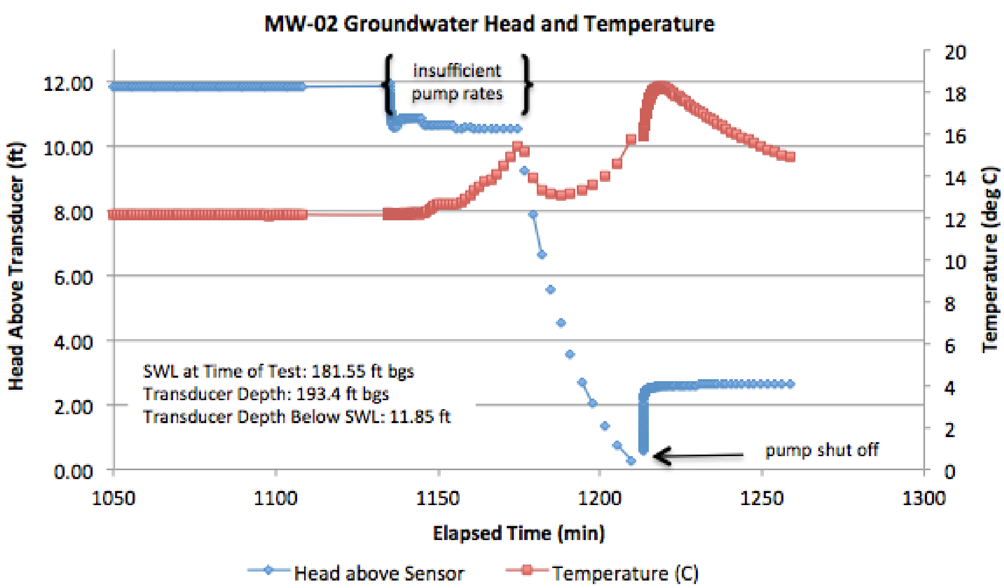


Figure 9-10 MW-02 Drawdown and Initial Recovery with Groundwater Temperature

MW-03 Test Summary

The aquifer test for MW-03 occurred on October 23, 2014. A summary of pump settings and average discharge measurements made per gallon pumped is presented in **Table 9-10**. As noted in the table, water being pumped from the well was discolored, silty, and had a hydrocarbon odor. As the pumping test progressed, water discharging from the well alternated between clear and dark.

Table 9-10 MW-03 Pump Setting and Discharge Measurements

Time Since Pumping Began (minutes)	Pump Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[a]	Comment
-4	255	NA	NA	NA	NA	Overcurrent shutdown[b]
-2	235	NA	NA	NA	NA	Overcurrent shutdown[b]
0	225	NA	NA	NA	NA	Pump started
1.02	225	1:01	4:04	3.05	0.33	Grey, silty hydrocarbon odor
4.07	225	4:04	7:02	2.97	0.34	Alternating clear and dark
7.56	225	NA	NA	NA	NA	0.091 psi
8.1	255	NA	NA	NA	NA	Pump off

Notes:
a. Average rate for the entire time of pumping 0.39 gpm considering the total volume pumped, including the volume of the discharge tubing, which filled to top if casing in the first minute of pumping (1.1 gallons).
b. A small amount of water may have been drawn into the tubing and subsequently released each time the pump was started and stopped due to current overload.
Key:
gpm gallons per minute
mm:ss minutes:seconds
NA not applicable
Psi pounds per square inch

The recovery period for MW-03 began 8.1 minutes after pumping began. Similar to what was observed in the other wells, the water level increased by about 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing. The recovery period was observed for approximately one hour before securing the wellhead with the down-hole equipment intact and the transducer continuing to log the recovering water level. The MW-03 site was revisited after eight days and the logging terminated followed by removal of the test equipment.

The results from the testing conducted in MW-03 are summarized in **Table 9-11, Figure 9-11**, and **Figure 9-12**. The average pumping rate for the total pumping time was 0.39 gpm.

Table 1-11 Summary of Results from MW-03

Analysis	Discharge Rate (gpm)[a]	Volume Pumped (gallons)	Duration of Test Period	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	0.39	3.14	8.1 minutes	7.41	6E-02	7E-03
Theis Recovery	0.39	--	8 days	6.25	4.3	0.52

Notes:
a. Average rate for the entire time of pumping is 0.39 gpm calculated from time pumping started to when water stopped flowing, and considering the calculated volume of the discharge tubing that filled with water before water appeared at land surface (1.1 gallons).
Key:
ft/day feet per day
ft^2/day square feet per day
gpm gallons per minute

A chart of drawdown in MW-03 computed for the period of record starting from when pumping began until the transducer was removed from the well is presented in **Figure 9-11**. While MW-03 exhibited an increased rate of recovery compared to MW-01 and MW-02, recovery was poor overall, failing to reach pretest water levels even after eight days of recharge.

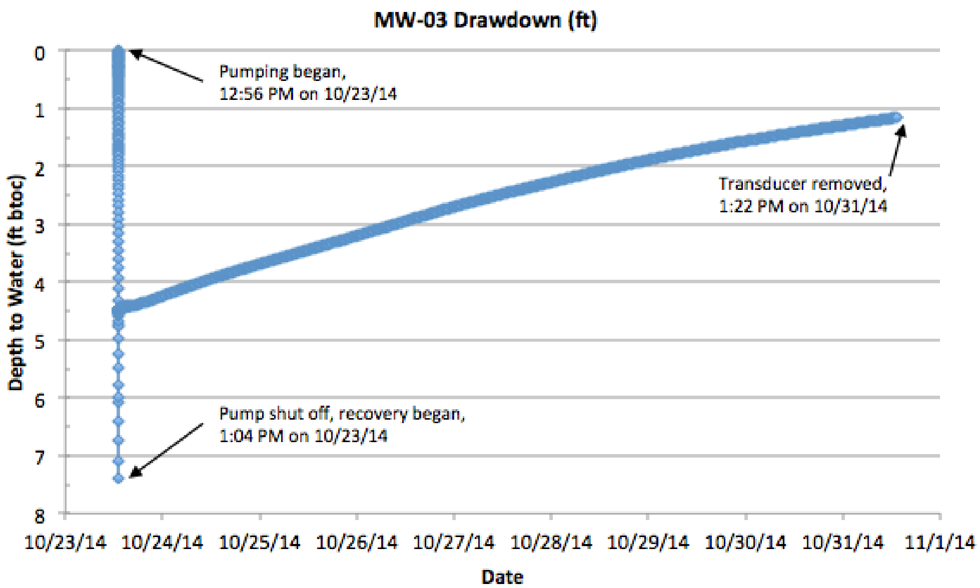


Figure 9-11 MW-03 Drawdown Computed for Pumping and Recovery Period of Record

Figure 9-12 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery in MW-03. This figure shows a steady drop in water level in response to a fairly constant pump rate over a short period of time. A small temperature increase is noted, likely due to the initial attempts at pumping that resulted in overcurrent condition. After flow is achieved, the temperature drops slightly as groundwater at ambient temperatures is drawn into the well screen.

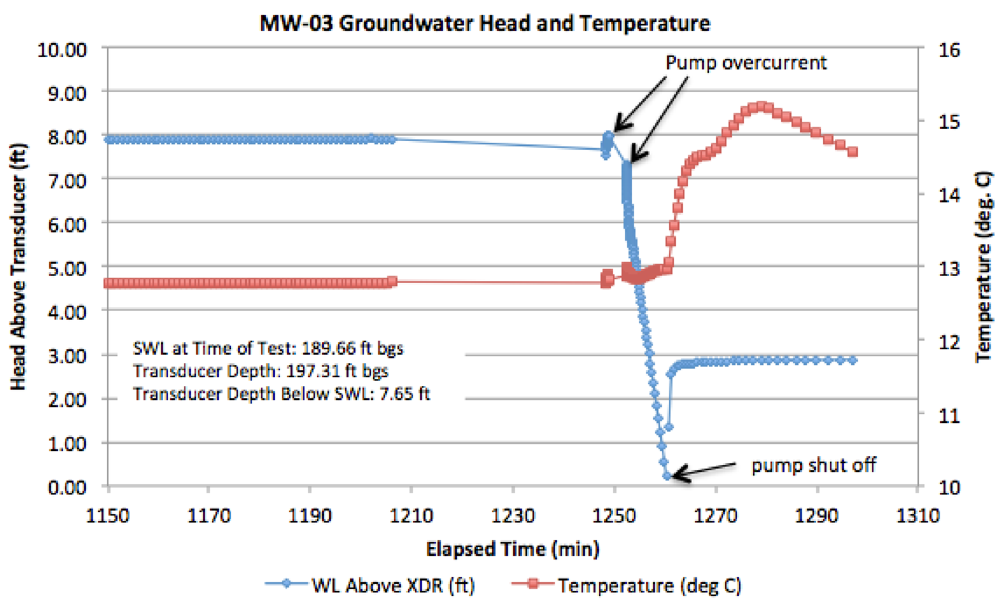


Figure 9-12 MW-03 Drawdown and Initial Recovery with Groundwater Temperature

Discussion

As noted in the summaries above, water pumped from the wells was discolored and silty (**Figure 9-13**). Water pumped from the wells also had a hydrocarbon odor. These same conditions were noted when the wells were initially developed in 2013.

Figure 9-13 View into Graduated Bucket Containing Black Discharge Water from MW-03

Measured depths to water obtained in October 2013 and a year later in October 2014, maximum water level drawdown during pumping, cumulative gallons pumped and best engineering estimates of hydraulic properties are presented in **Table 9-12**. Despite each well being allowed to recharge for more than a week, none of the three wells recovered fully; all three had water levels at the end of the observation period that were lower than pretest levels. Likewise, the lack of significant head in each well suggests that substantial water bearing zones are not present beneath the TomCo site. This conclusion is also supported by the diminished capacity of each well to transmit appreciable amounts of groundwater when pumped at low rates (generally 0.1 to 0.34 gpm). Specific capacities ranged from a low of 0.02 gallons per minute per foot to a high of 0.05 gallons per minute per foot, which reflects the efficiency of the well and suggests that the well screens are in contact with material of low permeability, or are affected by well skin (clogged pores in the rock wall of the well).

Table 9-12 Summary of TomCo Monitoring Well Test Observations

WELL ID	October 2013 DTW (ft bgs)	October 2014 DTW (ft bgs)	Water Level Decrease (foot)	Maximum Drawdown (foot)	Volume Pumped (gallons)	BEE Specific Capacity (gpm/ft)	BEE T (ft^2/day)	BEE K (ft/day)
MW-01	175.3	173.69	+1.61	10.7	5.76	0.02	6E-03	2E-04
MW-02	180.3	181.85	-1.55	11.42	6.85	0.02	1E-02	7E-04
MW-03	180.7	190.03	-9.33	7.41	3.14	0.05	6E-02	7E-03

Notes:
a. In all cases, value obtained from the Moench (1997) analysis.
Key:
BEE best engineering estimate
DTW depth to water
ft bgs feet below ground surface
ft/day feet per day
ft^2/day square feet per day
gpm/ft gallons per minute per foot
K Hydraulic Conductivity
T Transmissivity

An evaluation of the data included the use of analytic models to estimate values for transmissivity, for which best estimates ranged from $6x10^{-3}$ ft^2/day to $6x10^{-2}$ ft^2/day, assuming unconfined conditions under the Moench (1997) model. Estimates of transmissivity obtained using the Theis (1935) residual recovery method as described by Driscoll (1986) were up to several orders of magnitude larger, underscoring the limitations of that method under non-confined conditions, casing storage effects, and boundary influences resulting in non-infinite acting aquifer conditions, and non-radial flow.

By the assumption that the wetted screen length represented the thickness of the zone thought to have potential to bear water, estimates of hydraulic conductivities ranged from a low of $2x10^{-4}$ feet per day to a high of $7x10^{-3}$ feet per day. These values are consistent with published values representative of silt, clayey sand, or silty sand (Halford and Kuniansky 2002; Fetter 1994).

The testing and analysis presented herein indicates that while minor water-bearing zones may be present in the sub-surface in the vicinity of the TomCo project site, these by definition cannot be classified as aquifers due to the low yield, and apparent limited lateral and vertical extent of the water-bearing zones in contact with the screened intervals of TomCo MW-01, 02, and 03.

9.3.2.3 Water Quality

Water samples were collected from monitoring wells approximately one week after their completion. Collected samples were analyzed for bulk parameters, major cations and anions, metals, and selected organic constituents. Samples were maintained under chain-of-custody delivery to TestAmerica. The laboratory analytical reports are provided in **Appendix E**. In addition, samples from MW-04 were collected for analyses of stable and radioisotopes of carbon in order to estimate the age of water from the Douglas Creek Aquifer at TomCo's project area.

Monitoring well water quality for wells screened in the Parachute Creek Member (MW-01, MW-02, and MW-03) was poor compared to MW-04, the deeper well screened in the Douglas Creek Aquifer. A comparison of parameter concentrations between the shallower wells and the deep well shows a number of distinct differences and supports geologic studies indicating that there is no hydrologic communication between these two zones. Groundwater from the shallower monitoring wells had foul odors of sulfur and petroleum and exceeded a number of Utah Groundwater Quality standards (**Table 9-13**). Conversely, MW-04 had relatively low total dissolved solids, and there were no parameters exceeding Utah Groundwater Quality Standards. Additionally, there were a number of parameters sampled for which there are no Utah Standards, but that in some cases differed by an order of magnitude between the deep and shallower wells (e.g., cobalt, nickel, benzene, and others). Based on analyses of monitor well samples from this study, groundwater from the Parachute Creek Member at the TomCo project area would be classified as Limited Use (Class III), while groundwater from the Douglas Creek Aquifer would be classified as Drinking Water Quality (Class II).

Deleted: ¶
¶

Deleted: *2*

Deleted: 4

Table 9-13 Utah Groundwater Quality Standards and Analytical Results from TomCo Monitor Wells

Deleted: ¶

Deleted: 4

Parameter	DWQ Groundwater Quality Standard	MW-01	MW-02	MW-03	MW-04
Metals (dissolved; µg/L)					
Antimony	6	14	8.1	4.6	5
Arsenic	50	87	19	26	11
Barium	2,000	150	120	220	12
Beryllium	4	0.1[a]	0.08[b]	0.08[b]	0.08[b]
Cadmium	5	0.21[a]	0.1[b]	0.1[b]	0.1[b]
Chromium	NA	0.59[a]	0.5[b]	9.7	0.5[b]
Cobalt	NA	0.91[a]	3.1	1	0.05[b]
Copper	1,300	0.56[b]	14	0.56[b]	0.56[b]
Lead	15	0.18[b]	0.18[b]	0.18[b]	0.18[b]
Manganese	NA	200	36	290	7.9
Nickel	NA	11	59	16	0.51
Selenium	50	0.81[a]	5.8	3.3[a]	0.7[b]
Silver	1,000	0.092[a]	0.033[a]	0.033[a]	0.033[a]
Thallium	2	0.14[a]	0.057[a]	0.05[b]	0.05[b]
Vanadium	NA	5	5.9	4.1[a]	0.5[b]
Zinc	5,000	6.9[a]	17	2.5[a]	4.5[a]
Metals (total; µg/L)					
Antimony	NA	14	5.1[a]	4.5[a]	5.7[a]
Arsenic	NA	93	73	37	15
Barium	NA	790	740	480	14
Beryllium	NA	2.7	3.8	0.91[a]	0.08[b]
Cadmium	NA	1.4	0.77[a]	0.34[a]	0.1[b]
Chromium	100	230	38	140	0.66[b]
Cobalt	NA	23	32	14	0.23[a]
Copper	NA	65	93	22	2.4[b]
Lead	NA	47	38	15	0.89[b]
Manganese	NA	1300	1600	740	17
Nickel	NA	180	100	100	2.2[b]
Selenium	NA	1.9[a]	6.5	4.2[a]	0.7[b]

Table 9-13 Utah Groundwater Quality Standards and Analytical Results from TomCo Monitor Wells

Parameter	DWQ Groundwater Quality Standard	MW-01	MW-02	MW-03	MW-04
Silver	NA	0.69[a]	0.18[a]	0.23[a]	0.033[b]
Thallium	NA	0.68[a]	0.49[a]	0.27[b]	0.09[b]
Vanadium	NA	88	110	54	0.89[a]
Zinc	NA	290	350	110	12[a]
Anions (mg/L)					
Chloride	NA	530	21	180	66
Fluoride	4.0	28	8.2	40	3.2[a]
Sulfate	NA	110	180	340	250
Nitrate as N	10.0	0.21[b]	0.53[a]	0.21[a]	0.042[b]
Nitrite as N	1.0	0.25[b]	0.59[a]	0.25[b]	0.049[b]
Cations (µg/L /L)					
Calcium	NA	100,000	140,000	65,000	2,000
Magnesium	NA	49,000	58,000	54,000	1,600
Potassium	NA	17,000	6,100	9,200	1,400
Silica	NA	100,000	74,000	64,000	16,000
Sodium	NA	1,800,000	350,000	1,200,000	500,000
BTEX+ (µg/)					
Benzene	5	0.16[b]	0.16[b]	0.23[a]	3
Toluene	1,000	0.91[b]	0.99[b]	3.9[a]	5.1[a]
Ethyl Benzene	700	0.16[b]	0.16[b]	0.28[a]	1.1
m&P Xylene	NA	0.34[b]	0.34[b]	0.34[b]	0.34[b]
O – Xylene	NA	0.19[b]	0.19[b]	0.19[b]	0.19[b]
Total Xylenes	10,000	0.19[b]	0.19[b]	0.19[b]	0.22[a]
Naphthalene	NA	0.22[b]	0.22[b]	0.22[b]	0.22[b]
Extractable organics					
HEM (mg/L)	NA	8	19	5	1.3[a]
DRO (mg/L)	NA	5.1	19[a]	4.1	0.41
GRO (µg/L)	NA	21[a]	10[b]	59	38
Miscellaneous					
pH (measured in field)	NA	9.34	8.54	8.47	10.62

Table 9-13 Utah Groundwater Quality Standards and Analytical Results from TomCo Monitor Wells

Deleted: 4

Parameter	DWQ Groundwater Quality Standard	MW-01	MW-02	MW-03	MW-04
Alkalinity (total; mg/L)	NA	3,500	710	2,100	790
Bicarbonate (CaCO3; mg/L)	NA	2,800	710	2,100	400
Carbonate (CaCO3;mg/L)	NA	620	1.1[b]	1.1[b]	390
Mercury (total; µg/L)	NA	0.082	0.2	0.027[b]	0.027[b]
Mercury (dissolved; µg/L)	2	0.027[b]	0.027[b]	0.027[b]	0.027[b]
TDS (mg/L)	Class I[c]: <500mg/L Class II: >500 mg/L & <3,000 mg/L Class III: >3,000 mg/L & <10,000 mg/L Class IV: >10,000 mg/L	5,700	1,100	3,900	1,400
TOC (mg/L)	NA	130	37	410	25

Notes:
Gray shaded table cells indicate groundwater quality standards exceedances.
a Result estimated
b Not detected at or above method detection limit
c Class 1 is divided into 1A, 1B and 1C subclasses; the limit for Class 1A is<500mg/L and the remaining subclass limits are narrative
Key:
µg/L micrograms per liter
DWQ Utah Division of Water Quality
mg/L milligrams per liter
NA Not Analyzed
TOC Total Organic Carbon

Deleted: to Table

Deleted: 9-4:

9.3.2.4 Aquifer Age Dating

Deleted: 3

In addition to water quality parameters, MW-04 water samples were analyzed for isotopes of carbon to assess the age of the water. Isotopes are atoms of the same chemical element having the same number of protons but differing in numbers of neutrons and mass. Carbon has three naturally occurring isotopes, two of which are stable isotopes (12C and 13C), with the third (14C) being a radioisotope.

Radioisotopes are useful for age dating, and 14C is widely used to date groundwater. 14C is produced continuously in the earth's atmosphere, and 14C atoms oxidize to form 14CO2 molecules, which become mixed with inactive atmospheric carbon dioxide (CO2). The CO2 mixes with oceans and meteoric waters through CO2 exchange and with living biomass both directly and indirectly through photosynthesis. Once this water becomes isolated from the atmosphere by entering the zone of saturation and becoming recharge, 14CO2 will diminish at a rate of half of the radiocarbon every 5,730 years. Thus, the level of 14C atoms can be used to estimate the age of groundwater.

14C ages are expressed in terms of years before present with the 14C concentrations expressed as percent modern carbon (pMC). The groundwater age or residence time represents the length of elapsed time between the recharge water entering into an aquifer and the time at which a groundwater sample is collected.

Based on the measured pMC of 15.9, the groundwater collected from MW-04 is estimated to have entered the groundwater system approximately 7,600 years before present, with a potential range of 7,600 to 15,200 years before present (**Appendix G**). This is consistent with data from Mayo et al. (2003), which show that water from the southern Book Cliffs from 300 to 700 meters was aged and determined to be up to from 500 years to 20,000 years old. Stable isotopes measured from MW-04 were within ranges of the values observed by Mayo et al. (2003) as well.

9.3.2.5 Seep and Spring Inventory

Deleted: *4*

TomCo conducted desktop research to identify the most likely conditions and locations for seeps and springs to occur. Specifically, this study:

- Reviewed state and USGS records to determine whether there were known seeps and springs in and around the project area;

- Reviewed aerial photography and topographic maps to locate high potential seep and spring sites; and
- Reviewed seep and spring reports from other projects in the area to determine whether, and under what conditions, other known seeps and springs near the project area are known to occur.

On October 2 and October 3, 2013, field surveys were conducted by two staff via off-road vehicle and on foot. The survey area included TomCo's project area and a 0.5-mile buffer. Field personnel used maps, binoculars, and global positioning system (GPS) units to help identify survey areas and document the presence of seeps and springs. At each seep or spring location, field teams recorded their observations in field books, took a number of photographs, and marked each location with a Trimble GPS unit. At each site, the following data were collected to document seep and spring locations:

- Topographic, landscape, and geologic features;
- Wetland and aquatic vegetation;
- Erosional features indicative of seep flow;
- Evidence of repeated and prolonged wetting, such as moss and calcium deposits from evaporation; and
- Where possible, pH, conductivity, temperature, dissolved oxygen, and total dissolved solids.

Preliminary desktop studies revealed only one known spring in the study area. This spring is identified on USGS maps and is located on the eastern side of the study area, outside of TomCo's project area, but within the study's 0.5-mile buffer.

A total of two springs (including the previously identified spring discussed above) and 12 seeps were identified during the field surveys (**Table 9-14; Figure 9-1**). The two springs were outside the project area but within the 0.5-mile buffer area. Both springs exhibited some flow, and moss and other vegetation found at these two features suggest that the areas are at least moist year-round. Seeps were damp to wet and, in some cases, exhibited flows that were diminutive and too

Deleted: 5

low to be accurately measured. Almost all of the seeps and springs appeared to originate in or near drainage channels and at points where substrate incisions exposed impervious to semi-impervious shale layers, stopping the vertical percolation of rainfall.

Springs S1 and S3 are shown on **Figure 9-1 and** are indicated in **Figure 5-3** to the east of the word "spring," adjacent to the east boundary of the project area. These springs are located up-gradient of, and approximately 80 feet higher than, the highest mine excavation planned at TomCo. The springs' recharge area is the slopes upgradient and northeast of the springs. This area is further away from proposed mining and processing areas. As with the seeps identified, these springs are located within a drainage channel where an impervious layer outcrops. Because of these characteristics it is unlikely that either of these small springs would be affected by mining or processing activities.

Deleted: ¶

Most of the seeps identified during this survey appeared to be ephemeral, with occurrences closely linked to recent rainfalls. During this survey, field personnel routinely encountered wet soils beneath a thin layer (less than an inch) of drier soil in the drainage channels. The weather preceding the field surveys had been relatively wet. Depending on when surveys occur, it is possible that additional or fewer seeps could be discovered. While the surrounding areas of a few of the seeps and springs supported mesic vegetation, there was no change in vegetation at most of the seeps, also suggesting an intermittent occurrence of most of the seeps at this site.

Deleted: features

Table 9-14 Seep and Spring Locations and Water Quality Characteristics

Deleted: 5

ID	Seep/ Spring	Latitude	Longitude	Elevation (feet)[a]	Flow (gpm)[c]	Flow Method	Temperature (ºC)	pH	Dissolved Oxygen (mg/L)	Conductivity (mS/cm)	Turbidity (NTU)	Total Dissolved Solids (g/L)
S1	Spring	39° 46' 38.971" N	109° 9' 56.067" W	6,253	3.3	measured	10.97	8.7	12.2	1.18	0.0	0.752
S2	Seep	39° 46' 36.666" N	109° 9' 59.345" W	6,243	NA		10.95	8.9	12.9	2.51	45.7	1.610
S3	Spring	39° 46' 36.156" N	109° 10' 0.300" W	6,283	0.5	estimate	13.20	8.9	13.1	1.17	3.4	0.750
S4	Seep	see note b	see note b		NA		-	-	-	-	-	
S5	Seep	39° 46' 20.398" N	109° 9' 57.450" W	6,305	NA		-	-	-	-	-	-
S6	Seep	39° 46' 21.080" N	109° 9' 57.407" W	6,308	NA		11.00	10.0	17.9	2.34	173	1.500
S7	Seep	39° 45' 39.739" N	109° 9' 27.591" W	6,419	NA		-	-	-	-	-	-
S8	Seep	39° 46' 23.604" N	109° 10' 51.887" W	6,227	NA		8.68	9.5	17.1	2.80	405.0	1.790
S9	Seep	39° 46' 10.927" N	109° 11' 39.105" W	6,198	NA		-	-	-	-	-	-
S10	Seep	39° 46' 37.020" N	109° 11' 34.649" W	6,179	NA		13.14	9.4	9.9	2.56	3.8	1.640
S11	Seep	39° 46' 38.157" N	109° 11' 38.247" W	6,181	NA		16.16	9.6	15.8	2.58	14.2	1.650
S12	Seep	39° 46' 37.749" N	109° 11' 48.371" W	6,148	NA		-	-	-	-	-	-
S13	Seep	39° 47' 11.688" N	109° 11' 44.628" W	6,093	NA		17.28	9.6	13.5	2.30	35.3	1.470
S14	Seep	39° 45' 46.080" N	109° 11' 55.680" W	6,260	NA		-	-	-	-	-	-

Notes:
a Elevations were taken by GPS and are not survey grade
b GPS coordinates and elevations at S4 could not be acquired; S4 is approximately 5 to 10 meters downgradient of S3.
c By definition, seeps do not exhibit flow; however at some seeps, water could be seen moving downgradient but at rates too slow to accurately estimate (i.e., <0.05 gpm).
- There was not enough moisture at seeps S4, S5, S7, S9, S12, and S14 to measure water quality parameters.

Key:
g/L grams per liter
gpm gallons per minute
GPS global positioning system
ID identifier
mg/L milligrams per liter
mS/cm micro-siemens per centimeter
NA Not applicable
NTU Nephelometric Turbidity Units
ºC degrees Celsius

10 CONSTRUCTION QUALITY CONTROL PLAN

10.1 Bentonite Amended Soil Quality Control

Deleted: Shale

10.1.1 General

The quality of BAS placement, compaction, and projected performance will be determined using field moisture density monitoring correlating to a suite of data developed from more rigorously evaluated test fill performance. The following sections present the approach for test fill preparation, performance monitoring, and correlation development as the basis for this quality control approach for the EPS. The acceptability of materials used, testing outcomes, and other determinations required will be evaluated and accepted as determined by a qualified Utah professional engineer selected by TomCo. The hydraulic conductivity of the floor, walls, and final cover will be $\leq 1 \times 10^{-7}$ cm/sec, or functionally equivalent.

10.1.2 Test Fill Development and Materials for Construction

A minimum of two test fills will be constructed using similar size and type of equipment proposed for capsule bottom liner and cap and BAS sidewalls. Each test fill will be constructed using BAS manufactured on site with processed screened shale meeting the target design gradation, blended with a 10 percent Sure Seal 80 (80 percent passing #200 mesh sieve) bentonite clay product to be provided by Western Clay, or comparable product/vendor. High-activity clay products that are comparable or better may be substituted for Sure Seal 80. The blended mixture will be moisture conditioned to achieve a water content between optimum and +2 to 4 percent and transported to the test fill site via truck. The size of each test fill will be approximately 20 by 40 feet.

Alternative BAS mixtures may be developed (e.g., though modification of the -3/8-base BAS material, substitution of the bentonite product, or their combination, including its percentage) to produce a modified or alternative BAS manufactured material. In the event that TomCo's professional engineer determines that a change is needed for the BAS mixture, an additional confirmatory sealed double ring infiltrometer (SDRI) test fill will be performed on site-specific material at the TomCo project site.

10.2 Bottom Liner Test Fill

BAS fill will be placed on a prepared cleared surface and bladed to a maximum loose lift thickness of 18 inches, as proposed for liner construction, and compacted with successive passes of a compactor equal in size and type to that proposed for actual cell construction. Successive lifts will be similarly placed on the BAS to achieve full test fill depth. A minimum of two to four passes will be applied uniformly over the fill, depending on initial loose lift thickness. At the end of the last initial pass, a series of nuclear density measurements at various depths will be performed and recorded. Two additional passes of the compactor will then be performed, and an additional nuclear density test will be performed if required to achieve compaction. Two subsequent passes and additional density test series will be performed as required to facilitate evaluation of the appropriate number of passes needed to achieve the minimum 95 percent compaction.

Compacted materials within the fill will be ripped and recompacted if it is determined that less than the maximum number of passes is required to achieve required compaction. If the full maximum number of passes used during compaction evaluation is required, the fill will not be ripped, but instead protected with a temporary 6-inch lift of BAS or heavy plastic cover until infiltration testing equipment is ready to be installed. Any delay in installation of SDRI testing equipment will require that the test fill be appropriately protected from moisture loss or surface disturbance.

10.3 Side Liner Test Fill

BAS fill will be placed on a cleared, prepared surface to a maximum loose lift thickness of 12 inches, as proposed for side liner construction, and compacted with successive passes of a compactor of size and type equal to that proposed for actual cell construction. A minimum of two to four passes will be applied uniformly over the fill, depending on initial loose lift thickness. At the end of the last initial pass, a series of nuclear density measurements will be performed and recorded. Two additional passes of the compactor will then be performed if required, and an additional nuclear density test will be performed. A series of subsequent passes and density tests will be performed to evaluate the number of passes needed to achieve the required 95 percent compaction for the 12-inch lift thickness, if required.

Compacted materials within the fill will be ripped and recompacted if it is determined that less than maximum number of passes used in test fill construction is needed to achieve required compaction. If the maximum number of passes is required, no ripping will be performed. The fill in either case will be protected from moisture loss with either a temporary 6-inch lift of BAS or heavy plastic tarp or cover until infiltration testing equipment is ready to be installed.

10.4 Test Fill Evaluation

The hydraulic conductivity of each test fill will be evaluated in situ using an SDRI. Testing will be performed in general accordance with American Society for Testing and Materials (ASTM) D5093-02 (2008)[1] methods. Additionally, at the conclusion of the test, relatively undisturbed 2.5-inch-minimum diameter tube samples of the test fill will be obtained for laboratory analysis. This analysis will determine hydraulic conductivity as a means of comparing the test fill performance and projected future performance under the compression that will occur from ultimate cell construction and loading with up to 100 feet of oil shale. Laboratory testing will be performed in accordance with ASTM D-5084-10.[2] A minimum of four test specimens will be obtained from the fill within the innermost ring. A complete complement of index tests, including Atterberg limits, grain-size and moisture, and density will be performed on the tube specimens that undergo laboratory hydraulic conductivity evaluations.

Field density measurements will also be obtained from within the inner ring area to assess any potential density loss that may have occurred as a result of swelling.

---

[1] ASTM D5093 - 02(2008) Standard Test Method for Field Measurement of Infiltration Rate Using Double-Ring Infiltrometer with Sealed-Inner Ring[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

[2] Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Deleted: ¶

The results of the testing program protocols outlined above will form the basis for quality control testing during actual liner construction and side wall construction.

10.5 Proposed BAS Testing Frequency

During actual BAS construction, the following frequency and types of test are proposed to confirm acceptance of the means and methods.

10.6 Bottom and Top

For the bottom and top of the BAS, Field Moisture and Density measurement (ASTM D-6938 – 10) will be performed at the rate of one test per 400 cubic yards of liner, or approximately every 10,000 square feet of lift.

10.7 Side Walls

For the side walls of the BAS, Field Moisture and Density measurement (ASTM D-6938 – 10) will be performed at the rate of one test per 50 cubic yards of liner, or approximately every 270 feet of wall/lift.

11 GROUNDWATER DISCHARGE CONTROL PLAN

The zero-discharge design of the capsule is described in detail in **Section 5**, and the plan for ensuring the design specifications for the BAS installation is described in Section 10. Both mining operations and the capsule itself are designed to be zero-discharge.

After review of TomCo's first GWDPA in February 2014, the DWQ requested that TomCo conduct SPLP tests on spent shale from TomCo's project area to determine if leachable contaminants are present in spent oil shale. Results of these tests can be used to determine potential for contaminant release from spent shale waste and to assess possible impacts on groundwater quality. TomCo conducted a review and analysis of published geological data to determine if geologic site conditions at the nearby Red Leaf site are sufficiently similar to TomCo for SPLP results from RLR's SPLP tests to serve as surrogate data set for waste rock

Deleted: The DWQ has requested that RLR analyze samples of spent shale for leachable constituents.

characteristics Results of this study are summarized in Section 11.1. The results of RLR's SPLP analyses, which are directly applicable to TomCo's project, are described in **Section 11.2**. This work was reviewed by Mike Vanden Berg of Utah States Geological Survey and revised based upon his input (Vanden Berg 2014.)

Deleted: these

Deleted: below

11.1 Geologic Comparison Between Red Leaf and TomCo

Digital data obtained from USGS (Johnson et al. 2010) and the Utah Geological Survey (Vanden Berg 2008) from over 630 wells drilled in the study region were reviewed. Data were supplemented with well data obtained directly from the DOGM Online Oil and Gas Information System available from these sources and included collar elevations, formation tops, Fischer assay results, and various geophysical logs. These data were parsed for appropriate location, focusing on the Red Leaf and TomCo sites and the intervening area between the sites.

Review of each of the datasets yielded a series of numerical comparisons of bedding and assay values (Table 11-1), which illustrate the following:

1. A-Groove bedding thickness and Fischer assay results are consistent between the two sites, varying in thickness between about 16 feet at the Red Leaf site to about 9.5 feet at the TomCo site. Fischer assays ranged from about 2.5 to about 3.6 gallons of oil per ton.

2. Mahogany Zone bedding thickness and Fischer assay results are fairly consistent between the two sites, varying in thickness between about 95 feet at the Red Leaf site to about 65 feet at the TomCo site. Fischer assays ranged from about 17 to about 21 gallons of oil per ton oil.

3. B-Groove bedding thickness and Fischer assay results are consistent between the two sites, varying in thickness from about 7 feet at the Red Leaf site to about 11 feet at the TomCo site. Fischer assays ranged from about 17 to about 21 gallons of oil per ton.

4. Bed R6 bedding thickness and Fischer assay results are fairly consistent between the two sites, varying in thickness from about 235 feet at the Red Leaf site to about 193 feet at the TomCo site. Fischer assays ranged from about 2.7 to about 5.2 gallons of oil per ton.

Table 11-1 Representative Values of Compared Bed Thicknesses and Assay Values Between TomCo and Red Leaf Sites

Compared Bed	TomCo Site Representative Bed Thickness (feet)	Red Leaf Site Representative Bed Thickness (feet)		TomCo Site Representative Assay (GPT Oil)	Red Leaf Site Representative Assay (GPT Oil)
A-Groove	9.5	16		3.6	2.5
Mahogany Zone	65	95		21	17
B-Groove	11	7		21	17
Bed R6	235	193		5.2	2.7

Key:
GPT gallons per ton

The analysis demonstrated that the stratigraphy between the sites is similar and contiguous and that the Fischer analyses obtained for the Mahogany Zone were similar throughout the region studied. The similarity of the Fischer analyses suggest that these data can be extrapolated to the waste ore characteristics based on the hypothesis that spent waste rock of similar lithology, containing similar amounts of hydrocarbon, sharing a common geologic origin, and demonstrated to be contiguous throughout the region studied, should yield similar SPLP results. TomCo believes that completed SPLP testing, and upcoming Meteoric Water Mobility Procedure tests, performed at Red Leaf adequately represent spent ore characteristics that would occur in the TomCo EPS capsule. Additional testing of spent shale will occur after processing in the EPS capsule is completed at Red Leaf and TomCo.

11.2 Spent Shale Leachate Evaluation

Deleted: 1

Although the EPS capsule is designed to prevent contact of meteoric water with capsule-contained spent shale, RLR conducted leachability testing using the EPA's SPLP methodology on samples of spent shale from the Red Leaf project area. Samples were collected from spent shale derived from bench-scale testing and stored in sealed containers at RLR's contract testing laboratory. Samples were collected from the sealed containers in appropriate laboratory-supplied sample containers and in accordance with appropriate collecting methods. Samples were transported chilled and under chain-of-custody to American West Analytical Laboratories (AWAL) for SPLP testing.

The SPLP test is an EPA SW-846 analytical method (Method 1312) that can be used to determine the concentration of contaminants that will leach from soil and similar materials due to contact with, and subsequent leaching by, precipitation (EPA 1998). Method 1312 specifies three distinct extraction fluids, depending on the relative location of the sample area in the United States (east or west of the Mississippi River) and the compounds to be analyzed in the leachate. Extraction Fluid #1 is deionized water very weakly acidified to a pH of 4.2 and is used for samples collected east of the Mississippi. Extraction Fluid #2, for samples collected west of the Mississippi, is acidified to a pH of 5.0. Extraction Fluid #3 is filtered deionized water and is used for extraction of volatile organic compounds (VOCs) regardless of sample location. For the RLR spent shale samples, leachate derived from leaching with Reagent #2 was analyzed for all parameters except VOCs, for which Reagent #3 was used.

Three samples of the spent shale, designated R11-122 210#1, #2, and #3, were collected for analysis. The samples are duplicates and were collected to ensure representativeness in the event that the stored samples were inhomogeneous. Samples were leached with appropriate leaching solution, and the leachates were analyzed for the following parameters:

- General chemistry: pH total dissolved solids, major ions (Ca, Cl-, F-, K, Mg, Na, SO4); alkalinity; nitrate/nitrite (as N); oil and grease; Sr; and total organic carbon;
- Organic compounds: VOCs and semi-volatile organic compounds (SVOCs); and
- Trace metals and metalloids: Ag, As, B, Ba, Be, Cd, Cr, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sn, Tl, V, and Zn.

Both the VOC and SVOC leachates were analyzed for an extensive list of compounds determined by the laboratory, based on its experience.

Deleted: will be

The entire laboratory report provided by AWAL is attached as **Appendix G**. The results for the general chemistry analyses are summarized in **Table 11-2**.

Deleted: 1

Table 11-2 Spent Shales SPLP – General Chemistry From Red Leaf Resources

Deleted: 1

Sample Number	Lab	R11-122 210			Ground-water Quality Standard	Water Quality Standard for White River and Its Tributaries
Parameter	**Report-ing Limit**	**#1**	**#2**	**#3**		**4-Day Average 1-hour Average**
pH (pH units)	1.00	9.92	9.99	10.2	6.5–8.5	6.5–9.0
TDS (mg/L)	20.0	172	220	220	≥500 mg/L	N/S
Calcium (mg/L)	1.0	3.44	3.64	3.48	N/S	N/S
Fluoride (mg/L)	0.100	1.56	1.64	1.84	4.0	N/S
Potassium (mg/L)	1.00	4.23	<1.00	4.28	N/S	N/S
Magnesium (mg/L)	1.00	1.14	1.25	<1.00	N/S	N/S
Sodium (mg/L)	1.00	36.9	33.5	37.4	N/S	N/S
Sulfate (mg/L)	5.00	17.4	18.5	19.8	N/S	N/S
Alkalinity (mg/L)	40.0	68.9	82.0	78.7	N/S	N/S
nitrate/nitrite (as N) (mg/L)	0.0100	0.0106	0.0251	0.0142	10.0	N/S
oil and grease (mg/L)	1.00	9.92	<3.0	<3.00	N/S	N/S

Key:
mg/L milligrams per liter
N/S no standard has been set
TDS total dissolved solids

The results of the metals analyses are shown in **Table 11-3**, VOCs in **Table 11-4**, and SVOCs in **Table 11-5**. Note that only parameters with detectable quantities are shown in the tables. Complete analytical results are shown in **Appendix G**.

Deleted: 2

Deleted: 3

Deleted: 4

Table 11-3 Spent Shale SPLP – Detected Metals

Sample Number	Lab	R11-122 210			Ground-water Quality Standard	Water Quality Standard for the White River and Its Tributaries
Parameter	Report-ing Limit	#1	#2	#3		4-Day Average 1-hour Average
Antimony (mg/L)	0.00500	**0.00923**	**0.00761**	**0.00929**	0.006	N/S
Arsenic (mg/L)	0.00300	0.0367	0.0371	0.0391	0.05	0.150 0.340
Barium (mg/L)	0.00200	0.0483	0.0479	0.0410	2.0	N/S
Boron (mg/L)	0.500	0.840	0.832	0.878	N/S	N/S
Molybdenum (mg/L)	0.0200	0.129	<0.0200	0.159	N/S	N/S
Selenium (mg/L)	0.00400	0.00786	0.00753	0.00725	0.05	0.0046 0.0184
Strontium (mg/L)	0.0040	0.0686	0.0707	0.0640	N/S	N/S
Vanadium (mg/L)	0.0500	0.0638	0.0640	0.0666	N/S	N/S

Key:
mg/L milligrams per liter
N/S no standard has been set
SPLP synthetic precipitation leaching procedure
bold these figures exceeded groundwater standards

Deleted: 2

Table 11-4 Spent Shale SPLP – Detected VOCs.

Sample Number	Lab	R11-122 210			Groundwater Quality Standard
Parameter	Reporting Limit	#1	#2	#3	
Acetone (µg/L)	0.0100	0.0195	0.0178	0.0152	N/S
Acrylonitrile (µg/L)	0.00500	0.0171	0.0134	0.0118	N/S

Key:
µg/L micrograms per liter
N/S no standard has been set
SPLP synthetic precipitation leaching procedure
VOC volatile organic compound

Deleted: 3

Table 11-5 Spent Shale SPLP – Detected SVOCs.

Sample Number	Lab	R11-122 210			Groundwater Quality Standard
Parameter	Reporting Limit	#1	#2	#3	
Benzoic acid	0.0200	0.0326	0.0354	0.0259	N/S

Key:
N/S no standard has been set
SPLP synthetic precipitation leaching procedure
VOC volatile organic compound

Deleted: 4

Tables 11-3, 11-4, and 11-5 compare the detectable concentrations of ions and compounds identified in the spent shale by the laboratory analysis described above to both Utah Ground Water Quality Standards and established Water Quality Standards for the Asphalt Wash watershed, a tributary to the White River. The following excerpt from UAC R317-2.6, Standards of Quality for Waters of the State, Use Designations, indicates the applicable uses designated for the White River and its tributaries, including Asphalt Wash:

Deleted: 2
Deleted: 3
Deleted: 4

> Class 2B – Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.
>
> Class 3B – Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
>
> Class 4 – Protected for agricultural uses including irrigation of crops and stock watering.

The water quality standards shown in **Tables 4-3, 4-4, and 4-5** are those established by the UAC for Class 3B waters, which apply to the White River and its tributaries.

Deleted: 2
Deleted: 3
Deleted: 4

The analytical results for the three samples are consistent for almost all parameters analyzed, indicating that the spent shale is homogenous and that the samples analyzed are representative of the spent shale from the bench tests. The results of the analyses found only two parameters that exceeded groundwater quality standards: pH and antimony. Two parameters, pH and selenium, exceed the water quality standards established for Class 3B-designated streams. The antimony and selenium results are less than twice the laboratory reporting limit, which makes the accuracy of the results questionable.

The VOCs acetone and acrylonitrile are not constituents of oil shale, shale oil, or spent shale. Their identification in the AWAL report is due to either laboratory contamination or a false positive from the detector. False positives occur when the mass detector detects an ion designated as "characteristic" of a compound. This problem occurs when a given ion may not be exclusive to that compound and hence is misidentified. Standardized tests have not advanced to a point where these cases of misidentification are detected. Individual research is required to determine which of the two is required. Water quality standards have not been established for either compound.

Benzoic acid was the only SVOC detected. This constituent has no established water quality standard.

Deleted: The single SVOC detected, b

Deleted: ,

Deleted: Both acetone and benzoic acid were detected at levels less than twice the lab reporting limit, which suggests that the reported concentrations are questionable.

The exceedingly low concentrations of the few detected ions and compounds would, even if unconfined by the clay-enclosed capsules, not reach either groundwater or surface water in detectable concentrations.

12 RECLAMATION AND CLOSURE EVALUATION

The post-reclamation configuration of the capsules was evaluated to assess both erosion of the surface and infiltration of precipitation-derived water through reclamation cover, including the BAS.

12.1 Infiltration Modeling

Potential for infiltration of precipitation was analyzed using the Hydrologic Evaluation of Landfill Performance (HELP), which was developed by the EPA for evaluation of landfill designs. **Appendix H** contains the report describing the model setup, inputs, and results.

The modeling results demonstrated that the designed capsule cap and evapotranspiration cover provides adequate control on infiltration into the capsules for the vegetated cover case using the design parameters.

12.1 Time for Spent Shale to Reach Field Capacity

The DWQ requested that TomCo provide an estimate of the time that would elapse before infiltration through the upper BAS layer would cause the capsule to reach field capacity. In order to provide this same information, TomCo used the approach outlined by RLR in **Appendix L** of its GWDPA and used the same assumptions, key of which are:

- The field capacity for spent shale is 8.3 percent. The spent shale is a graded mixture with particle sizes ranging from coarse sand to cobbles. Published field capacity values for coarse grained materials could not be located, and RLR based the field capacity on published values for a sandy material with 1 inch of water holding capacity per foot of material.
- The absorptive capacity for soil is 10.2 percent. This value is based on the reported laboratory value in the RLR GWDPA of 11.3% reduced by 10% to be conservative.

In addition, after settlement, capsule thickness of the rectangular portion will be 90.0 feet (**Figure 5-5**).

To calculate the time to reach field for a representative, homogeneous column of spent shale, the following equation was used:

Water retention capacity (feet) = (spent shale absorption capacity + spent shale field capacity) x spent shale thickness (feet)

X= (10.2% + 8.3%) x 90 feet = 16.65 feet

With a HELP model predicted average annual infiltration rate of 0.070 inches per year (0.0058 feet per year) and 16.64 feet of retention capacity , the spent shale column could potentially reach field capacity in approximately 2,800 years (16.65 feet / 0.0058 feet per year = 2,871 years).

Deleted: The results are especially conservative given the absorptive capacity of the spent shale. Raw (un-retorted) shale and spent shale were tested under ASTM protocol ASTM C 127, Specific Gravity and Absorption, Coarse Aggregate. Raw shale had an absorptive capacity (by weight) of 2.7 percent, while spent shale had an absorptive capacity of 11.3 percent, a four-fold increase. ¶ HELP modeling conservatively predicted annual infiltration through the upper BAS layer of 0.07 inches per year. The gravel layer between the BAS and crushed fines, in conjunction with the sloped design of the EPS, helped drain water away from the capsule and decreased the amount of infiltration that would have occurred otherwise. The HELP model did not consider the fate of infiltrating precipitation that penetrated the upper BAS layer. However, this absorptive capacity will have a significant impact upon the potential for migration of fluids through the spent shale to the bottom of the capsule and the 3-foot BAS under-liner.

Deleted: RLR

Deleted: 83.5

Deleted: necessary

Deleted: capacity for the lower part of the capsule only, the following equation was used:¶ Water retention capacity (feet) = (soil absorption capacity + field capacity) x capsule thickness (feet)¶ X= (10.2% + 8.3%) x 83.5 feet = 15.45 feet¶ With a HELP model predicted infiltration rate of 0.07 inches per year (0.006 feet/year) and 11.84 feet of retention capacity, 2,575 years are estimated as the time necessary for the lower part of the EPS to reach field capacity (15.45 feet / 0.006 feet/year = 2,575 year).

13 COMPLIANCE MONITORING PLAN

The monitoring plan for the EPS capsule is described in **Section 5.5**. EPS capsule monitoring will occur during and after operations, through the cooling period and beyond to evaluate capsule performance. The capsule is intended to be protective of groundwater. The cover, capsule, and liner system all serve to prevent discharge and protect groundwater. The liner system includes from top to bottom:

- Vegetative cover;
- Layers of fill above the BAS liner;
- The BAS liner itself; [3]
- The gravel layer that serves as a capillary barrier;
- The capsule's significant central volume made up of spent shale;
- An additional gravel layer;
- An underlying collection pan that can practically serve as a collection lysimeter following the production phase;
- Underlying layers of road base; and
- The final BAS liner.

Due to the anticipated settling of the cover during production, the BAS will be evaluated on a weekly basis to identify settlement. Restoration and repair will be performed if necessary. Information gained from operation of the EPS capsule will be applied to the final commercial design, construction, and operation of the capsules during the operational stage of production.

[3] The functional equivalent design calls for a geosynthetic membrane, as shown on **Figure 5-7**.

As described in **Section 5.5**, monitoring will focus on discharges from the EcoShale™ capsule, and the proposed compliance monitoring plan is designed to detect an occurrence of pollutant discharge nearest the source. The proposed monitoring points include sampling from the EcoShale™ capsules' product collection pan and sampling from two pipe systems underlying the EcoShale™ capsules which constitute three separate monitoring systems.

Among other features, capsules are designed with an underlying collection pan to collect oil during the capsule's production phase. The EcoShale™ capsules' product collection pan is constructed within the lower portion of the capsule, beneath the heating/retort zone. During the production phase, the EcoShale™ capsule product collection pan is used to collect oil and water.

Following the production phase, the collection pan remains and acts as a large restrictive barrier beneath the entire capsule. This pan collection system will be monitored for the presence of liquid from a downgradient monitoring location on the north side of the capsule structure. Monitoring and sampling the capsule collection pan will provide an early indication of any liquid percolation through the capsule. This pan and monitoring system also provides a system of liquid removal, should that become necessary after production is completed. This monitoring approach is expected to provide the best indication of potential discharge to groundwater from the capsule. Due to the design of the capsule, which minimizes and prevents percolation through the capsule layers and into the capsule, significant volumes of liquid percolation through the capsule are not expected.

Two additional sample collection and monitoring areas will be located underneath the collection pan and within the constructed capsule. The associated piping network for these two collection areas will pass through the bulkhead and exit the external MSE wall that forms the north end of the capsule to provide a readily accessible monitoring and sampling location. The first collection area will be a pipe system located on the down-gradient, north end of the capsule on top of the lower BAS layer. The second will be between the bedrock foundation of the capsule and the outside edge of the BAS containment layer on the east, west, and north sides of the capsule. Analyses of liquid samples collected from this network of pipes will also provide an indication of possible discharge of chemical constituents from the capsule.

In addition to these three leak detection systems, exterior facilities will be in place to capture surface runoff during the construction and operation phases of the project. The EPS capsule will be constructed on bedrock that slopes approximately 3 degrees to the northwest. Any storm water coming into contact with overburden, ore, and construction materials during capsule construction or operation phases will primarily be held within the bermed work area, and secondarily, will be conveyed to a holding pond sized for the 20-year, 24-hour storm event, located on the north side of the EPS construction pad. Any collected storm water that has come in contact with overburden or ore will be contained on site and will be used on site for BAS production, dust control, or will be left in place until it evaporates. Stormwater management, including figures showing hold pond locations, is discussed in detail in **Appendix A**.

14 CERTIFICATION/SIGNATURE

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

PAUL RANKINE, CEO	801-833-0412
NAME & OFFICIAL TITLE (type or print)	PHONE NO. (area code & no.

	December 5, 2014
SIGNATURE	DATE SIGNED

Deleted: EPS capsule monitoring will occur during and after operations, through the cooling period and beyond to evaluate capsule performance. The capsule is intended to be protective of groundwater. The cover, capsule, and liner system all serve to prevent discharge and protect groundwater. The liner system includes: ¶
<#>Vegetative cover; ¶
<#>Layers of fill above the BAS liner; ¶
<#>The BAS liner itself; ¶
<#>The gravel layer that serves as a capillary barrier; ¶
<#>The capsule's significant central volume made up of spent shale; ¶
<#>An additional gravel layer;¶
<#>An underlying collection pan that can practically serve as a collection lysimeter following the production phase; ¶
<#>Underlying layers of road base; and¶
<#>The final BAS liner. ¶
Due to settling of the cover during production, the BAS will be evaluated following settlement. Restoration and repair will be performed if necessary. Information gained from operation of the EPS capsule will be applied to modifications in design, construction, and operation of the capsules during the full operational stage of production. ¶
The design of, and reclamation plan for, RLR's EcoShale™ capsules promote high evapotranspiration while ensuring that remaining water reports primarily as runoff with minimal infiltration. Nevertheless, baseline water quality and quantity data will be collected in the event that monitoring may be appropriate in the future. ¶
Monitoring will focus on discharges from the EcoShale™ capsule, and the proposed compliance monitoring plan is designed to detect an occurrence of pollutant discharge nearest the source. The proposed monitoring points include sampling from the EcoShale™ capsules' product collection pan and sampling from trenches underlying the EcoShale™ capsules.¶
Among other features, capsules are designed with an underlying collection pan to collect oil during the capsule's production phase. The EcoShale™ capsules' product collection pan is constructed within the lower portion of the capsule, beneath the heating/retort zone. During the production phase, the EcoShale™ capsule product collection plan is used to collect oil and water. ¶
Following the production phase, the collection pan remains and acts as a large collection lysimeter beneath the entire capsule. This pan collection system will be monitored for the presence of water. Monitoring and sampling the capsule collection pan will provide an early indication of any water percolation throu ... [1]

Deleted: 14

15 REFERENCES

Birgenheier, Lauren, Michael Vanden Berg, Morgan Rosenberg, and Jeah Toms. 2013. Sedimentology and Stratigraphy of the Green River Formation, Uinta Basin, A Field Trip for GRF Project Sponsor, Total, April 30 – May 3, 2013.

BLM (Bureau of Land Management). 2008. Proposed Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah, and Wyoming and Final Programmatic Environmental Impact Statement. FES 08-32. September 2008

Cashion, W.B. 1992 Oil-Shale Resources of the Uintah and Ouray Indian Reservation, Uinta Basin, Utah, *in* Hydrocarbon and Mineral Resources of the Uinta Basin, Utah and Colorado, Utah Geological Association Guidebook 20, Thomas D. Fouch, Nuccio, V.F., Chidsey, T.C., Jr., eds.

DWQ (Division of Water Quality). 2014. Statement of Basis, Red Leaf Resources Southwest #1 Oil Shale Mine, Ground Water Discharge Permit No UGW470002.

Driscoll, F.G., 1986. Groundwater and Wells (2nd ed.), Johnson Filtration Systems, Inc., St. Paul, Minnesota, pp. 252-257.

Duffield, G.M., 2007. AQTESOLV for Windows Version 4.5 User's Guide, HydroSOLVE, Inc., Reston, VA.

Epic Engineering. 2013. Waters of the United States Jurisdictional Assessment, TomCo Inc.

Fetter, C.W., 1994. Applied Hydrogeology (3rd Edition), Prentice-Hall, Inc., Upper Saddle River, New Jersey, pg 98.

Freethey, Geoffrey W. and Gail E. Cordy. 1991. Geohydrology of Mesozoic Rocks in the Upper Colorado River Basin in Arizona, Colorado, New Mexico, Utah, and Wyoming, Excluding the San Juan Basin. U.S. Geological Survey Professional Paper 1411-C.

Halford, K.J. and Kuniansky, E.L., 2002. Documentation of Spreadsheets for the Analysis of Aquifer-Test and Slug-Test Data, U.S. Geological Survey Open-File Report, 02-197, 51 p.

Holmes, Walter F. 1980. Results of Test Drilling for Ground Water in the Southeastern Uinta Basin in Utah and Colorado. U.S. Geological Survey, Water-Resources Investigations 80-951.

Holmes, Walter F. and Briant A. Kimball. 1987. Ground Water in the Southeastern Uinta Basin, Utah and Colorado. U.S. Geological Survey Water-Supply Paper 2248.

Glover, Kent C., David L. Natz, and Lawrence J. Martin. 1998. Geohydrology of Tertiary Rocks in the Upper Colorado River Basin in Colorado, Utah, and Wyoming, Excluding the San Juan Basin Regional Aquifer System Analysis. Water-Resources Investigations Report 96-4105. U.S Geological Survey.

Keighin, C. William. 1977. Preliminary Geologic Map of the Cooper Canyon Quadrangle, Uintah County, Utah. U.S. Geological Survey.

Lowham Walsh, 2013, Groundwater Monitoring Plan, Proposed TomCo Mine Site, Uintah County, Utah, Prepared for The Oil Mining Company, Inc.

Mayo A.L., Morris T.H., Peltier S., Petersen E.C., Payne K., Holman L.S., Tingey D., Fogel T., Black B.J., Gibbs T.D. 2003. Active and Inactive Groundwater Flow Systems: Evidence from a Stratified, Mountainous Terrain. GSA Bulletin. 115(12): 1456—1472.

Moench, A.F., 1997. Flow to a well of finite diameter in a homogeneous, anisotropic water-table aquifer, Water Resources Research, vol. 33, no. 6, pp. 1397-1407.

Norwest Corp. 2011. Operations and Reclamation Drainage Plan, Red Leaf Resources.

Pipiringos, George N. 1978. Preliminary Geologic Map of the Bates Knolls Quadrangle, Uintah County, Utah. U.S. Geological Survey.

Price, Don and Louise L. Miller. 1975. Hydrologic Reconnaissance of the Southern Uinta Basin, Utah and Colorado. State of Utah Department of Natural Resources Technical Publication No. 49. Prepared by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights.

RLR (Red Leaf Resources, Inc.). 2010. Pre-Design Conference, August 4, 2010. PowerPoint presentation for the conference.

_____. 2011. Notice of Intention To Commence Large Mining Operations, Red Leaf Resources, Inc., Seep Ridge Block: Southwest #1 Mine. April 28, 2011.

Sprinkel, Douglas A. 2009. Interim Geologic Map of the Seep Ridge 30' X 60' Quadrangle, Uintah, Duchesne, and Carbon counties, Utah, and Rio Blanco and Garfield Counties, Colorado. Utah Geological Survey Open-File Report 549DM.

Stokes, W.L. 1986. Geology of Utah. Utah Museum of Natural History and Utah Geological and Minerals Survey.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

USGS (United States Geological Survey). 2010. Geographic information system (GIS) shapefile titled SGID93_WATER_SpringsNHDHighRes, obtained from the Utah Automated Geographic Reference Center downloaded from **http://gis.utah.gov/agrc**. Data source is the USGS, USEPA, and the US Forest Service.

_____. 2011. National Water Information System (NWIS) accessed online March 25, 2011 at **http://waterdata.usgs.gov/nwis/nwisman/**

Vanden Berg, Michael. 2008. Basin-Wide Evaluation of the Uppermost Green River Formation's Oil-Shale Resource Uinta Basin Utah and Colorado, Special Study 128, Utah Geological Survey.

_____. January 21, 2014. Personal Communication. Geologist, Utah Geological Survey. Meeting with Tom Ferraro, Ecology and Environment, Inc., Salt Lake City, Utah.

_____. December 2, 2014. Personal Communication. Utah Geological Survey. Review of Geological report prepared by Jon Kaminsky, P.G. for Lowham Walsh, Salt Lake City. Utah.

Wallace, Janea. 2012. Baseline Water Quality and Estimated Quantity for Selected Sites in the Southeastern Uinta Basin, Utah. Open File Report 595, Utah Geological Survey, Utah Department of Natural Resources, 2012, 66 p.

Woods et al. 2011. Ecoregions of Utah (color poster with map, descriptive text summary table, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1, 175,000).

APPENDIX A

OPERATIONS AND RECLAMATION DRAINAGE DESIGN PLAN

APPENDIX A

THE OIL MINING COMPANY, INC.

EARLY PRODUCTION SYSTEM STORM WATER DRAINAGE PLAN

NORWEST CORPORATION

TABLE OF CONTENTS

Tables

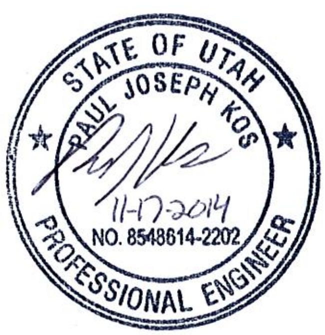
Figures

NORWEST
CORPORATION

Certificate of Engineer

I, Paul Kos, certify that all the information presented in the following report and figures are true and correct to the best of my knowledge and information.

Item	Date of Preparation	Title
Appendix A	November 17, 2014	EPS Storm Water Draiange Plan
Figure A	November 17, 2014	EPS Site Drainage Plan
Figure B	November 17, 2014	Typical Ditch Details
Figure C	November 17, 2014	Typical Settling Pond Detail



Paul J. Kos, P.E. - Utah P.E. No. 8548614-2202

NORWEST
CORPORATION

Early Production System Storm Water Drainage Plan
TomCo Oil Shale Project Located in Uintah County, Utah

Project Location

The Oil Mining Company, Inc. (TomCo) holds an oil shale mineral lease on roughly 1,200 acres of School and Institutional Trust Land Administration (SITLA) lands in the Uinta Basin in an area called the "Holliday Block," for which TomCo has SITLA Mineral Lease ML-49571. TomCo proposes to develop oil shale mining and processing operations in this area, referred to in this report as "the project." The project site is located in Section 13 and portions of Sections 11, 12, and 14 of Township 12 South, Range 24 East of the Salt Lake Principal Meridian in Uintah County, Utah. The approximate elevation of the project site ranges between 6,060 and 6,500 feet above mean sea level (EPIC 2013).

Report Objective

The goal of this report is to provide a plan for effective surface water runoff control from TomCo's proposed Early Production System (EPS) project. The EPS project will test the Eco-Shale capsule technology, a patented process used to extract oil from kerogen-rich oil shale ore. The process involves placing ore in sealed capsules, heating the encapsulated ore, and extracting liquid hydrocarbons via a pipe and tank storage system. The capsule is designed to prevent impacts to groundwater and the surrounding ecosystem by utilizing an impermeable liner of bentonite amended soil (BAS). To conduct the test, a capsule that is approximately ¾ the size of proposed standard production capsules will be constructed. During construction, heating, and cooling periods, observations will be made to measure and assess design concepts and components such as insulation effectiveness, fluid recovery, and capsule containment. Data obtained during EPS operation will be applied to the final design of commercial scale capsules. This report addresses the following topics to meet the requirements of the EPS permits:

(1) EPS water management plan

(2) Clean and sediment-laden water ditch design

(3) Pond design, including earthen embankment dams

Clean water diversion ditches will be installed prior to any development to divert upland runoff around the project site. These ditches will be designed to carry flows from the 100-year, 24-hour event.

Water intercepted by EPS capsule-related disturbance will be managed by storing water on site, using berms and sumps to provide source control and to limit the migration of any hydrocarbons around the site. If high flows occur, water will be directed to engineered ditches and ponds where water will be stored until it evaporates. These ditches have been designed to carry runoff flows resulting from the 10-year, 24-hour event. Topsoil will be salvaged and placed in a dedicated stockpile shown in Figure A prior to commencement of excavation and testing, and reused during the reclamation phase. The proposed mining process consists of simultaneously mining the oil shale and constructing heating capsules where the oil shale will be heated to extract oil and gas in a controlled environment. During the EPS test, a single capsule will be constructed to evaluate the design. The capsule will be lined with an impermeable liner to prevent impacts to ground water. A series of ditches and ponds will be used to manage rainfall runoff on site.

The capsule will be reclaimed once the oil and gas are extracted from the shale, as explained in Section 12 of the GWDPA.

Site Soil and Vegetative Cover Conditions

The project site is located in an arid climate and is primarily a high plains desert. As described in a survey report for the area conducted by Cardno-ENTRIX (2013): “The vegetative cover type for the site is characterized by three communities: a “Pinyon-Juniper Woodland/ Shrubland,” dominated by Utah juniper and pinyon pine; a “Mixed Sagebrush/Greasewood Shrubland” community, dominated by sagebrush, rabbitbrush, greasewood, and shadscale; and a “Mixed

Bedrock Canyon and Tableland Community" of pinyon and juniper and scattered cool season grasses."

The primary soil type on site to the south of the East Seep Draw is classified as the Gompers-Bigpack Association. This soil type consists of approximately 60 percent Gompers, 25 percent Bigpack, and 15 percent minor components. The Natural Resources Conservation Service (NRCS) classifies this soil as type D hydrologic soil group. The secondary soil group to the north of the natural drainage channel is the Walknolls-Bullpen-Walknolls Association, which also belongs to a type D hydrologic soil group (NRCS 2003).

The project site predominantly has type D Hydrologic Soil Group and a vegetative cover of scattered pinyon-juniper and sagebrush plants, which yields a range of Curve Numbers between 84 and 88. A Curve Number of 88 was chosen for the storm water drainage design to be conservative.

There are two areas of the site where the Curve Number will be greater: (1) the active disturbance areas where vegetation and the topsoil will be removed, and (2) the northern portions of the lease that have been affected by recent wildfire. A Curve Number of 94 was used for both of these areas for the following reasons:

(1) Newly graded areas with no vegetation and cultivated agricultural lands with bare soil (type D) both have a Curve Number of 94 (Warner et al. 2004).

(2) To estimate a post-fire Curve Number, a simple rule of adding 5 to 15 units to the undisturbed, pre-fire Curve Number has been suggested by Higgonson and Jarnecke (2007).

Using these guidelines, a Curve Number of 94 was used to estimate runoff from disturbed areas as well as burned areas affected by wildfire.

Curve numbers for watersheds with multiple soil types or cover types are calculated using a weighted average of each watershed area and the corresponding curve number.

Rainfall Data

The Bonanza, UT rain gauge is located approximately 30 miles north-northeast of the project site in Bonanza, Utah. Three rainfall events were used in the design of the storm water drainage plan: the 10-year, 24-hour; the 25-year, 24-hour; and the 100-year, 24-hour storm events. The corresponding amounts of rainfall for these three events are 1.60 inches, 1.93 inches, and 2.46 inches, respectively (Bonin 2006). The Type II Rainfall Distribution, which consists of short, high-intensity storms that cause flash flooding, was used for modeling of rainfall runoff.

EPS Storm Water Management Plan

The Early Production System (EPS) storm water management plan uses clean water diversion ditches to divert clean water around disturbed areas, sediment-laden water collection ditches to collect impacted water from disturbed areas, and settling ponds to remove sediment from sediment-laden water. Clean water diversion ditches will collect clean water entering the site from adjacent areas and overland flow, and route it around the active mining areas back into one of the natural drainages that are outside the mine lease. Sediment-laden water collection ditches will collect runoff water inside the active disturbance areas and route it to one of the settling ponds. Sediment that is in suspension will be allowed time to settle after it is collected into one of the settling ponds. Treated water will be stored until it evaporates, if feasible. .

Clean Water Diversion Ditches

Clean water diversion ditches will provide protection to workers and the active disturbance areas. They are excavated into native ground and designed to divert clean water around disturbance areas to natural drainages. Clean water diversion ditches will typically be functional during operations and reclamation; thus, they have been designed to route peak runoff flows resulting from the 100-year, 24-hour storm event with one foot of freeboard.

Clean water diversion ditch CWDD-1 collects runoff from watersheds upgradient and south of the mine pit. CWDD-3 and CWDD-4 collect runoff from watersheds located upstream and divert it around the EPS and other associated structures. CWDD-5 collects runoff from watersheds north of the Facilities area and diverts it around Pond 1 (Figure A). Clean water diversion ditches were designed to be trapezoidally shaped with bottom widths that maintain peak velocities below the erosive limit of 5.5 feet/second (Figure B). Clean water drainages have steep grades near their outlets where water discharges back into natural drainages. In order to protect against erosion, these areas will need to be armored with riprap (Figure B). CWDD-4 and CWDD-5 are armored with riprap to protect against erosion. In addition, these ditches will need check dams installed approximately every 50' where slopes are steep (approximately 16%) to reduce peak runoff velocity. Table 1 shows a summary of the clean water diversion ditches. Figure B shows typical cross sectional configurations of earthen and riprap armored ditches.

Table 1: EPS Water Management Plan Clean Water Diversion Ditch Summary

Ditch #	Location	Drainage Area (acres)	100-year Storm Event (2.46 inches)		Slope (%)	Trapezoidal Ditch Geometry	
			Peak Runoff (cfs)	Peak Velocity (ft/sec)		Bottom Width (feet)	Total Depth (feet)
CWDD-1	SE corner of mine pit	4.1	3.89	3.26	4.0	5	1.21
CWDD-3	SW corner of EPS pad	124.0	83.46	4.20	1.0	20	1.88
CWDD-4	SE corner of EPS pad (riprap armored)	233.2	211.20	NA-15" Riprap	16.0	20	1.75
CWDD-5	Facilities area	21.2	17.06	NA-6" Riprap	19.0	12	1.12

Key:
cfs cubic feet per second
ft/sec feet per second

Sediment-Laden Water Collection Ditches

Sediment-laden water collection ditches will be used to collect runoff from disturbed areas and convey it to settling ponds. These ditches have been designed to carry runoff flows resulting from the 10-year, 24-hour storm event with one foot of freeboard. Sediment-laden water will be kept separate from clean water until after it is treated. Sediment-laden ditches will have a trapezoidal cross-section with side slopes of 3:1, and the bottom widths will vary to keep the peak flow velocity below 5.5 feet per second to minimize erosion as shown on Table 2.

Sediment-laden water collection ditches will have a non-erosive velocity that is less than that of clean water diversion ditches that are constructed in bedrock.

Sediment-laden water collection ditches, CD-1A/B, CD-4, and CD-8A/B, shown on the EPS Site Drainage Plan (Figure A) are designed to collect sediment-laden runoff from disturbed areas and route it to one of the settling ponds.

Table 2: EPS Water Management Plan Sediment-Laden Water Collection Ditch Summary

			10-year Storm Event (1.60 inches)			Trapezoidal Ditch Geometry	
Ditch #	**Location**	**Drainage Area (acres)**	**Peak Runoff (cfs)**	**Peak Velocity (ft/sec)**	**Slope (%)**	**Bottom Width (feet)**	**Total Depth (feet)**
CD-1A	Facilities North (riprap armored)	14.3	10.33	4.36	9.8	15	1.15
CD-1B	Facilities South	5.0	5.10	5.04	20.4	12	1.08
CD-4	W end of mine lease	18.4	16.17	3.69	1.0	5	1.64
CD-8A	E half of EPS Pad	55.0	35.49	3.24	0.5	3	2.47
CD-8B	W half of EPS Pad	112.5	70.57	3.87	0.5	3	3.01

Key:
cfs cubic feet per second
ft/sec feet per second

Settling Ponds

The settling ponds have been designed to fully contain runoff from the 10-year, 24-hour storm event and approximately three years of sediment storage. The design details typical for all the settling ponds are included as Figure C. The trapezoidal emergency spillways with 3H:1V side slopes will safely handle flows from the 25-year 24-hour event with at least 0.3 feet of freeboard, when flowing at peak design capacity. Spillway channels may be armored with rip-rap, if required to ensure non-erosive velocities. The sizes of the settling ponds associated with the EPS project are summarized in Table 3. The settling ponds are designed to hold sediment-laden water. Below-grade settling ponds or sumps are located at low spots within open pits, and this water must be pumped out, allowed to infiltrate into the ground, or be evaporated over time. Water in below-grade settling ponds cannot be returned to natural drainages by gravity alone as the sumps are located below the natural drainage grade.

The settling ponds have been designed to have earthen embankment dams on the downstream side. Each earthen embankment dam has been designed with the following specifications in order to meet the requirements for Small, Low Hazard Dams established by the Utah Department of Natural Resources (UDNR Division of Water Rights, 2003):

(1) A 10-foot (or less) dam height, including 3 feet of freeboard

(2) Dam crest width of 12 feet

(3) Total above-grade storage capacity of less than 20 acre-feet (AC-FT)

(4) Embankment side slopes of 3:1

Table 3: EPS Water Management Plan Pond Summary

Pond #	Location	Description	Curve Number	Watershed Area (acres)	Total Runoff (acre-feet)
					10-year Storm Event (1.60 inches)
1	Down gradient from facilities area	On channel pond	92.7	24.8	1.72
7A	Inside YR 1 Mine Pit	In pit sump	94	39.1	2.67
8	North of EPS Pad	On channel pond	93.7	174.9	11.87
9	Near western edge of mine lease	On channel pond	89.6	37.8	2.35

Summary

Drainage control at the EPS site will consist of the diversion of upgradient flows around disturbed areas, and establishment of collection ditches within the disturbed facility areas which will flow to settling ponds. Other stormwater BMP strategies may be used to minimize runoff into the settling ponds.

References

Bonin, G.M., et.al. 2004 revised 2006. NOAA Atlas 14 Precipitation-Frequency Atlas of the United States Volume 1 Version 5: Semiarid Southwest (Arizona, Southeast California, Nevada, New Mexico, Utah). NOAA, National Weather Service, Silver Spring, Maryland. http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ut, Accessed 12/16/13.

Cardno-ENTRIX. 2013. Vegetation Survey and Protected Biological Resources Survey for The Oil Mining Company Inc. Parcel, Uintah County, Utah. June 2013.

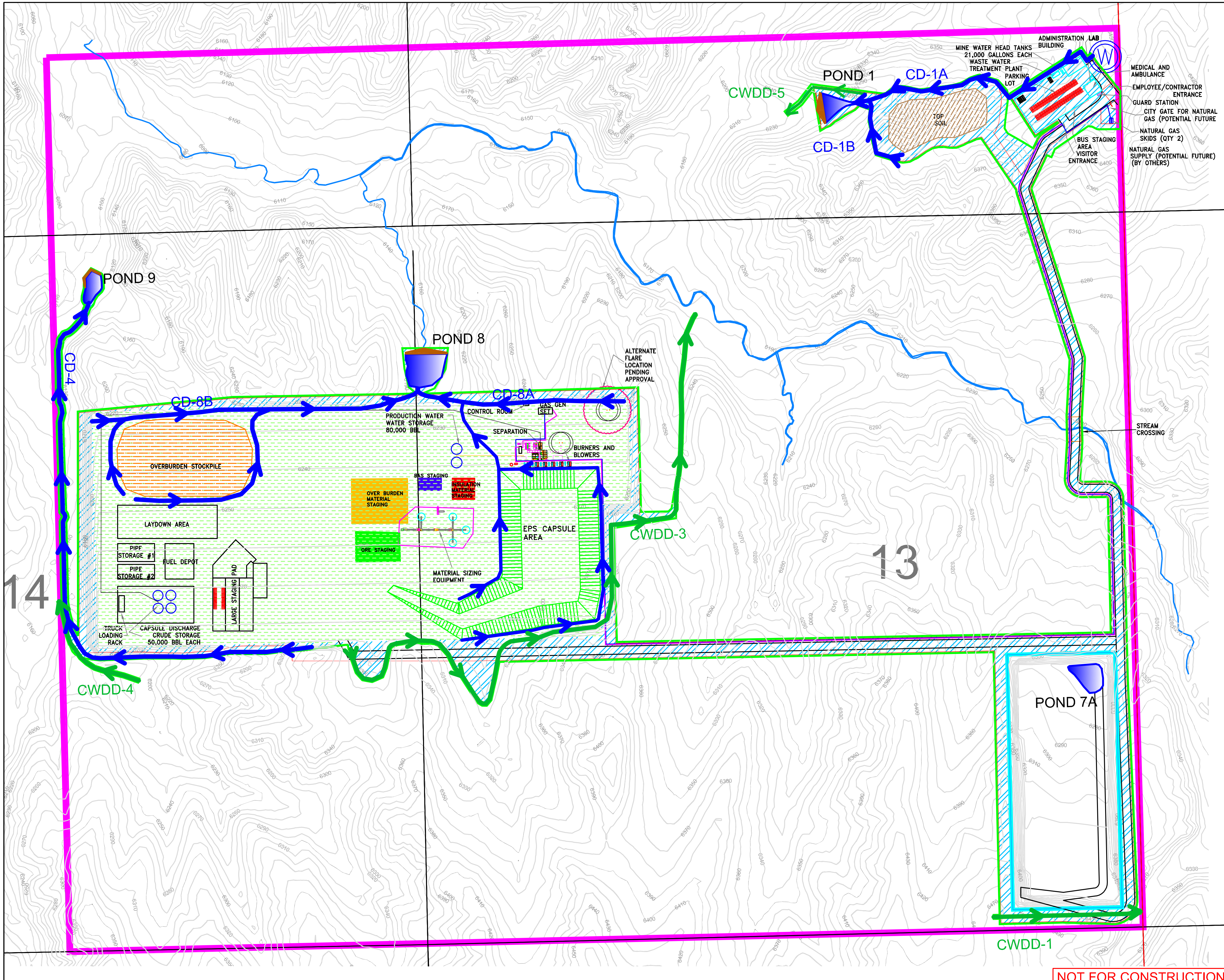
EPIC Engineering. 2013, Waters of the United States Jurisdictional Assessment, Report No. 001, Uintah County, Utah. Prepared by EPIC Engineering for TomCo Energy PLC, July 11, 2013, 168 p.

Higginson, Brad; Jarnecke, Jeremy. 2007. Salt Creek BAER-2007 Burned Area Emergency Response. Provo, Utah: Uinta National Forest; Hydrology Specialist Report. 11p

Natural Resource Conservation Service (NRCS), 2003, United States Department of Agriculture, Soil Survey of Uintah Area, Utah – Parts of Daggett, Grand, and Uintah Counties. http://soildatamart.nrcs.usda.gov/Manuscripts/UT047/0/UT047.pdf Accessed 12/16/13

Utah Department of Natural Resources Division of Water Rights. 2003. Dam Safety Guidelines for Small, Low Hazard Dams, 12 p. http://www.waterrights.utah.gov/daminfo/forms.asp Accessed 12/16/13

Warner C. R., Schwab, J. P., & Marshall, J. D. (2004), SEDCAD 4 Design Manual and User's Guide.

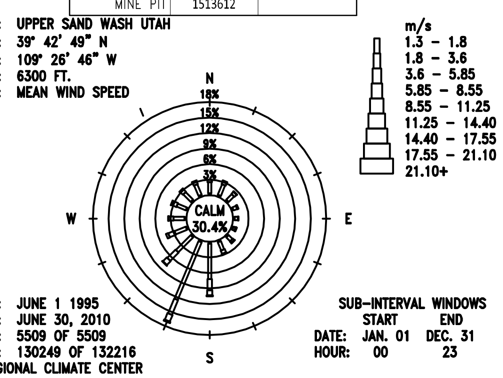


LEGEND

- OVERBURDEN STAGING
- ORE STAGING
- INSULATION MATERIAL STAGING
- BAS STAGING
- TOPOGRAPHY CONTOUR
- MINE PIT BOUNDARY
- DISTURBANCE BOUNDARY
- EXISTING RD
- PROPOSED RD
- MINE WATER
- POTABLE WATER
- FIREWATER SYSTEM
- POWER LINE (POTENTIAL FUTURE)
- NATURAL GAS SUPPLY (POTENTIAL FUTURE)
- FENCE LINE
- CAPSULE DISCHARGE WATER
- CRUDE OIL LINE
- CLEAR AND GRUB
- STRIP AREAS
- TOPSOIL STOCKPILE
- OVERBURDEN STOCKPILE
- CLEAN WATER DIVERSION DITCH
- SEDIMENT-LADEN WATER COLLECTION DITCH
- SETTLING POND AND EMBANKMENT
- WATER WELL

	AREA (sqft)	VOLUME (cuft)
CLEAR & GRUB	3808925	
STRIP	6705912	72222672
STOCKPILE	452355	
MINE PIT	1513612	

STATION : UPPER SAND WASH UTAH
LATITUDE : 39° 42' 49" N
LONGITUDE : 109° 26' 46" W
ELEVATION : 6300 FT.
ELEMENT : MEAN WIND SPEED



START DATE : JUNE 1 1995
END DATE : JUNE 30, 2010
OF DAYS : 5509 OF 5509
OBS:POSS : 130249 OF 132216
WESTERN REGIONAL CLIMATE CENTER

SUB-INTERVAL WINDOWS

	START	END
DATE:	JAN. 01	DEC. 31
HOUR:	00	23

UPPER SAND WASH REFERENCE WIND ROSE

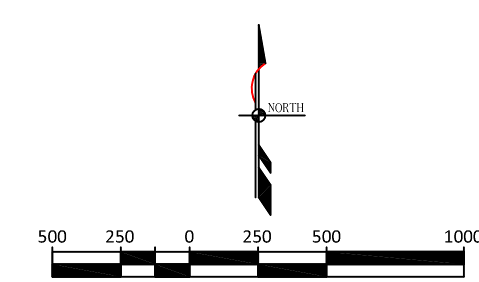
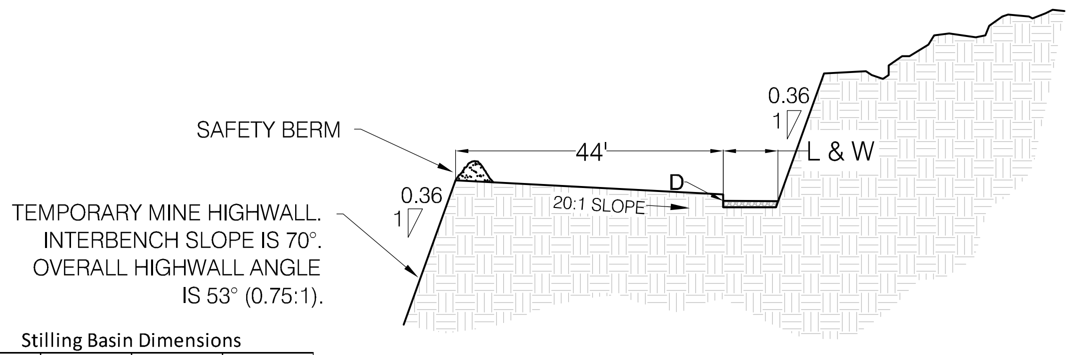


FIGURE A

EPS Site Drainage Plan
The Oil Mining Company, Inc.
Uintah County, Utah

NOT FOR CONSTRUCTION

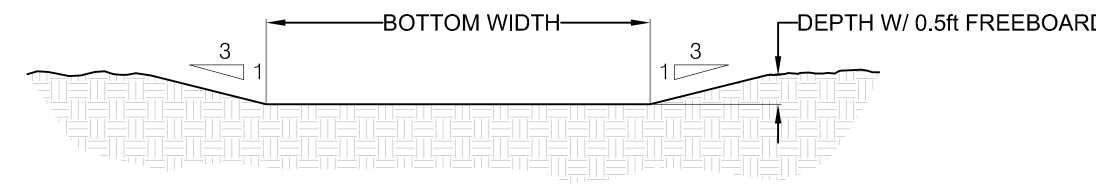
DATE: 11/17/2014
FILE: Figure A EPS Site Plan.dwg
SCALE: AS NOTED
NORWEST CORPORATION



Stilling Basin Dimensions

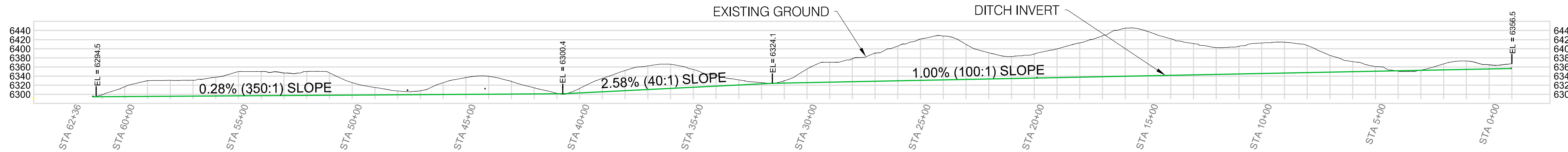
100-Yr 24-Hr Flow (cfs)	D_{50} (ft)	Length & Width (ft)	Depth (ft)
20	0.5	13	3
10	0.5	7	1.5
105	1	16	4
230	1	33	8
271	1	40	9.6

Typical Highwall Clean Water Diversion Ditch Stilling Basin Cross Section



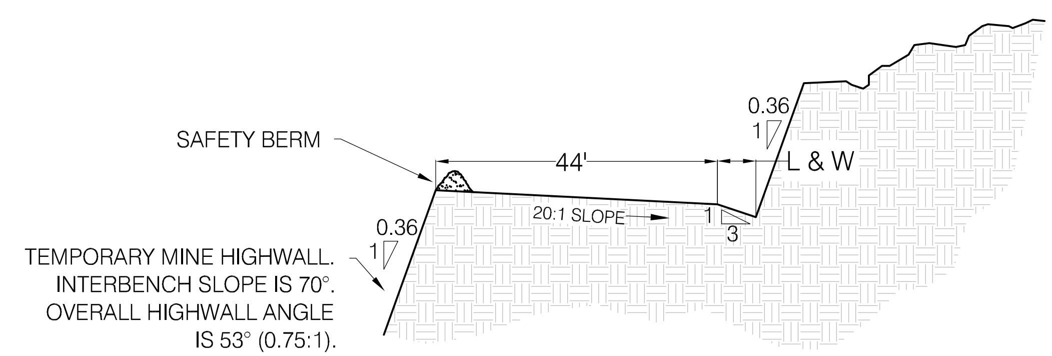
Clean Water Diversion Ditch Typical Cross Section

(SEE DITCH TABLE 1 FOR BOTTOM WIDTH AND DEPTH)

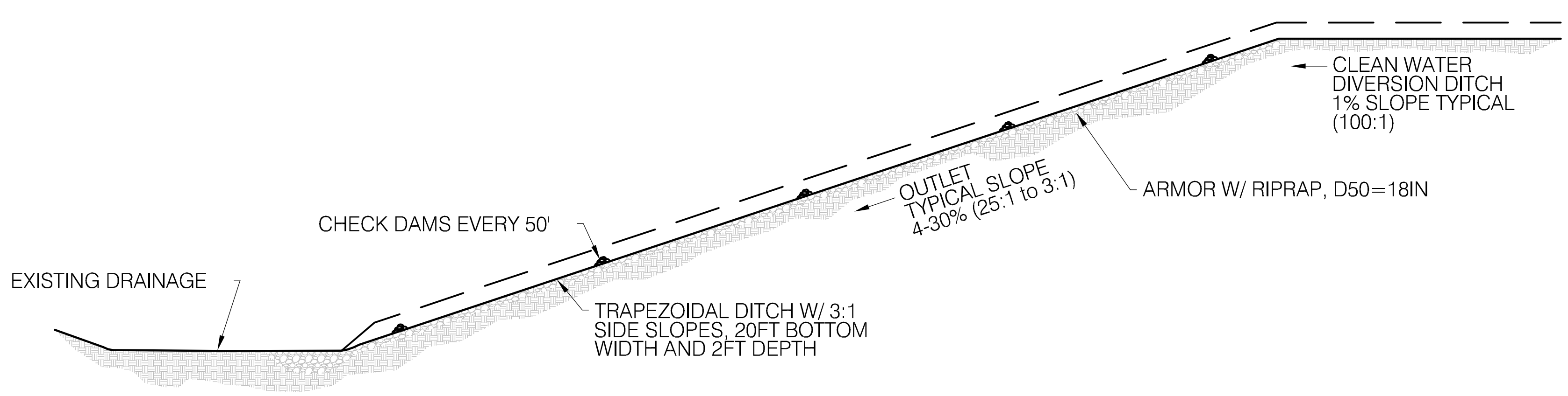


SW Clean Water Diversion Ditch Profile

(x2 VERTICAL EXAGGERATION)



Typical Highwall Clean Water Diversion Ditch Cross Section



Typical Clean Water Diversion Ditch Outlet Profile

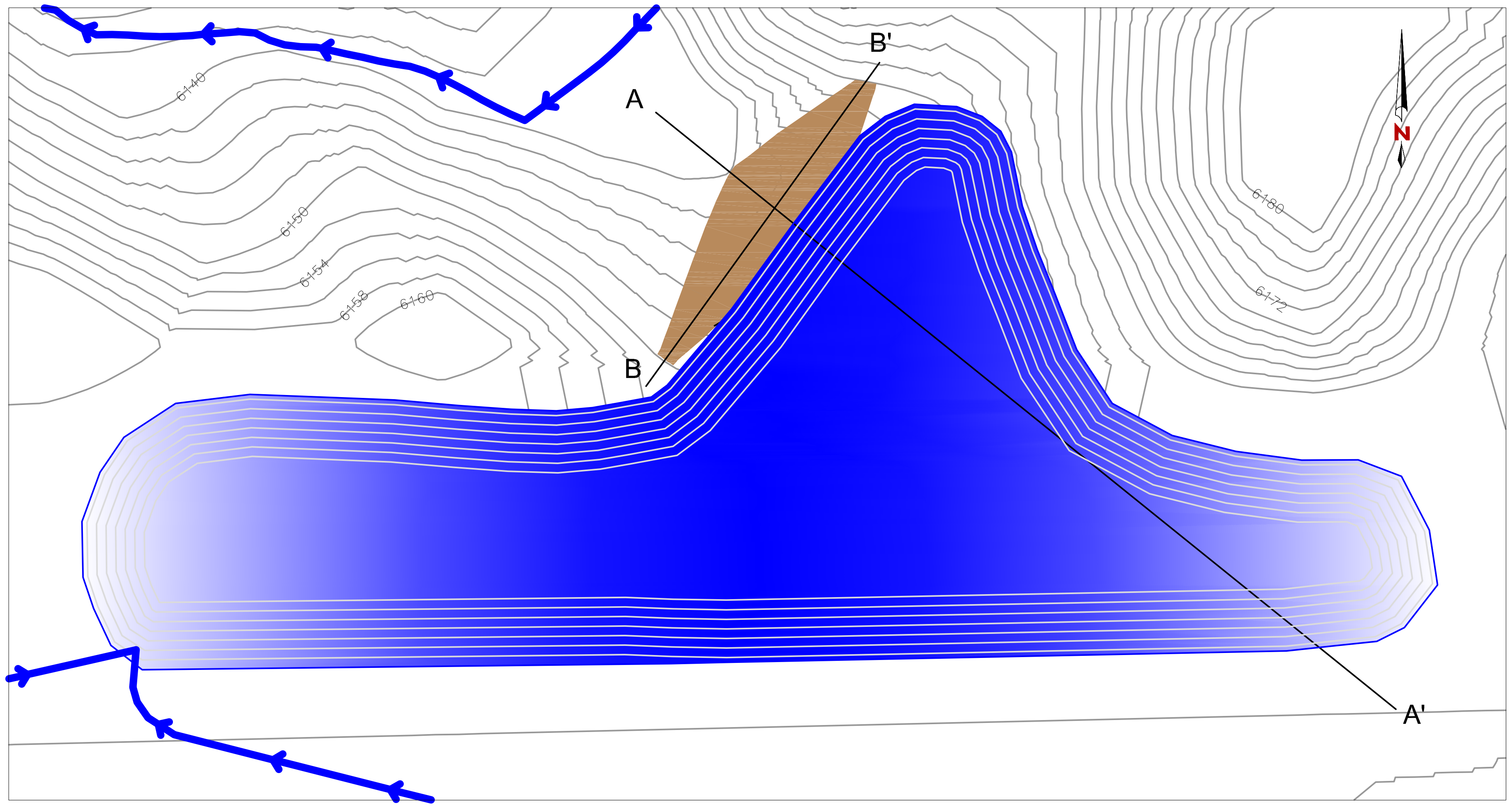
NOT FOR CONSTRUCTION

FIGURE B

Typical Ditch Details

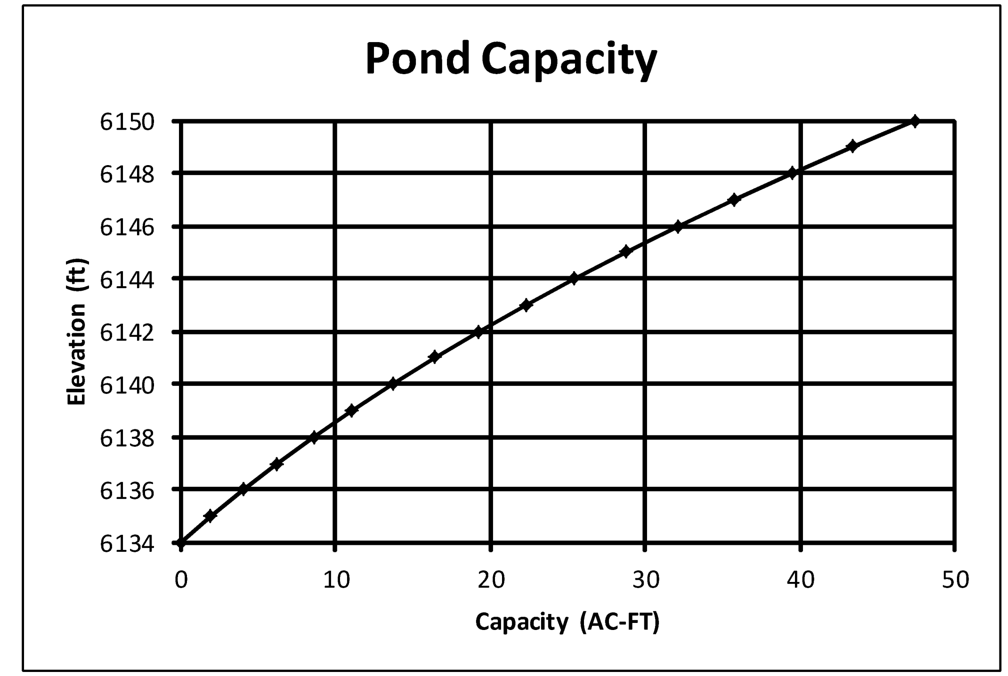
The Oil Mining Company, Inc.
Uintah County, UT

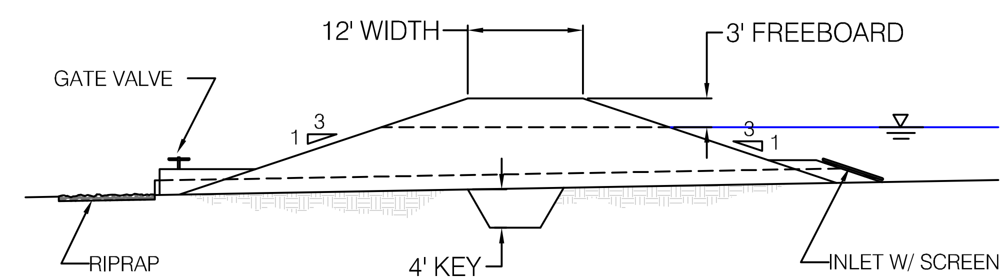
DATE: 11/17/2014
FIG B CWD DITCH.DWG
SCALE: NTS
NORWEST CORPORATION



SETTLING POND PLAN VIEW

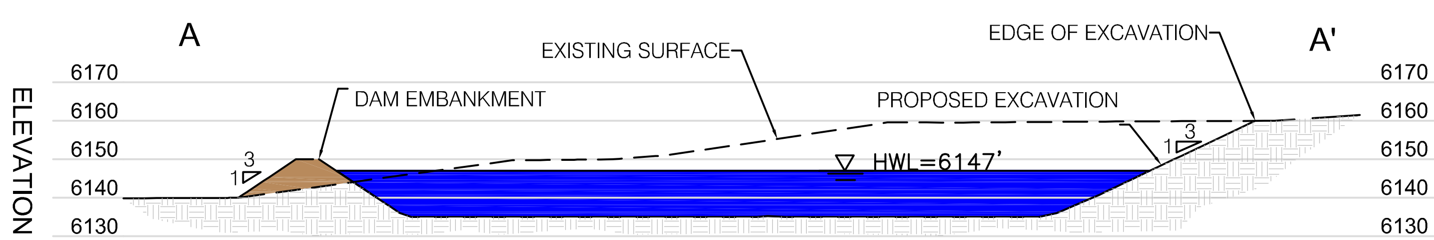
SCALE 1"=100'





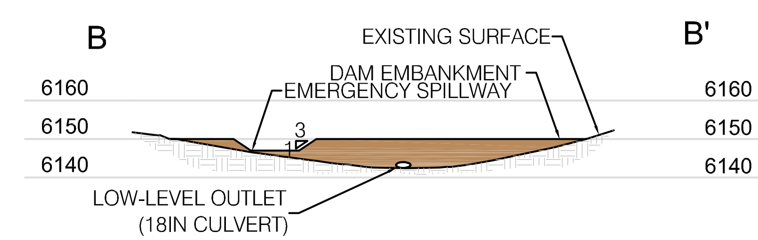
DAM EMBANKMENT DETAILS

SCALE 1"=20'



CROSS SECTION A-A'

VERTICAL EXAGGERATION X2



CROSS SECTION B-B'

VERTICAL EXAGGERATION X2

LEGEND

Sediment-Laden Water Ditch

Settling Pond

NOT FOR CONSTRUCTION

FIGURE C

Typical Settling Pond Detail

The Oil Mining Company, Inc.
Uintah County, UT

DATE: 11/17/2014 | SCALE: AS NOTED
FILE: FIG C POND4.DWG

NORWEST CORPORATION

APPENDIX B

STEEL SPECIFICATIONS: COLLECTION PLAN AND CAPSULE PIPING

ACR Steel Sales, LLC
PO Box 150, Valley Park, MO, 63088 • (636) 517-1420

HOT ROLL BLACK STEEL

Grade
Commercial Quality: Steel of this quality is produced for uses that involve simple bending or moderate forming. The steel can be bent flat on itself in any direction at room temperature. Designation CS Type B

Chemical Composition

C	Mn	P	S	Al	Si	Cu	Ni	Cr	Mo	V	Cb	Ti	N
.02 - .15	.60 max	.030 max	.035 max	---	---	.20 max	.20 max	.15 max	.06 max	.008 max	.008 max	.025 max	---

Mechanical Property Requirements

Yield Strength min. ksi: 30 to 50
Tensile Strength min. ksi: none
Elongation in 2in.: 25% and over

Recommended Processes
1. Pickled dry: removes surface scale
2. Temper roll: reduced the tendency of the steel to coil break.

ACR Steel Sales, LLC
PO Box 150, Valley Park, MO, 63088 • (636) 517-1420

Specifications for material supplied to Red Leaf Resources.
Delivered to Tinhorns Are Us, Tuttle, OK 11/03/2011

Hot Roll Black Steel
.058 x 27.250” x coil
Weight: 9,360 lbs (2 coils)
CS Type B
Pickled Dry
Temper Rolled
Heat Number: 41125790
Chemical Properties

C	Mn	P	S	Al	Si	Cu	Ni	Cr	Mo	V	Cb	Ti	N
.06	.32	.01	.005	.026	.030	.090	---	.060	---	.001	---	---	---

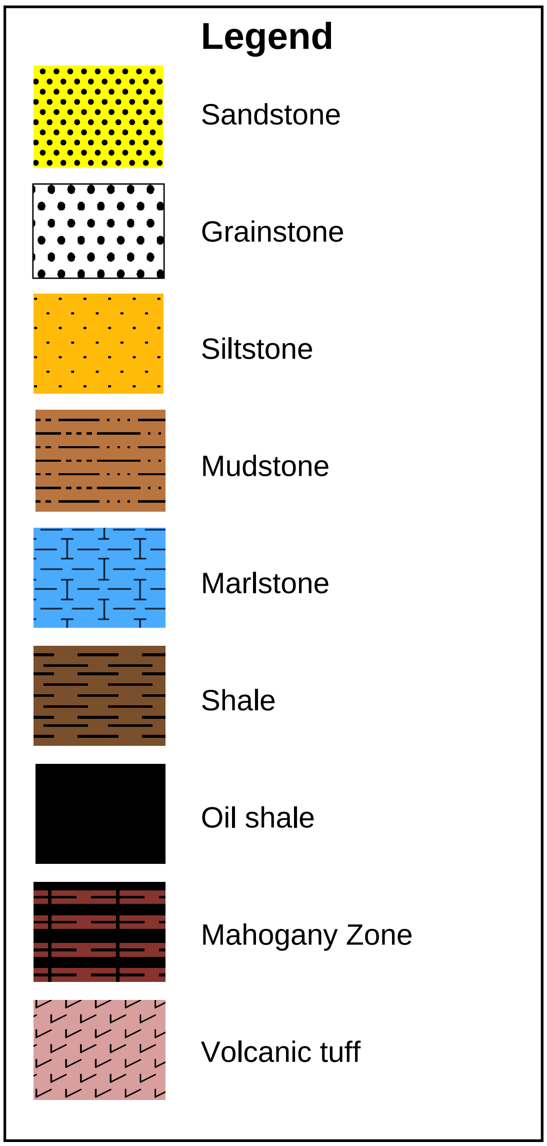
APPENDIX C

PROJECT MONITORING WELLS AND COREHOLES

Appendix C
Lithological Logs

MW-01, MW-02, MW-03, MW-04
Installed September 19th to October 9th, 2013

The Oil Mining Company, Inc.
Uintah County, Utah



Borehole / Well Completion Log

Client The Oil Mining Company

Project Holliday Block Groundwater Study

Well ID MW-01 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

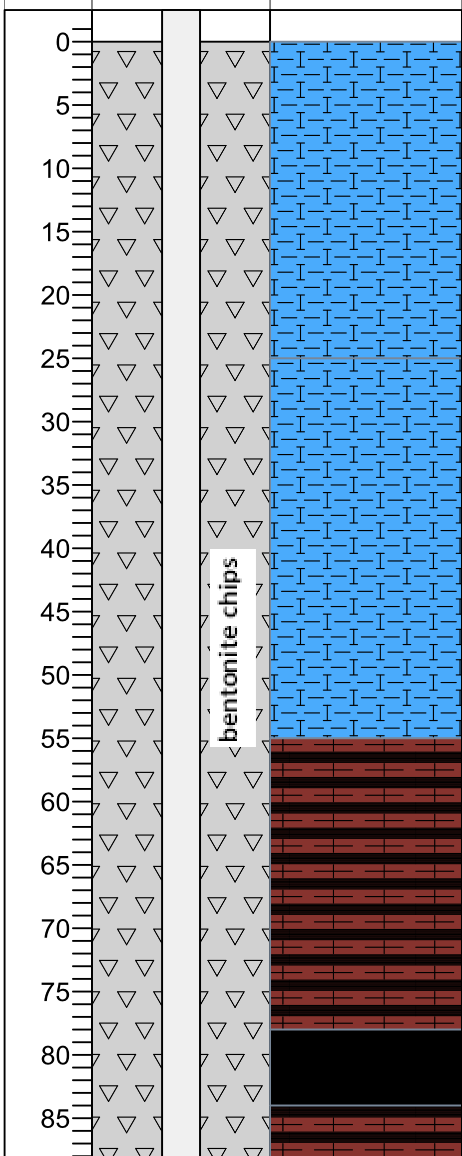
Drilling

Drilling Contractor	Himes Drilling			Northing	4405433.9
Drilled by	Sam Homedew	Completion Date	10/09/2013	Easting	654547.7
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6092.0
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	200'	TOC Elev. (ft)	6094.5
Drilling Method	Rotary	Borehole Dia. (in)	6.25"	Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 134.1'	DTW (ft. btoc)	150.5 10/1/2013
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	* DTW measured after well development	
Casing Joints	Threaded / Flush	Filter Interval	140.4' - 200'	Notes:	
Casing Dia. (in)	2"	Seal Material	Bentonite pellets		
Screen Type	Sch. 80 PVC	Seal Interval	134.'1 - 140.4'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	148' - 198'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13		

DEPTH (ft) / WELL / LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS
	Brown to gray marlstone.	
	Gray to black flakey, marlstone.	A Groove, 40 - 55 feet.
	Dark brown to black shale with strong petroleum odor. Visible moisture on sample return, dust ceased at 70 feet. Very damp at 75 feet.	Mahogany Zone, 55 - 125 feet.
	Dark brown to black oil shale.	Mahogany Bed.
	Dark brown to black shale with petroleum odor. <2gpm water at 80 foot drill string reset, per driller.	



Borehole / Well Completion Log

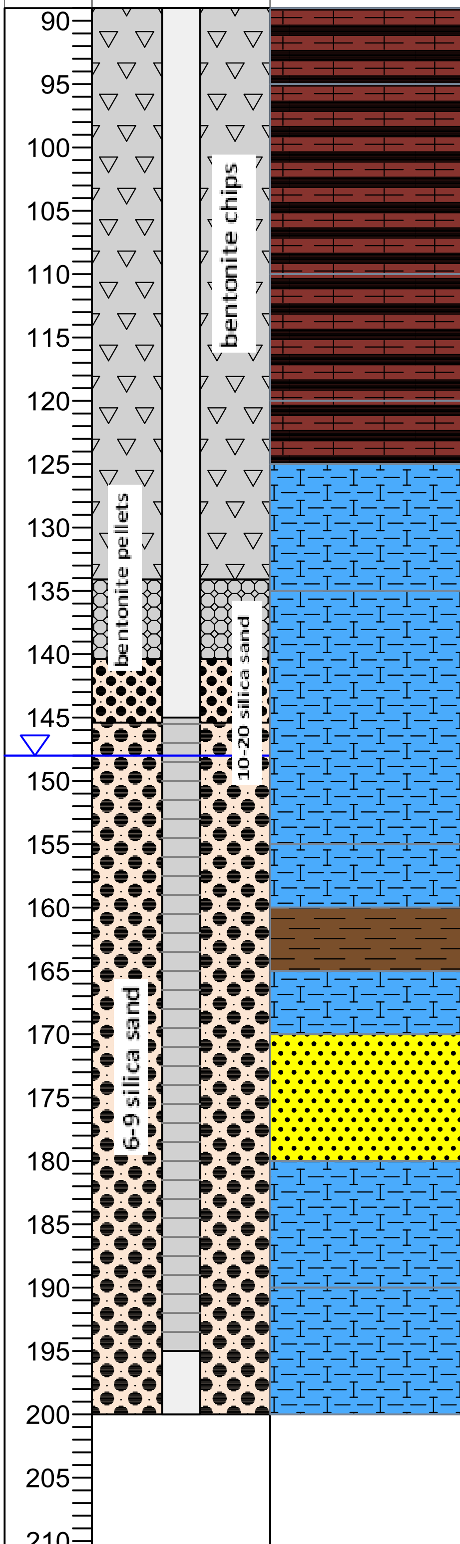
Client: The Oil Mining Company

Project: Holliday Block Groundwater Study

Well ID: MW-01

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists



LITHOLOGICAL DESCRIPTION	REMARKS
Dark brown to black shale with petroleum odor. <2gpm water at 80 foot drill string reset, per driller.	
Dark brown to black shale with occasional light brown to light gray claystone, medium petroleum odor.	
Brown shale to marlstone with medium petroleum odor.	
Brown to gray shale to marlstone with reducing petroleum odor and very fine chips.	Possible Curly Tuff.
Gray to brown marlstone, very fine chips.	B Groove, 125 - 135 feet.
Gray to light brown marlstone with dark brown to black fine sandstone.	
Gray to brown marlstone.	
Gray shale to marlstone with thin flaky chips	
Gray to black marlstone with gray sandstone. Mild petroleum odor.	
Black to gray very fine sandstone.	
Coarse gray marlstone with occasional fine sand.	
Gray marlstone to shale.	

Borehole / Well Completion Log

Client The Oil Mining Company

Project Holliday Block Groundwater Study

ecology and environment, inc.
Global Environmental Specialists

Well ID MW-02 **Project No.** LO-000080-0003-10TTO

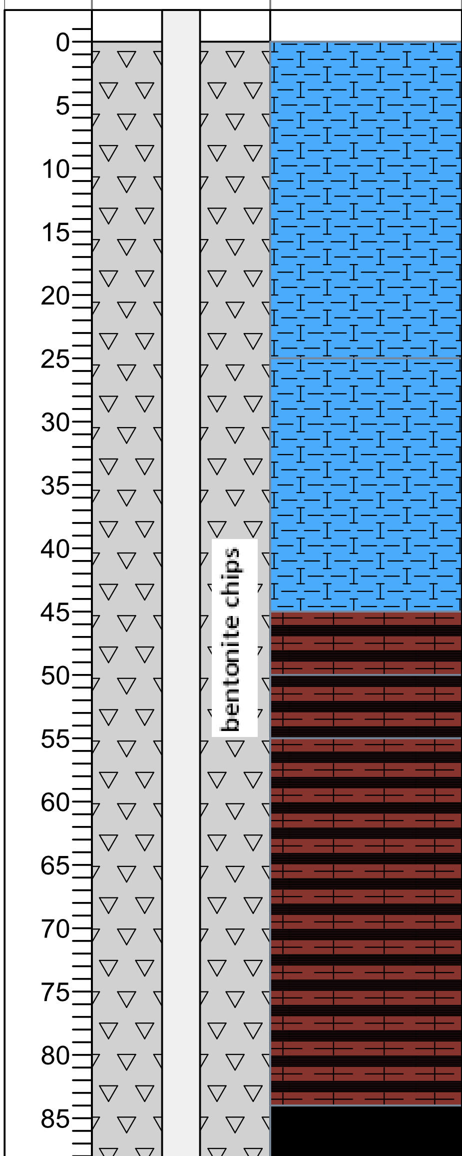
Drilling

Drilling Contractor	Himes Drilling			Northing	4403964.9
Drilled by	Sam Homedew	Completion Date	10/08/2013	Easting	654602.0
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6232.0
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	200'	TOC Elev. (ft)	6234.5
Drilling Method	Rotary	Borehole Dia. (in)	6.25"	Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 127.4'		
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	DTW (ft. btoc)	115.3 10/1/2013
Casing Joints	Threaded / Flush	Filter Interval	134.5' - 200'		* DTW measured after well development
Casing Dia. (in)	2"	Seal Material	Bentonite pellets	Notes:	
Screen Type	Sch. 80 PVC	Seal Interval	127.4' - 134.5'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	148' - 198'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13		

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



LITHOLOGICAL DESCRIPTION	REMARKS
Gray marlstone.	
Gray to brown marlstone.	A Groove, 25-45 feet.
Dark gray to dark brown shale with strong petroleum odor. Visible moisture with sample return.	Mahogany Zone, 45 - 120 feet.
Dark gray to dark brown shale with strong petroleum odor.	
Dark gray to dark brown oil shale with strong petroleum odor. Pushed 1-2 gpm water at 60 foot pipe reset per driller.	
Light brown to light gray shale with very strong petroleum odor.	Mahogany Bed.

Borehole / Well Completion Log

Client The Oil Mining Company

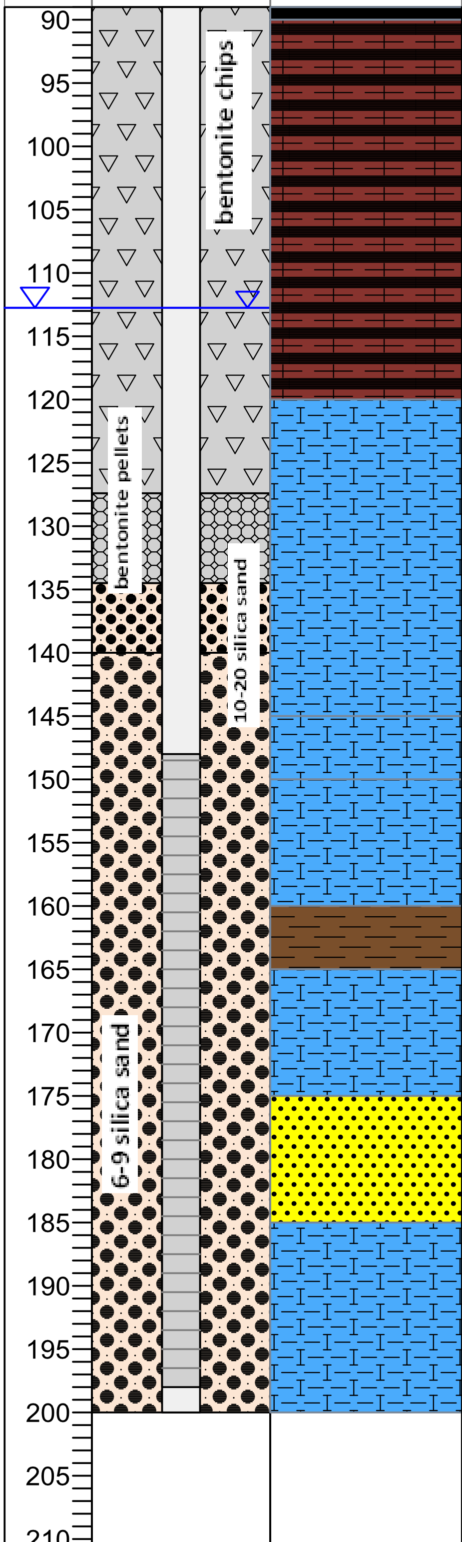
Project Holliday Block Groundwater Study

Well ID MW-02

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



LITHOLOGICAL DESCRIPTION	REMARKS
Light brown to light gray shale with very strong petroleum odor.	
Light brown to light gray shale with petroleum odor.	
Gray marlstone.	B Groove, 120 - 130 feet.
Gray to light brown marlstone.	
Gray to light brown marlstone with occasional buff to yellowish brown tuff.	
Gray to brown marlstone to shale.	
Gray to black marlstone.	
Black to gray very fine sandstone to very coarse marlstone	
Gray marlstone.	

Borehole / Well Completion Log

Client The Oil Mining Company

Project Holliday Block Groundwater Study

ecology and environment, inc.
Global Environmental Specialists

Well ID MW-03 **Project No.** LO-000080-0003-10TTO

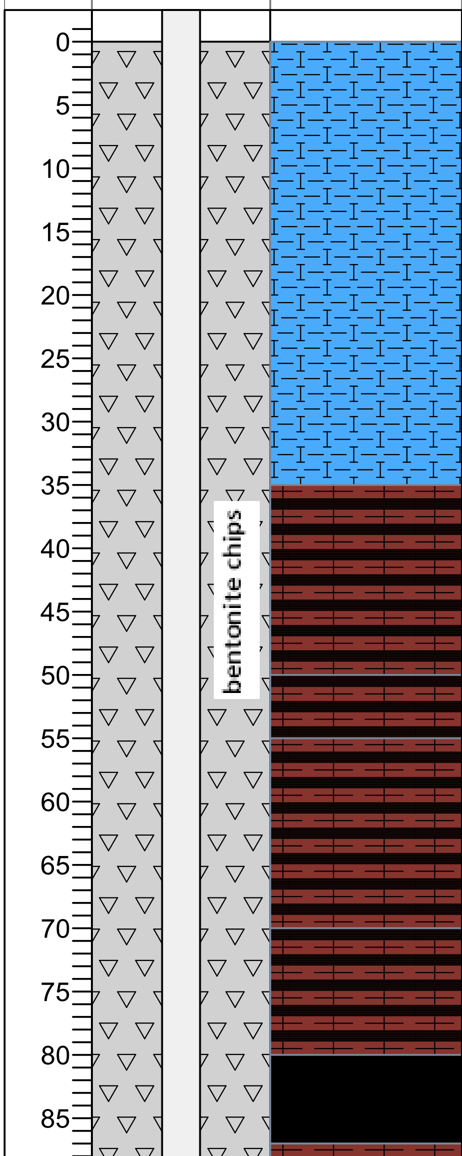
Drilling

Drilling Contractor	Himes Drilling	Completion Date	10/09/2013`	Northing	4405418.3
Drilled by	Sam Homedew	Drilling Fluid	Air and foam	Easting	655179.6
Logged By	J.J. Brown	Borehole Depth	200'	Surface Elev. (ft)	6132.4
Drill Rig	Truck-mounted Portadrill TKT	Borehole Dia. (in)	6.25"	TOC Elev. (ft)	6134.9
Drilling Method	Rotary			Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 110.8'	DTW (ft. btoc)	129.4 10/1/2013
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	* DTW measured after well development	
Casing Joints	Threaded / Flush	Filter Interval	117.3' - 199.3'	Notes:	
Casing Dia. (in)	2"	Seal Material	Bentonite pellets		
Screen Type	Sch. 80 PVC	Seal Interval	102.6' - 110.8'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	117.3' - 197.3'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13		

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS

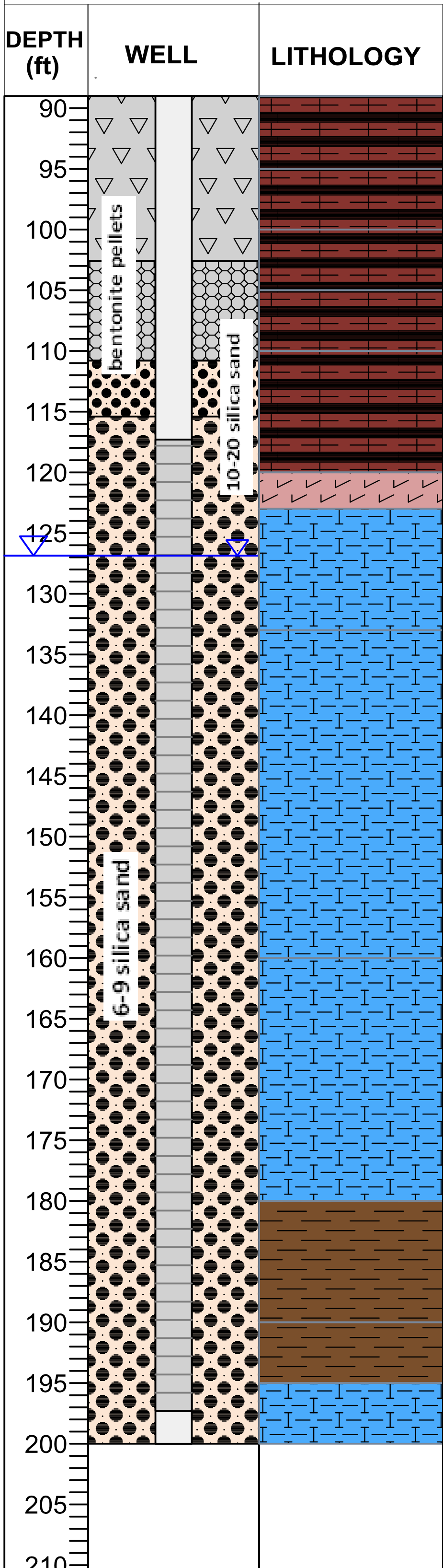


Depth (ft)	Lithological Description	Remarks
0 - 35	Gray marlstone, large chip size.	A Groove, 17 - 35 feet.
35 - 50	Gray to dark brown shale with mild petroleum odor and platy chips.	Mahogany Zone, 35 - 120 feet.
50 - 55	Dark brown shale with mild petroleum odor.	
55 - 70	Dark brown friable oil shale with strong petroleum odor.	
70 - 80	Brown to gray friable oil shale with strong petroleum odor.	
80 - 87	Gray to brown shale with persistent strong petroleum odor and very fine flaky chips.	Mahogany Bed.

Borehole / Well Completion Log

Client The Oil Mining Company
Project Holliday Block Groundwater Study
Well ID MW-03 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists



LITHOLOGICAL DESCRIPTION	REMARKS
Light gray to dark brown marlstone and shale with odor and chips as above.	
Gray to dark brown marlstone and shale with odor and chips as above.	
Gray to dark brown shale with odor and chips as above.	
Gray to dark brown marlstone and shale with odor and chips as above.	
Gray to dark brown shale with odor as above.	
Buff colored tuff.	Wavy Tuff, 120 - 123 feet.
Dark gray coarse marlstone, very fine chips, poor strength.	B Groove, 123 - 133 feet.
Dark gray weak coarse marlstone with trace very fine sandstone. Tangy odor. Coarse silt and very fine pulverized sand in cuttings with low plasticity.	
Gray to brown marlstone and shale.	
Dark gray to brown shale.	
Light gray shale with light gray to white marlstone with low competency.	
Gray marlstone.	

Borehole / Well Completion Log

Client The Oil Mining Company
Project Holliday Block Groundwater Study
Well ID MW-04 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

Drilling

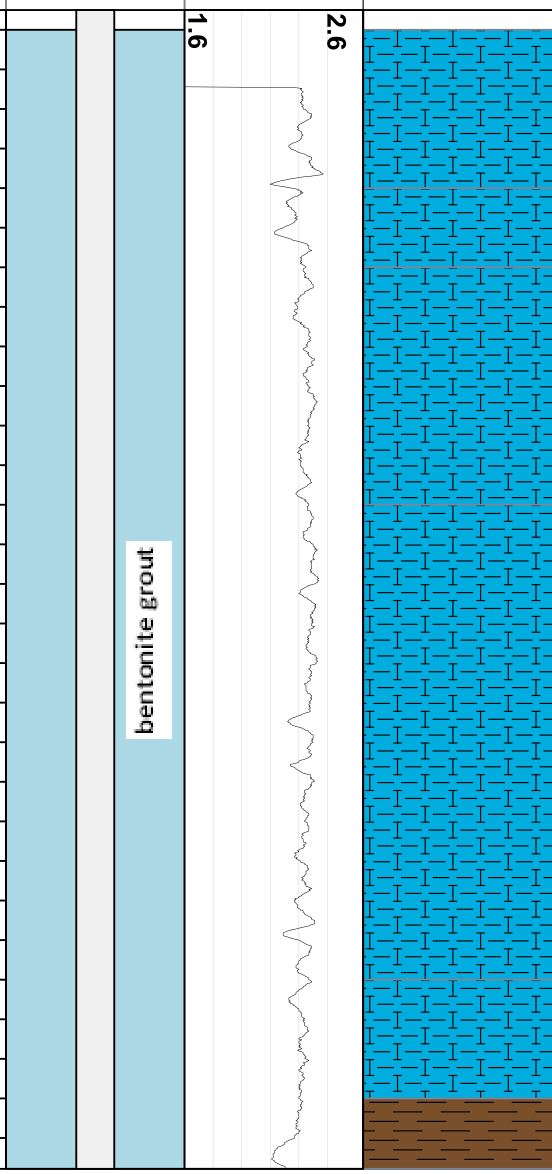
Drilling Contractor	Himes Drilling			Northing	4405549.0
Drilled by	Sam Homedew	Completion Date	10/08/2013	Easting	656647.8
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6437.6
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	1,100'	TOC Elev. (ft)	6440.1
Drilling Method	Rotary	Borehole Dia. (in)	8.75"	Stick-up/down	2.5

Well

Well Depth (bgs)	1,100'	Backfill Interval	0' - 786'	DTW (ft. btoc)	699.5 9/25/2013
Casing Type	Carbon Steel	Filter Material	6-9 Colorado Silica Sand	* DTW measured after well development	
Casing Joints	Threaded / Flush	Filter Interval	798' - 1100'	Notes:	
Casing Dia. (in)	4"	Seal Material	Bentonite pellets		
Screen Type	Carbon Steel	Seal Interval	786' - 791'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	1058' - 1100'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite grout		Surge, airl lift on 10/10/13		

DEPTH (ft)	WELL	DENSITY (g/cc)	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS
0				Micaceous gray marlstone with dark gray to dark brown laminar bedding visible in chips.	
20				Dark brown marlstone.	
30				Gray marlstone.	
60				Gray marlstone to shale. Cuttings size reduced to very fine flakes.	
120				Gray marlstone.	
135				Gray to brown shale. Visible moisture in air return, dust died at 135 feet.	

Depth scale (ft): 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140



Borehole / Well Completion Log

Client: The Oil Mining Company

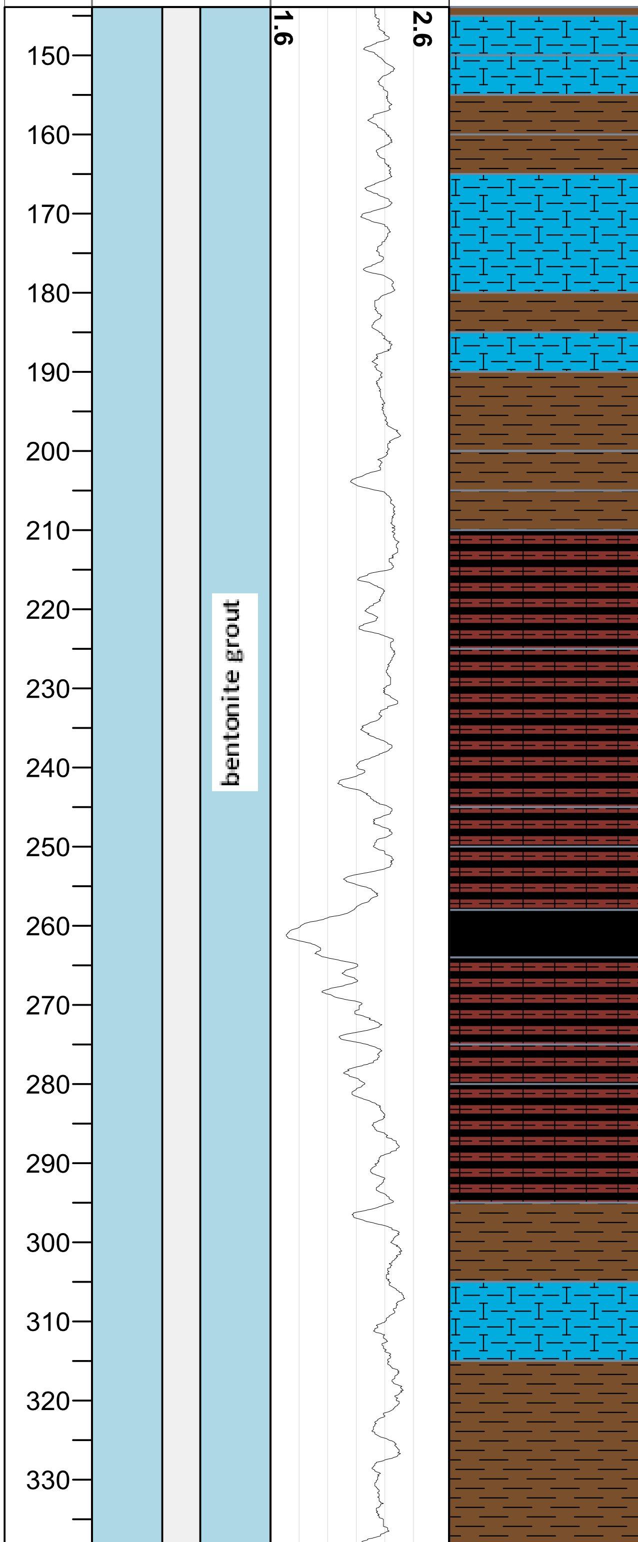
Project: Holliday Block Groundwater Study

Well ID: MW-04

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	DENSITY (g/cc)	LITHOLOGY



LITHOLOGICAL DESCRIPTION	REMARKS
Gray to brown shale. Visible moisture in air return, dust died at 135 feet.	
Gray marlstone.	
Gray to brown marlstone.	
Gray to brown shale.	
Dark brown to gray shale with mild petroleum odor.	
Gray marlstone. Petroleum odor noticeable during drilling.	
Dark brown to gray shale with mild petroleum odor.	
Gray marlstone to shale.	
Dark brown to gray oil shale, micaceous.	Wavy Tuff, 198 - 200 feet.
Dark brown to black oil shale.	A Groove, 200 - 213 feet.
Dark brown to black friable oil shale with pulverized cuttings.	
Dark brown to gray oil shale. Petroleum odor noticeable during drilling.	Mahogany Zone, 213 - 300 feet.
Gray shale to marlstone.	
Dark brown to gray oil shale. Possible Mahogany Bed.	
Dark brown to black oil shale.	
Dark brown to black oil shale.	Mahogany Bed, 258-264 feet.
Dark brown to black oil shale.	
Gray to light gray shale.	
Gray to light gray shale to marlstone.	
Gray shale to marlstone.	Curly Tuff., 300 - 303 feet.
Gray marlstone with occasional very fine-grained, friable (crumbles under pressure) dark brown sandstone, strong petroleum odor when crumbled.	B Groove, 303 - 313 feet.
Light gray to gray shale to marlstone with occasional pink to orange marlstone to claystone.	

Borehole / Well Completion Log

Client: The Oil Mining Company

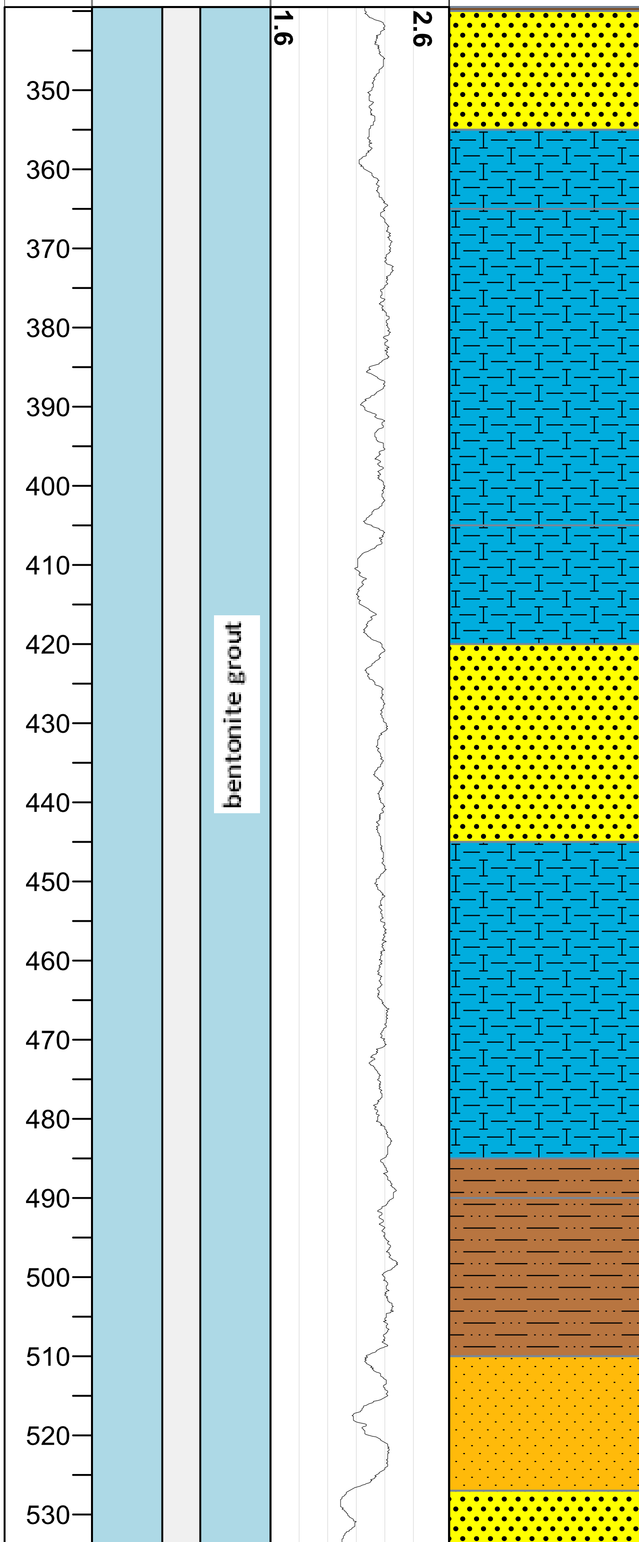
Project: Holliday Block Groundwater Study

Well ID: MW-04

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	DENSITY (g/cc)	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



Light gray to gray shale to marlstone with occasional pink to orange marlstone to claystone.

Gray coarse marlstone to very fine sandstone with occasional very fine-grained, friable black sandstone.

Gray very fine mudstone with occasional very fine-grained, friable black sandstone.

Gray micaceous mudstone and marlstone. Homogenous grain size.

Gray coarse marlstone to very fine sandstone with occasional very fine-grained, friable black sandstone.

Gray coarse marlstone to very fine sandstone.

Gray coarse, micaceous mudstone with occasional white marlstone to claystone.

Gray coarse, micaceous mudstone with occasional white siltstone to claystone, poorly lithified.

Gray coarse, micaceous mudstone with occasional white siltstone to claystone.

White to gray siltstone with laminated beds, cemented but friable. Medium chip size.

Gray fine to medium sandstone.

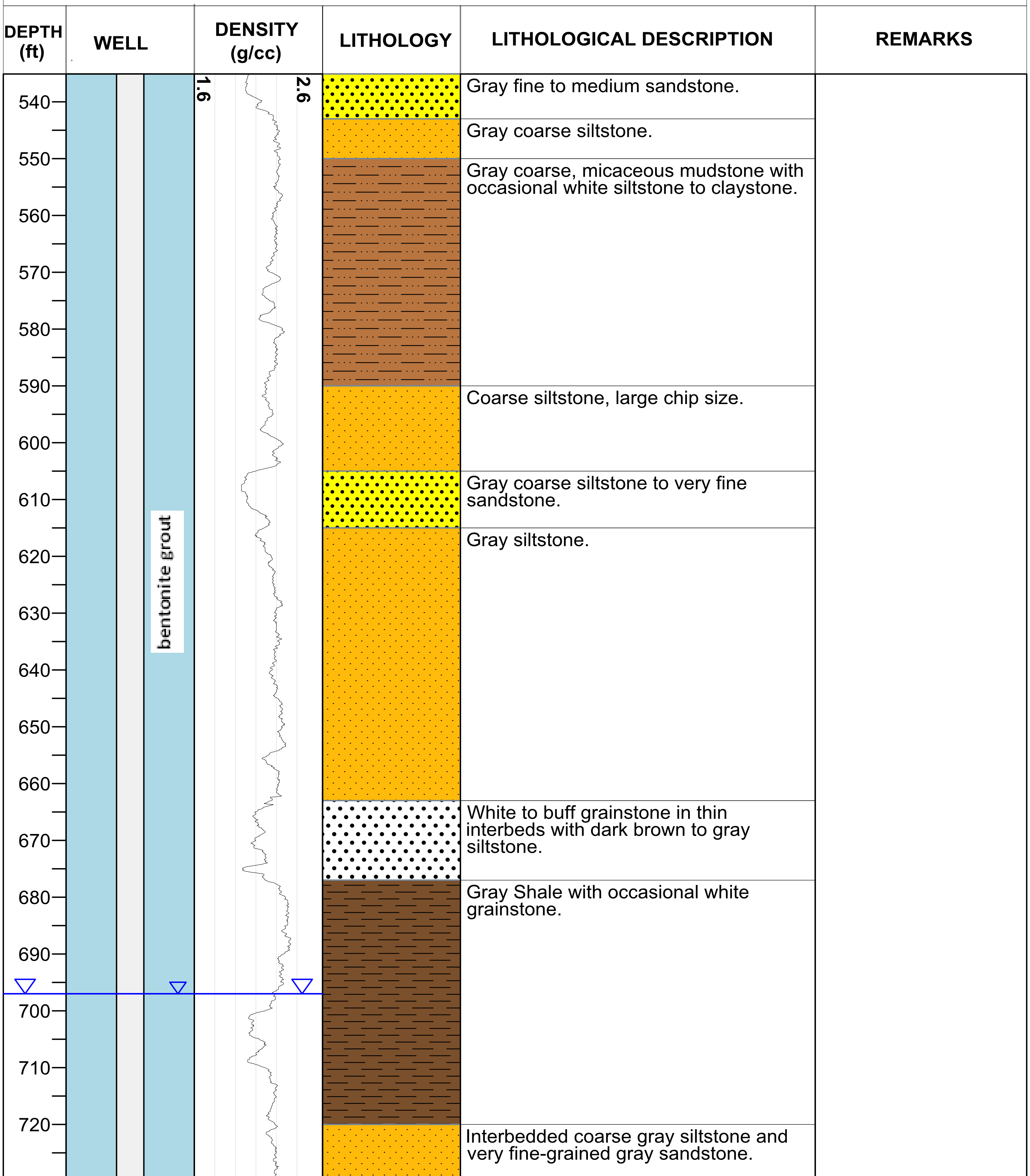
Borehole / Well Completion Log

Client: The Oil Mining Company

Project: Holliday Block Groundwater Study

Well ID: MW-04

Project No. LO-000080-0003-10TTO

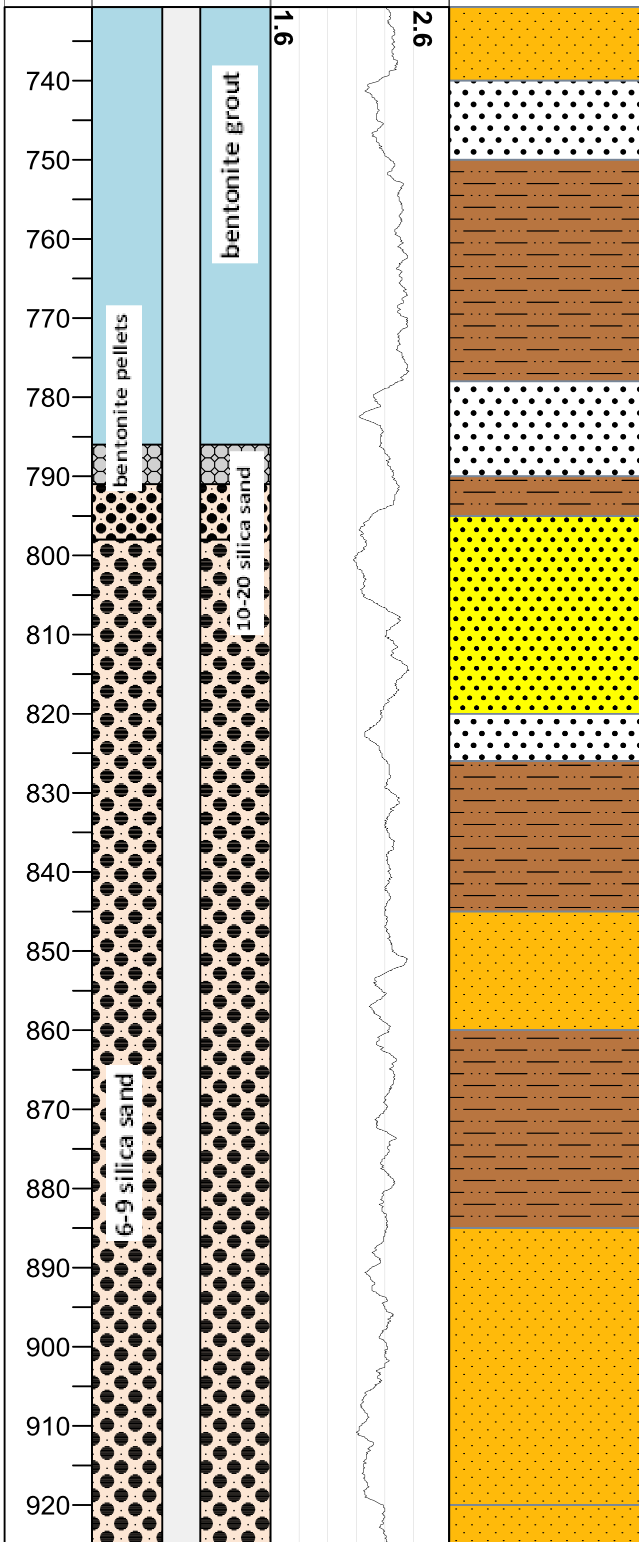


Borehole / Well Completion Log

Client The Oil Mining Company
Project Holliday Block Groundwater Study
Well ID MW-04 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	DENSITY (g/cc)	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



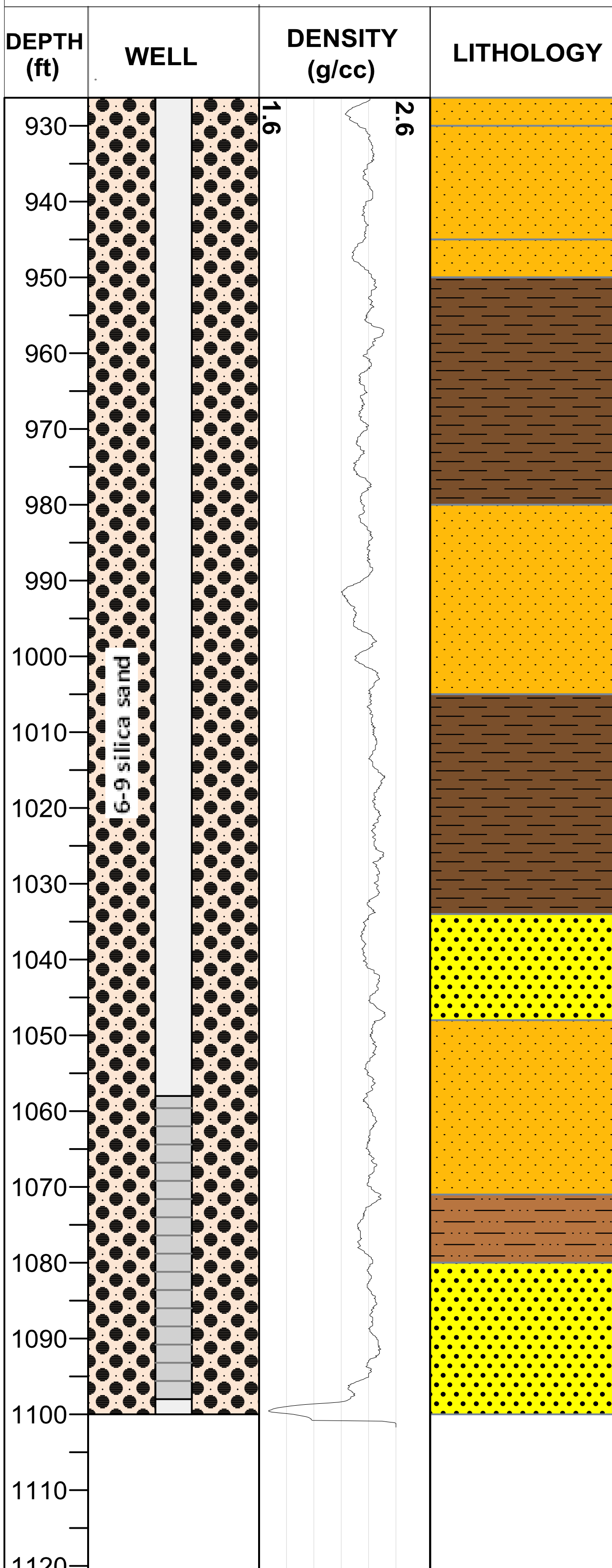
Lithological description:

- Interbedded coarse gray siltstone and very fine-grained gray sandstone.
- White grainstone.
- Gray coarse, micaceous mudstone with occasional white grainstone.
- Poorly-cemented buff to white fine grainstone
- Gray coarse, micaceous mudstone with occasional white grainstone.
- Gray coarse, micaceous mudstone and very fine gray to black sandstone, with occasional white grainstone.
- White grainstone with visual oil remnant in interstitial spaces between spherical nodules.
- Gray coarse, micaceous mudstone.
- Gray siltstone and fine-grained gray sandstone. Increase in water production per driller.
- Gray coarse, micaceous mudstone with occasional white grainstone. Drill water estimated at 3-5 gpm per driller.
- Gray coarse siltstone interbedded with grainstone.
- Gray siltstone with fine grained

Borehole / Well Completion Log

Client: The Oil Mining Company
Project: Holliday Block Groundwater Study
Well ID: MW-04
Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists



LITHOLOGICAL DESCRIPTION	REMARKS
Gray siltstone with fine grained sandstone and grainstone.	
Gray siltstone.	
Gray siltstone with thin interbeds of coarse black siltstone.	
Gray shale. Increase in water production per driller.	
Gray siltstone interbedded with very fine-grained gray sandstone.	
Gray micaceous shale with very fine-grained sandstone in poorly-defined lenses.	
Very fine-grained sandstone with lens of buff lime mudstone.	
Gray siltstone and fine-grained gray sandstone.	
Beige to tan dolomite.	
Gray very fine sandstone.	

SRK Exploration Services

Borehole ID	From (ft)	To (ft)	Diameter	Casing
HB-007	0	10	HQ	cement
HB-007	10	20	HQ	N
HB-007	20	29	HQ	N
HB-007	29	35	HQ	N
HB-007	35	45	HQ	N
HB-007	45	51	HQ	N
HB-007	51	55	HQ	N
HB-007	55	65	HQ	N
HB-007	65	75	HQ	N
HB-007	75	85	HQ	N
HB-007	85	95	HQ	N
HB-007	95	105	HQ	N
HB-007	105	115	HQ	N
HB-007	115	125	HQ	N
HB-007	125	135	HQ	N
HB-007	135	145	HQ	N
HB-007	145	155	HQ	N
HB-007	155	165	HQ	N
HB-007	*164.60*	*174.60*	HQ	N
HB-007	*174.60*	*184.60*	HQ	N
HB-007	*184.60*	*194.60*	HQ	N
HB-007	*194.60*	*204.60*	HQ	N
HB-007	*204.60*	*214.60*	HQ	N
HB-007	*214.60*	*224.60*	HQ	N
HB-007	*224.60*	*234.60*	HQ	N
HB-007	*234.60*	*244.60*	HQ	N
HB-007	*244.60*	*254.60*	HQ	N
HB-007	*254.60*	*264.60*	HQ	N
HB-007	*264.60*	*274.60*	HQ	N
HB-007	*274.60*	*284.60*	HQ	N
HB-007	*284.60*	*294.60*	HQ	N
HB-007	*294.60*	*304.60*	HQ	N
HB-007	***EOH***			N
HB-001	*0.00*	*10.00*	HQ	Y
HB-001	*10.00*	*14.60*	HQ	N
HB-001	*14.60*	*24.60*	HQ	N
HB-001	*24.60*	*34.60*	HQ	N
HB-001	*34.60*	*44.60*	HQ	N
HB-001	*44.60*	*54.60*	HQ	N
HB-001	*54.60*	*64.60*	HQ	N
HB-001	*64.60*	*74.60*	HQ	N
HB-001	*74.60*	*84.60*	HQ	N
HB-001	*84.60*	*94.60*	HQ	N
HB-001	*94.60*	*114.60*	HQ	N
HB-001	*114.60*	*124.60*	HQ	N
HB-001	*124.60*	*134.60*	HQ	N

Borehole ID	From (ft)	To (ft)	Diameter	Casing
HB-001	*134.60*	*144.60*	HQ	N
HB-001	*144.60*	*154.60*	HQ	N
HB-001	*154.60*	*164.60*	HQ	N
HB-001	***EOH***			
				N
				N
HB-005	*0.00*	*3.20*	HQ	y
HB-005	*3.20*	*13.20*	HQ	N
HB-005	*13.20*	*23.00*	HQ	N
HB-005	*23.00*	*25.00*	HQ	N
HB-005	*25.00*	*35.00*	HQ	N
HB-005	*35.00*	*45.00*	HQ	N
HB-005	*45.00*	*55.00*	HQ	N
HB-005	*55.00*	*65.00*	HQ	N
HB-005	*65.00*	*75.00*	HQ	N
HB-005	*75.00*	*85.00*	HQ	N
HB-005	*85.00*	*95.00*	HQ	N
HB-005	*95.00*	*105.00*	HQ	N
HB-005	*105.00*	*115.00*	HQ	N
HB-005	*115.00*	*125.00*	HQ	N
HB-005	*125.00*	*135.00*	HQ	N
HB-005	*135.00*	*145.00*	HQ	N
HB-005	*145.00*	*155.00*	HQ	N
HB-005	*155.00*	*165.00*	HQ	N
HB-005	*165.00*	*175.00*	HQ	N
HB-005	***EOH***			N
HB-008	*0.00*	*16.90*	HQ	Y
HB-008	*16.90*	*25.00*	HQ	N
HB-008	*25.00*	*30.00*	HQ	N
HB-008	*30.00*	*40.00*	HQ	N
HB-008	*40.00*	*45.00*	HQ	N
HB-008	*45.00*	*55.00*	HQ	N
HB-008	55.00	65.00	HQ	N
HB-008	65.00	75.00	HQ	N
HB-008	75.00	85.00	HQ	N
HB-008	85.00	95.00	HQ	N
HB-008	95.00	105.00	HQ	N
HB-008	105.00	115.00	HQ	N
HB-008	115.00	125.00	HQ	N
HB-008	125.00	130.00	HQ	N
HB-008	130.00	135.00	HQ	N
HB-008	135.00	145.00	HQ	N
HB-008	145.00	155.00	HQ	N
	EOH			
HB-009	0.00	20.00	HQ	Y
HB-009	20.00	30.00	HQ	N
HB-009	30.00	40.00	HQ	N

Borehole ID	From (ft)	To (ft)	Diameter	Casing
HB-009	40.00	45.00	HQ	N
HB-009	45.00	50.00	HQ	N
HB-009	50.00	60.00	HQ	N
HB-009	60.00	70.00	HQ	N
HB-009	70.00	80.00	HQ	N
HB-009	80.00	90.00	HQ	N
HB-009	90.00	100.00	HQ	N
HB-009	100.00	110.00	HQ	N
HB-009	110.00	120.00	HQ	N
HB-009	120.00	130.00	HQ	N
HB-009	130.00	140.00	HQ	N
HB-009	140.00	150.00	HQ	N
HB-009	150.00	160.00	HQ	N
HB-009	160.00	170.00	HQ	N
HB-009	170.00	180.00	HQ	N
	EOH			
HB-006	0.00	20.00		Y
HB-006	20.00	30.00		N
HB-006	30.00	40.00		N
HB-006	40.00	45.00		N
HB-006	45.00	55.00		N
HB-006	55.00	65.00		N
HB-006	65.00	75.00		N
HB-006	75.00	85.00		N
HB-006	85.00	95.00		N
HB-006	95.00	105.00		N
HB-006	105.00	115.00		N
HB-006	115.00	125.00		N
HB-006	125.00	135.00		N
HB-006	135.00	145.00		N
HB-006	145.00	155.00		N
HB-006	155.00	**EOH**		
HB-002	0.00	15.00		Y
HB-002	15.00	25.00		N
HB-002	25.00	35.00		N
HB-002	35.00	45.00		N
HB-002	45.00	55.00		N
HB-002	55.00	65.00		N
HB-002	65.00	66.60		N
HB-002	66.60	75.00		N
HB-002	75.00	85.00		N
HB-002	85.00	95.00		N
HB-002	95.00	105.00		N
HB-002	105.00	115.00		N
HB-002	115.00	125.00		N
HB-002	125.00	135.00		N
HB-002	135.00	145.00		N
HB-002	145.00	155.00		N
HB-002	155.00	165.00		N

Borehole ID	From (ft)	To (ft)	Diameter	Casing
HB-002	165.00	175.00		N
HB-002	175.00	185.00		N
HB-002	185.00	195.00		N
HB-002	195.00	205.00		N
HB-002	205.00	215.00		N
HB-002	215.00	EOH		
HB-003	0.00	5.00		Y
HB-003	5.00	15.00		N
HB-003	15.00	25.00		N
HB-003	25.00	35.00		N
HB-003	35.00	45.00		N
HB-003	45.00	55.00		N
HB-003	55.00	65.00		N
HB-003	65.00	75.00		N
HB-003	75.00	85.00		N
HB-003	85.00	95.00		N
HB-003	95.00	105.00		N
HB-003	105.00	115.00		N
HB-003	115.00	125.00		N
HB-003	125.00	135.00		N
HB-003	135.00	145.00		N
HB-003	145.00	EOH		N
HB-003				N
HB-004	0.00	45.00		Y
HB-004	45.00	55.00		N
HB-004	55.00	59.00		N
HB-004	59.00	65.00		N
HB-004	65.00	75.00		N
HB-004	75.00	85.00		N
HB-004	85.00	95.00		N
HB-004	95.00	105.00		N
HB-004	105.00	115.00		N
HB-004	115.00	125.00		N
HB-004	125.00	135.00		N
HB-004	135.00	145.00		N
HB-004	145.00	155.00		N
HB-004	155.00	165.00		N
HB-004	165.00	175.00		N
HB-004	175.00	185.00		N
HB-004	185.00	195.00		N
HB-004	195.00			

Field Location and Depth of Coreholes

Borehole ID	Northing (Final)	Easting (Final)	Depth (Ft)	Date Started	Date completed	Elevation	Azimuth	Inclination
HB-001	4403904	656430	164.60	10/30/2010	10/30/2010	1961.00	0.00	90.00
HB-002	4403947	655104	215.00	11/9/2010	11/9/2010	1929.00	0.00	90.00
HB-003	4403958	654604	145.00	11/10/2010	11/10/2010	1835.00	0.00	90.00
HB-004	4404839	654575	195.00	11/11/2010	11/12/2010	1889.00	0.00	90.00
HB-005	4404819	655383	175.00	11/1/2010	11/2/2010	1881.00	0.00	90.00
HB-006	4404092	655730	155.00	11/7/2010	11/8/2010	1928.00	0.00	90.00
HB-007	4405284	656185	304.60	10/27/2010	10/29/2010	1957.00	0.00	90.00
HB-008	4405283	655228	155.00	11/3/2010	11/4/2010	1855.00	0.00	90.00
HB-009	4405434	654555	180.00	11/4/2010	11/5/2010	1835.00	0.00	90.00

SRK Exploration Services

Tomco Oil Shale

Lithology and Geotechnical Measurements

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB-007	0.00	10.10	10.10	SST		GY		HIGH		
HB-007	10.10	26.20	16.10	SLT		BK/BR		MED		
HB-007	26.20	30.00	3.80	SST		GY		MED		
HB-007	26.20	33.70	7.50	SLT		BK/BR				
HB-007	33.70	34.30	0.60	SST		GY		NILL		
HB-007	34.30	41.50	7.20	SLT		BK/BR		NILL		
HB-007	41.50	49.50	8.00	SST		GY		NILL		
HB-007	41.50	49.50	8.00	SLT		BK/BR		NILL		
HB-007	49.50	51.90	2.40	SST		GY		NILL		
HB-007	51.90	52.90	1.00	SLT		BK/BR		NILL		
HB-007	52.90	54.60	1.70	SST		GY		NILL		
HB-007	54.60	62.00	7.40	SLT		BK/BR		NILL		
HB-007	62.00	66.10	4.10	SST		GY		NILL		
HB-007	66.10	72.30	6.20	SLT		BK/BR		NILL		
HB-007	72.30	76.11	3.81	SST		GY		NILL		
HB-007	76.11	80.30	4.19	SLT		BK/BR		NILL		
HB-007	80.30	81.30	1.00	SST		GY		NILL		
HB-007	81.30	84.40	3.10	SLT		BK/BR		NILL		
HB-007	84.40	87.10	2.70	SST		GY		NILL		
HB-007	87.10	94.60	7.50	SLT		BK/BR		NILL		
HB-007	94.60	97.60	3.00		Mudstone	GY		NILL		
HB-007	97.60	114.60	17.00	SLT		BK/BR		NILL		Expected depth of wavy tuff
HB-007	114.60	116.80	2.20		Mudstone	GY		NILL		
HB-007	116.80	135.60	18.80	SLT		BK/BR		NILL		
HB-007	135.60	136.60	1.00		Mudstone	GY		NILL		
HB-007	136.60	142.00	5.40	SLT		BK/BR		NILL		
HB-007	142.00	142.90	0.90	SST		GY		NILL		
HB-007	142.90	146.60	3.70	SLT		BK/BR		NILL		
HB-007	146.60	146.11	-0.49	SST		GY		NILL		
HB-007	146.11	154.40	8.29	SLT		BK/BR		NILL		
HB-007	154.40	156.60	2.20		Mudstone	GY		NILL		
HB-007	156.60	161.00	4.40	SLT		BK/BR		NILL		
HB-007	161.00	162.40	1.40	SST		GY		NILL		
HB-007	162.40	166.20	3.80	AT		OR/GY		NILL		wavy tuff
HB-007	166.20	174.90	8.70	SLT		BK/BR		NILL		
HB-007	174.90	179.11	4.21		Mudstone	GY		NILL		
HB-007	179.11	182.70	3.59	SLT		BK/BR		NILL		
HB-007	182.70	184.60	1.90	SST		GY		NILL		#
HB-007	184.60	186.60	2.00		Mudstone			NILL		
HB-007	186.60	192.40	5.80	SLT		BK/BR		NILL		
HB-007	192.40	194.80	2.40		Mudstone	GY		NILL		
HB-007	194.80	197.20	2.40	SLT		BK/BR		NILL		
HB-007	197.20	198.10	0.90	SST		GY		NILL		
HB-007	198.10	200.50	2.40	SLT		BK/BR		NILL		
HB-007	200.50	206.30	5.80		Mudstone	GY		NILL		
HB-007	206.30	206.10	-0.20	SLT		BK/BR		NILL		
HB-007	206.10	207.60	1.50	SST		GY		NILL		
HB-007	207.60	212.60	5.00	SLT		BK/BR		NILL		
HB-007	212.60	214.80	2.20		Mudstone	GY		NILL		
HB-007	214.80	216.00	1.20	SLT		BK/BR		NILL		
HB-007	216.00	220.70	4.70	MB		BK		NILL		
HB-007	220.70	222.30	1.60	SLT		BK/BR		NILL		
HB-007	222.30	222.11	-0.19	MB		BK		NILL		
HB-007	222.11	223.40	1.29	SLT		BK/BR		NILL		
HB-007	223.40	223.12	-0.28	MB		BK		NILL		
HB-007	223.12	224.90	1.78	SLT		BK/BR		NILL		
HB-007	224.90	225.60	0.70	MB		BK		NILL		
HB-007	225.60	226.10	0.50	SLT		BK/BR		NILL		
HB-007	226.10	226.90	0.80	MB		BK		NILL		
HB-007	226.90	231.60	4.70	SLT		BK/BR		NILL		
HB-007	231.60	232.60	1.00	MB		BK		NILL		
HB-007	232.60	224.60	12.00	SLT		BK/BR		NILL		
HB-007	224.60	245.60	21.00	MB		BK		NILL		
HB-007	245.60	254.60	9.00	SLT		BK/BR/GY		NILL		
HB-007	254.60	256.80	2.20	SST		GY		NILL		
HB-007	256.80	261.80	5.00	SLT		BK/BR		NILL		
HB-007	261.80	261.11	-0.69	SST		GY		NILL		
HB-007	261.11	262.11	1.00	SLT		BK/BR		NILL		
HB-007	262.11	263.60	1.49	SST		GY		NILL		
HB-007	263.60	271.40	7.80	SLT		GY/BR		NILL		
HB-007	271.40	271.10	-0.30	AT		OR/GY		NILL		curvy tuff
HB-007	271.10	281.80	10.70	SLT		GY/BR		NILL		base of mahogany
HB-007	281.80	282.20	0.40	SST		GY		NILL		
HB-007	282.20	289.10	6.90	SLT		GY/BR		NILL		
HB-007	289.10	290.11	1.01			OR/GY		NILL		
HB-007	290.11	294.60	4.49	SLT		GY/BR		NILL		
HB-007	294.60	304.60	10.00	SST		GY		NILL		
HB-007	**EOH**									
			0.00							
HB-001	0.00	10.00	10.00		CASING					
HB-001	10.00	11.00	1.00	SST		GY		Low		
HB-001	11.00	22.90	11.90	SLT	Shale	GY/BR		Nill		
HB-001	22.90	25.80	2.90	SST		GY		Nill		
HB-001	25.80	28.90	3.10		Mudstone	CR/GY		Nill		
HB-001	28.90	29.80	0.90	SLT	Shale	GY		Nill		
HB-001	29.80	30.60	0.80		Mudstone	CR/GY		Nill		
HB-001	30.60	32.40	1.80	SLT	Shale	GY		Nill		
HB-001	32.40	35.60	3.20		Mudstone	GY		Nill		
HB-001	35.60	37.30	1.70	SLT	Shale	GY/BR		Nill		Mahogany Zone
HB-001	37.30	38.30	1.00		Mudstone	CR/GY		Nill		
HB-001	38.30	39.60	1.30	SLT	Shale	GY/BR		Nill		
HB-001	39.60	42.20	2.60		Mudstone	CR/GY		Nill		
HB-001	42.20	47.20	5.00	SLT	Shale	GY/BR		Nill		
HB-001	47.20	47.90	0.70		Mudstone	CR/GY		Nill		
HB-001	47.90	50.10	2.20	SLT	Shale	GY/BR		Nill		
HB-001	50.10	51.11	1.01		Mudstone	CR/GY		Nill		
HB-001	51.11	54.10	2.99	SLT	Shale	GY/BR		Nill		
HB-001	54.10	55.00	0.90		Mudstone	CR/GY		Nill		
HB-001	55.00	57.20	2.20	SLT	Shale	GY/BR		Nill		
HB-001	57.20	57.80	0.60		Mudstone	CR/GY		Nill		
HB-001	57.80	60.10	2.30	SLT	Shale	GY/BR		Nill		
HB-001	60.10	61.80	1.70		Mudstone	CR/GY		Nill		
HB-001	61.80	61.11	-0.69	MB	Shale	GY/BR		Nill		
HB-001	61.11	64.20	3.09		Mudstone	CR/GY		Nill		
HB-001	64.20	65.60	1.40	MB	Shale	BK/BR		Nill		
HB-001	65.60	66.50	0.90		Mudstone	GY		Nill		
HB-001	66.50	69.70	3.20	MB	Shale	BK/BR		Nill		
HB-001	69.70	70.20	0.50		Mudstone	GY		Nill		

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB-001	70.20	71.70	1.50	MB	Shale	BK/BR		Nill		
HB-001	71.70	72.70	1.00		Mudstone	GY		Nill		
HB-001	72.70	74.50	1.80	MB	Shale	BK/BR		Nill		
HB-001	74.50	76.00	1.50		Mudstone	GY		Nill		
HB-001	76.00	79.10	3.10	MB	Shale	BK/BR		Nill		
HB-001	79.10	82.10	3.00		Mudstone	GY		Nill		
HB-001	82.10	82.40	0.30	SLT	Shale	GY/BR		Nill		
HB-001	82.40	82.70	0.30		Mudstone	GY		Nill		
HB-001	82.70	83.10	0.40	SLT	Shale	BK/BR		Nill		
HB-001	83.10	85.20	2.10		Mudstone	GY		Nill		
HB-001	85.20	91.50	6.30	SLT	Shale	BR/BK		Nill		
HB-001	91.50	92.11	0.61		Mudstone	GY		Nill		
HB-001	92.11	94.10	1.99	SLT	Shale	BR/BK		Nill		
HB-001	94.10	94.80	0.70		Mudstone	GY		Nill		
HB-001	94.80	96.80	2.00	SLT		GY		Nill		
HB-001	96.80	97.50	0.70	SLT		GY/BR		Nill		
HB-001	97.50	97.90	0.40	SST		BK		Nill		
HB-001	97.90	102.10	4.20	SLT		BK/BR		Nill		
HB-001	102.10	103.60	1.50	SLT		GY		Nill		
HB-001	103.60	105.00	1.40	AT		OR/BR		Nill		
HB-001	105.00	109.90	4.90	SST		GY/PR		Nill		
HB-001	109.90	110.70	0.80	SLT		GY		Nill		
HB-001	110.70	110.90	0.20	SST		PR/GY		Nill		
HB-001	110.90	118.00	7.10	SLT		GY		Nill		
HB-001	118.00	118.30	0.30	AT		BR/GY		Nill		
HB-001	118.30	119.50	1.20	SLT		CR/GY		Nill		
HB-001	119.50	119.80	0.30	SST		GY		Nill		
HB-001	119.80	123.90	4.10	SLT		CR/GY		Nill		
HB-001	123.90	125.90	2.00	SST		GY		Nill		
HB-001	125.90	126.30	0.40	SLT		CR/GY		Nill		
HB-001	126.30	127.50	1.20	SLT		CR		Nill		
HB-001	127.50	127.80	0.30	SST		GY		Nill		
HB-001	127.80	128.90	1.10	SLT		CR/GY		Nill		
HB-001	128.90	129.40	0.50		clay	CR		Nill		
HB-001	129.40	130.00	0.60	SST		GY		Nill		
HB-001	130.00	130.20	0.20	SLT		CR/GY		Nill		
HB-001	130.20	131.20	1.00		clay	CR		Nill		
HB-001	131.20	140.11	8.91	SST		CRC/GY		Nill		
HB-001	140.11	145.40	5.29	SLT		GY		Nill		
HB-001	145.40	145.50	0.10	SST		CR/GY		Nill		
HB-001	145.50	145.80	0.30	SLT		GY		Nill		
HB-001	145.80	150.00	4.20		claystone	CR		Nill		
HB-001	150.00	164.40	14.40	SST		GY		Nill		
HB-001	EOH									
HB005	0.00	3.00	3.00		Collar					
HB005	3.20	13.30	10.10	CRM		GY		Med		
HB005	13.30	17.20	3.90	SLT		GY		Low		
HB005	17.20	17.80	0.60	CRM		GY		Nill		
HB005	17.80	18.40	0.60	SLT		BR		Nill		
HB005	18.40	18.70	0.30	CRM		GY		Nill		
HB005	18.70	19.60	0.90	SLT		BR/BK		Nill		
HB005	19.60	22.90	3.30	CRM		GY		Nill		
HB005	22.90	23.90	1.00	SLT		BR		Nill		
HB005	23.90	24.12	0.22	SLT		GY/BR		Nill		
HB005	24.12	25.70	1.58	CRM		GY		Nill		
HB005	25.70	27.40	1.70	SLT		GY		Nill		
HB005	27.40	27.11	-0.29	SLT		BR/GY		Nill		
HB005	27.11	29.10	1.99	SLT		GY		Nill		
HB005	29.10	30.12	1.02	SLT		GY/BR		Nill		
HB005	30.12	31.50	1.38	CRM		GY		Nill		
HB005	31.50	32.50	1.00	SLT		BR/BK		Nill		
HB005	32.50	36.30	3.80	SLT		GY		Nill		
HB005	36.30	41.12	4.82	CRM		GY		Nill		
HB005	41.12	42.12	1.00	SLT		GY/BR		Nill		
HB005	42.12	44.11	1.99	CRM		GY		Nill		
HB005	44.11	48.11	4.00	SLT		GY/BR		Nill		
HB005	48.11	49.11	1.00	SLT		GY		Nill		
HB005	49.11	51.50	2.39	SLT		BK		Nill		
HB005	51.50	52.50	1.00	SLT		GY/BR		Nill		
HB005	52.50	52.70	0.20	AT		OR		Nill		
HB005	52.70	54.90	2.20	CRM		GY		Nill		
HB005	54.90	55.80	0.90	SLT		GY/BR		Nill		
HB005	55.80	56.80	1.00	CRM		GY		Nill		
HB005	56.80	59.20	2.40	SLT		GY/BR		Nill		
HB005	59.20	59.70	0.50		SANDSTONE	BK/BR		Nill		
HB005	59.70	61.40	1.70	SLT		BR		Nill		
HB005	61.40	63.40	2.00	SLT		GY/BR		Nill		
HB005	63.40	64.10	0.70	SLT		GY/BK		Nill		
HB005	64.10	65.70	1.60	CRM		GY		Nill		
HB005	65.70	67.50	1.80	MB		BK		Nill		
HB005	67.50	67.90	0.40	SLT		GY		Nill		
HB005	67.90	69.10	1.20	MB		BK/BR		Nill		
HB005	69.10	71.90	2.80	SLT		GY/BR		Nill		
HB005	71.90	74.00	2.10	SLT		BK/BR		Nill		
HB005	74.00	75.00	1.00	SLT		GY		Nill		
HB005	75.00	76.00	1.00	MB		BK		Nill		
HB005	76.00	78.40	2.40	SLT		GY/BR		Nill		
HB005	78.40	79.50	1.10	SLT		GY/BK		Nill		
HB005	79.50	81.60	2.10	CRM		GY		Nill		
HB005	81.60	82.20	0.60	SLT		BR/GY		Nill		
HB005	82.20	83.00	0.80	CRM		GY		Nill		
HB005	83.00	84.30	1.30	SLT		GY/BR		Nill		
HB005	84.30	85.80	1.50	MB		BK		Nill		
HB005	85.80	89.10	3.30	SLT		GY/BR		Nill		
HB005	89.10	90.10	1.00	CRM		GY		Nill		
HB005	90.10	91.60	1.50	SLT		GY		Nill		
HB005	91.60	91.90	0.30	CRM		GY		Nill		
HB005	91.90	92.60	0.70	SLT		GY/BR		Nill		
HB005	92.60	93.10	0.50	CRM		GY		Nill		
HB005	93.10	93.60	0.50	SLT		GY/BR		Nill		
HB005	93.60	94.60	1.00	CRM		GY		Nill		
HB005	94.60	95.00	0.40	SLT		GY/BR		Nill		
HB005	95.00	96.00	1.00	SLT		BK/BR		Nill		
HB005	96.00	96.80	0.80	SLT		GY/BR		Nill		
HB005	96.80	98.80	2.00	SLT		GY		Nill		
HB005	98.80	99.80	1.00	CRM		GY		Nill		
HB005	99.80	100.80	1.00	SLT		GY/BR		Nill		
HB005	100.80	101.30	0.50	CRM		GY		Nill		
HB005	101.30	107.10	5.80	SLT		GY/BR		Nill		
HB005	107.10	108.70	1.60		SANDSTONE	BR/OR		Nill		
HB005	108.70	108.90	0.20	AT		OR		Nill		
HB005	108.90	113.30	4.40	SLT		BR/GY		Nill		
HB005	113.30	118.60	5.30	CRM		GY		Nill		
HB005	118.60	121.50	2.90	SLT		GY/BR		Nill		
HB005	121.50	121.80	0.30	CRM		PNK		Nill		
HB005	121.80	123.10	1.30	SLT		GY		Nill		
HB005	123.10	123.40	0.30		SANDSTONE	BK/GY		Nill		
HB005	123.40	124.60	1.20	SLT		GY		Nill		
HB005	124.60	124.90	0.30	CRM		BK/GY		Nill		
HB005	124.90	125.00	0.10	AT		OR		Nill		CURLY TUFF

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB005	125.00	127.90	2.90	SLT		GY		Nill		
HB005	127.90	128.00	0.10		SANDSTONE	BK/GY		Nill		
HB005	128.00	131.60	3.60	SLT		GY/BR		Nill		
HB005	131.60	132.00	0.40		SANDSTONE	GY/BK		Nill		
HB005	132.00	132.60	0.60	SLT		GY		Nill		
HB005	132.60	133.90	1.30	CRM		GY/BR		Nill		
HB005	133.90	134.20	0.30	CRM		GY/BK		Nill		
HB005	134.20	135.00	0.80	SLT		GY/BR		Nill		
HB005	135.00	137.30	2.30	CRM		CR		Nill		
HB005	137.30	140.50	3.20	SLT		BR/GY		Nill		
HB005	140.50	143.90	3.40	CRM		CR		Nill		
HB005	143.90	155.00	11.10	CRM		BR/BK		Nill		
HB005	155.00	163.70	8.70	CRM		GY		Nill		
HB005	163.70	168.50	4.80	CRM		GY/BK		Nill		
HB005	168.50	175.00	6.50	CRM		CR/GY		Nill		
HB005	175.00		-175.00							
	EOH									
HB008	0.00	16.90	16.90		Casing					
HB008	16.90	19.30	2.40	SLT		gy		Low		
HB008	19.30	20.80	1.50	SLT		gy/bk		Nill		
HB008	20.80	26.00	5.20	SLT		GY/BR		Nill		
HB008	26.00	30.00	4.00	SLT		GY		Nill		
HB008	30.00	30.11	0.11	MB		BK/BR		Nill		Water encountered
HB008	30.11	32.90	2.79	SLT		GY/BR		Nill		
HB008	32.90	33.10	0.20	CRM		GY		Nill		
HB008	33.10	33.30	0.20	SLT		GY/BR		Nill		
HB008	33.30	35.50	2.20	MB		BK/BR		Nill		
HB008	35.50	40.30	4.80	SLT		GY/BR		Nill		
HB008	40.30	41.60	1.30	MB		BK/BR		Nill		
HB008	41.60	42.30	0.70	CRM		GY		Nill		
HB008	42.30	43.80	1.50	MB		BK/BR		Nill		
HB008	43.80	45.00	1.20	CRM		GY		Nill		
HB008	45.00	49.60	4.60	MB		BK/BR		Nill		
HB008	49.60	52.00	2.40	SLT		GY/BR		Nill		
HB008	52.00	52.11	0.11	SLT		BR/BK		Nill		
HB008	52.11	53.60	1.49	CRM		GY		Nill		
HB008	53.60	56.10	2.50	SLT		GY/BR		Nill		
HB008	56.10	57.10	1.00	SLT		BK/BR		Nill		
HB008	57.10	58.90	1.80	CRM		GY		Nill		
HB008	58.90	58.11	-0.79	SLT		BK/BR		Nill		
HB008	58.11	59.20	1.09	CRM		GY		Nill		
HB008	59.20	59.50	0.30	SLT		BK/BR		Nill		
HB008	59.50	61.60	2.10	CRM		GY		Nill		
HB008	61.60	62.00	0.40	SLT		GY/BR		Nill		
HB008	62.00	63.30	1.30	CRM		GY		Nill		
HB008	63.30	63.90	0.60	SLT		GY/BR		Nill		
HB008	63.90	64.70	0.80	CRM		GY		Nill		
HB008	64.70	68.90	4.20	SLT		GY/BR		Nill		
HB008	68.90	69.10	0.20		SANDSTONE	BK		Nill		
HB008	69.10	72.40	3.30	SLT		GY/BR		Nill		
HB008	72.40	72.60	0.20	AT		GY		Nill		
HB008	72.60	73.00	0.40	SLT		GY/BR		Nill		
HB008	73.00	74.80	1.80	CRM		GY		Nill		
HB008	74.80	75.00	0.20	SLT		GY/BR		Nill		
HB008	75.00	76.60	1.60	CRM		GY		Nill		
HB008	76.60	80.60	4.00	SLT		GY		Nill		
HB008	80.60	82.00	1.40	SLT		GY/BR		Nill		
HB008	82.00	82.50	0.50	CRM		GY		Nill		
HB008	82.50	82.70	0.20	AT		GY/BK		Nill		Stop sampling
HB008	82.70	86.00	3.30	SLT		GY		Nill		
HB008	86.00	89.30	3.30	SLT		GY		Nill		
HB008	89.30	89.90	0.60	CRM		GY/BR		Nill		
HB008	89.90	90.90	1.00	SLT		PK/CR		Nill		
HB008	90.90	91.20	0.30		SANDSTONE	BK		Nill		
HB008	91.20	105.30	14.10	SLT		GY		Nill		
HB008	105.30	105.90	0.60	CAM				Nill		
HB008	105.90	108.60	2.70	SLT				Nill		
HB008	108.60	108.12	-0.48	CRM				Nill		
HB008	108.12	109.30	1.18	SLT				Nill		
HB008	109.30	113.80	4.50	CRM				Nill		
HB008	113.80	123.11	9.31		SANDSTONE			Nill		
HB008	123.11	124.70	1.59	CRM				Nill		
HB008	124.70	125.20	0.50		SANDSTONE			Nill		
HB008	125.20	128.20	3.00	CRM				Nill		
HB008	128.20	128.90	0.70	CRM	CLAYSTONE			Nill		
HB008	128.90	130.90	2.00	CRM				Nill		
HB008	130.90	131.90	1.00	SLT				Nill		
HB008	131.90	132.10	0.20	CRM				Nill		
HB008	132.10	133.00	0.90	SLT				Nill		
HB008	133.00	133.30	0.30	CRM				Nill		
HB008	133.30	136.20	2.90	SLT				Nill		
HB008	136.21	144.20	7.99	CRM				Nill		
HB008	147.60	148.00	0.40	SLT				Nill		
HB008	148.00	151.00	3.00	CRM				Nill		
HB008	151.00	151.30	0.30	CRM	CLAYSTONE			Nill		
HB008	151.80	152.70	0.90	CRM				Nill		
HB008	152.70	153.10	0.40	CRM	CLAYSTONE			Nill		
HB008	153.10	155.00	1.90	CRM				Nill		
HB008	**EOH**									
HB009	0.00	17.20			CASING					
HB009	17.20	20.00	2.80	CRM		GR/BR		Nill		
HB009	20.00	30.90	10.90	SLT		GY		Nill		
HB009	30.90	34.10	3.20	CRM		GY		Nill		
HB009	34.10	34.70	0.60	SLT		GY/BK		Nill		
HB009	34.70	35.50	0.80	CRM		GY		Nill		
HB009	35.50	37.00	1.50	SLT		GY/BK		Nill		
HB009	37.00	41.00	4.00	CRM		GY		Nill		
HB009	41.00	48.00	7.00	SLT		GY		Nill		
HB009	48.00	48.30	0.30	CRM		GY		Nill		
HB009	48.30	53.80	5.50	SLT		GY		Nill		
HB009	53.80	58.20	4.40	SLT		GY/BR		Nill		
HB009	58.20	58.90	0.70	SLT		GY/PK		Nill		
HB009	58.90	59.20	0.30	SLT		GY/BR		Nill		
HB009	59.20	59.90	0.70	CRM		GY		Nill		
HB009	59.90	62.50	2.60	SLT		GY/BR		Nill		
HB009	62.50	62.90	0.40	CRM		GY		Nill		
HB009	62.90	64.50	1.60	SLT		GY/BR		Nill		
HB009	64.50	65.00	0.50	AT		BR/OR		Nill		WAVY TUFF
HB009	65.00	69.20	4.20	SLT		GY/BR		Nill		
HB009	69.20	71.80	2.60	CRM		GY		Nill		
HB009	71.80	72.40	0.60	CRM		GY/BR		Nill		
HB009	72.40	72.90	0.50	SLT		GY/BK		Nill		
HB009	72.90	75.10	2.20	CRM		GY		Nill		Water at 75ft
HB009	75.10	79.30	4.20	MB		BK/BR		Nill		
HB009	79.30	80.30	1.00	CRM		GY		Nill		
HB009	80.30	82.50	2.20	MB		BK/BR		Nill		
HB009	82.50	85.00	2.50	CRM		GY		Nill		

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB009	85.00	86.40	1.40	MB		BK/BR		Nill		
HB009	86.40	86.90	0.50	CRM		GY		Nill		
HB009	86.90	88.60	1.70	MB		BK/BR		Nill		
HB009	88.60	90.60	2.00	CRM		GY		Nill		
HB009	90.60	91.60	1.00	MB		BK/BR		Nill		
HB009	91.60	93.90	2.30	CRM		GY		Nill		
HB009	93.90	94.60	0.70	SLT				Nill		
HB009	94.60	97.50	2.90	MB		BK/BR		Nill		
HB009	97.50	101.30	3.80	SLT				Nill		
HB009	101.30	101.80	0.50	CRM		GY		Nill		
HB009	101.80	102.80	1.00	SLT				Nill		
HB009	102.80	108.60	5.80	MB		BK/BR		Nill		
HB009	108.60	109.00	0.40	SLT		GY/BR		Nill		
HB009	109.00	110.00	1.00	SND		GY/BK		Nill		
HB009	110.00	113.30	3.30	SLT		BR/BK		Nill		
HB009	113.30	113.80	0.50	SND		GY/BR		Nill		
HB009	113.80	114.80	1.00	SLT		GY		Nill		
HB009	114.80	115.00	0.20	CRM		CR		Nill		
HB009	115.00	117.20	2.20	SLT		BR/OR		Nill		
HB009	117.20	117.80	0.60	CRM		GY		Nill		
HB009	117.80	120.10	2.30	SLT		GY		Nill		
HB009	120.10	127.10	7.00	SLT		GY/BK		Nill		
HB009	127.10	127.30	0.20	AT		GY/BR		Nill		
HB009	127.30	129.70	2.40	SLT		GY/BR		Nill		
HB009	129.70	130.40	0.70	SND		BK		Nill		
HB009	130.40	133.90	3.50	SLT		GY		Nill		
HB009	133.90	134.10	0.20	AT		OR/PK		Nill		CURLY TUFF - END OF MAHZ
HB009	134.10	138.00	3.90	SLT		GY		Nill		
HB009	138.00	138.20	0.20	SND		BK/GY		Nill		
HB009	138.20	141.40	3.20	SLT		GY		Nill		
HB009	141.40	141.90	0.50	SND		BK/GY		Nill		
HB009	141.90	142.70	0.80	SLT		GY		Nill		
HB009	142.70	142.90	0.20	CAM		CR		Nill		
HB009	142.90	145.30	2.40	SLT		GY		Nill		
HB009	145.30	145.90	0.60	CAM		CR		Nill		
HB009	145.90	146.11	0.21	SLT		GY		Nill		
HB009	146.11	147.90	1.79	CAM		GY		Nill		
HB009	147.90	149.50	1.60	CAM		BR		Nill		
HB009	149.50	153.90	4.40	CRM		CR/GY		Nill		
HB009	153.90	155.90	2.00	CRM		GY		Nill		
HB009	155.90	156.70	0.80	CRM		GY/BR		Nill		
HB009	156.70	164.60	7.90	CRM		BR		Nill		
HB009	164.60	167.60	3.00	SND		BR		Nill		
HB009	167.60	168.10	0.50	CRM		CR		Nill		
HB009	168.10	171.11	3.01	SND		BR		Nill		
HB009	171.11	172.40	1.29	CRM		CR		Nill		
	172.40	180.00	7.60	CRM		BR		Nill		
	EOH									
			0.00							
HB006	0.00	14.80	14.80		CASING					
HB006	14.80	17.10	2.30	SLT		GY/BK		Nill		
HB006	17.10	18.10	1.00	SLT		GY		Nill		
HB006	18.10	18.30	0.20		SANDSTONE	OR/CR		Nill		
HB006	18.30	22.70	4.40	SLT		GY/BK		Nill		oil seepage
HB006	22.70	23.90	1.20	CRM		CR		Nill		
HB006	23.90	25.90	2.00	SLT		GY/BR		Nill		oil seepage
HB006	25.90	27.00	1.10	CRM		CR		Nill		
HB006	27.00	30.00	3.00	SLT		GY		Nill		
HB006	30.00	31.00	1.00		SANDSTONE	BR/BK		Nill		OIL SEEPAGE
HB006	31.00	34.80	3.80	SLT		GY/BK		Nill		OIL SEEPAGE
HB006	34.80	35.40	0.60	SLT		GY		Nill		
HB006	35.40	37.20	1.80	CRM		CR		Nill		OIL SEEPAGE AT 40.0 TO 40.8FT
HB006	37.20	47.60	10.40	SLT		GY/BK		Nill		
HB006	47.60	48.00	0.40	SLT		GY		Nill		oil seepage
HB006	48.00	52.90	4.90	SLT		GY/BK		Nill		
HB006	52.90	55.00	2.10	CRM		GY		Nill		
HB006	55.00	55.50	0.50	SLT		CR		Nill		
HB006	55.50	60.40	4.90	SLT		BK/BR		Nill		oil seepage
HB006	60.40	61.90	1.50	CRM		CR		Nill		
HB006	61.90	62.90	1.00	SLT		GY/BR		Nill		
HB006	62.90	63.20	0.30	CRM		GY		Nill		
HB006	63.20	63.60	0.40	SLT		GY/BR		Nill		
HB006	63.60	65.00	1.40	CRM		CR		Nill		
HB006	65.00	67.00	2.00	SLT		GY/BR		Nill		
HB006	67.00	67.30	0.30	SLT		GY/BK		Nill		
HB006	67.30	67.90	0.60	CRM		GY		Nill		
HB006	67.90	68.40	0.50	SLT		GY/BR		Nill		
HB006	68.40	68.80	0.40	CRM		GY		Nill		
HB006	68.80	69.60	0.80	SLT		GY/BR		Nill		
HB006	69.60	70.00	0.40		SANDSTONE	BK		Nill		
HB006	70.00	74.60	4.60	SLT		GY/BR		Nill		oil seepage
HB006	74.60	76.50	1.90	CRM		GY		Nill		
HB006	76.50	77.20	0.70	SLT		GY/BR		Nill		
HB006	77.20	77.70	0.50		SANDSTONE	BK/BR		Nill		
HB006	77.70	78.50	0.80	SLT		GY/BR		Nill		
HB006	78.50	78.90	0.40	CRM		CR		Nill		
HB006	78.90	82.90	4.00	SLT		GY/BR		Nill		
HB006	82.90	83.00	0.10		SANDSTONE	GY		Nill		
HB006	83.00	84.90	1.90	CRM		GY/BR		Nill		
HB006	84.90	87.90	3.00	SLT		GY		Nill		
HB006	87.90	90.90	3.00	SLT		GY/BR		Nill		
HB006	90.90	92.30	1.40	CRM		BR/CR		Nill		
HB006	92.30	93.20	0.90	SLT		GY/BR		Nill		
HB006	93.20	93.50	0.30		SANDSTONE	BK/GY		Nill		
HB006	93.50	94.60	1.10	SLT		GY/BR		Nill		
HB006	94.60	94.90	0.30		SANDSTONE	BK/GY		Nill		
HB006	94.90	96.00	1.10	SLT		GY		Nill		
HB006	96.00	96.30	0.30		SANDSTONE	GY/BK		Nill		
HB006	96.30	98.10	1.80	SLT		GY/BR		Nill		
HB006	98.10	99.70	1.60	CRM		GY/BK		Nill		
HB006	99.70	101.10	1.40	SLT		GY		Nill		
HB006	101.10	101.40	0.30	CRM		GY/BR		Nill		
HB006	101.40	103.20	1.80	SLT		GY/BR		Nill		
HB006	103.20	107.00	3.80	CAM		CR		Nill		
HB006	107.00	107.90	0.90	SLT		GY/BR		Nill		
HB006	107.90	111.10	3.20	CRM		GY		Nill		
HB006	111.10	111.70	0.60	AT		GY/CR		Nill		Curly Tuff
HB006	111.70	112.00	0.30	CRM		CR/BK		Nill		OIL CONTENT?
HB006	112.00	118.70	6.70		SANDSTONE	BK		Nill		
HB006	118.70	119.90	1.20	CRM		GY		Nill		
HB006	119.90	120.60	0.70	SLT		GY		Nill		
HB006	120.60	121.40	0.80	CRM		GY		Nill		
HB006	121.40	123.90	2.50	SLT		GY		Nill		
HB006	123.90	124.70	0.80		SANDSTONE	BK		Nill		
HB006	124.70	126.60	1.90	CAM		GY		Nill		
HB006	126.60	128.80	2.20	CRM		GY/BK		Nill		
HB006	128.80	131.60	2.80	CAM		GY		Nill		
HB006	131.60	138.90	7.30		SANDSTONE	BK/PR		Nill		
HB006	138.90	142.10	3.20	CRM		GY		Nill		
HB006	142.10	145.90	3.80	SLT		GY		Nill		

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB006	145.90	146.90	1.00	CRM		GY		Nill		
HB006	146.90	147.90	1.00	SLT		GY		Nill		
HB006	147.90	148.90	1.00	CRM		GY		Nill		
HB006	148.90	149.80	0.90	SLT		GY		Nill		
HB006	149.80	151.50	1.70	CRM		GY		Nill		
HB006	151.50	153.20	1.70	SLT		GY		Nill		
HB006	153.20	154.10	0.90	CRM		GY		Nill		
HB006	154.10	155.00	0.90	SLT		GY		Nill		
HB006	155.00		-155.00							
	EOH									
HB-002	0.00	6.30	6.30		CASING					
HB-002	6.30	11.30	5.00	SLT		GY/BK		Low		
HB-002	11.30	18.30	7.00	CRM		GY		Low		
HB-002	18.30	18.90	0.60	SLT		GY/BK		Nill		
HB-002	18.90	20.20	1.30	SLT		GY		Nill		
HB-002	20.20	24.60	4.40	SLT		GY/BK		Nill		
HB-002	24.60	26.40	1.80	SLT		GY		Nill		
HB-002	26.40	26.90	0.50	SLT		GY/BK		Nill		
HB-002	26.90	28.10	1.20	SLT		GY		Nill		
HB-002	28.10	36.60	8.50	SLT		GY/BK		Nill		HIGH OIL
HB-002	36.60	39.20	2.60	SLT		GY		Nill		
HB-002	39.20	42.90	3.70	SLT		GY/BK		Nill		
HB-002	42.90	44.30	1.40	CRM		GY		Nill		
HB-002	44.30	48.00	3.70	SLT		GY/BK		Nill		
HB-002	48.00	48.90	0.90	CRM		GY		Nill		
HB-002	48.90	52.10	3.20	SLT		GY/BK		Nill		
HB-002	52.10	53.40	1.30	CRM		GY		Nill		
HB-002	53.40	57.11	3.71	SLT		GY/BK		Nill		HIGH OIL
HB-002	57.11	58.10	0.99	CRM		GY		Nill		
HB-002	58.10	60.30	2.20	SLT		GY/BK		Nill		HIGH OIL
HB-002	60.30	60.70	0.40	CRM		GY		Nill		
HB-002	60.70	68.10	7.40	SLT		GY		Nill		
HB-002	68.10	73.00	4.90	SLT		BK/GY		Nill		MAHOGANY ZONE - OIL SEEPAGE VISIBLE IN CORE RETURNS
HB-002	73.00	74.90	1.90	CRM		GY		Nill		
HB-002	74.90	81.20	6.30	SLT		BK/GY		Nill		HIGH OIL 66.5 - 81
HB-002	81.20	81.50	0.30	CRM		GY		Nill		
HB-002	81.50	97.30	15.80	SLT		BK/GY		Nill		HIGH OIL 85 - 87.9 & MED OIL 91.2 - 99.0
HB-002	97.30	104.30	7.00	SLT		GY/BR		Nill		HIGH OIL 99.8 - 102.5 & 108
HB-002	104.30	105.00	0.70		SANDSTONE	RD/BK		Nill		
HB-002	105.00	108.30	3.30	SLT		GY/BK		Nill		HIGH OIL
HB-002	108.30	110.60	2.30	SLT		GY/BR		Nill		HIGH OIL
HB-002	110.60	120.60	10.00	SLT		BR/GY		Nill		HIGH OIL - MEDIUM 116.4- 117.6
HB-002	120.60	121.80	1.20	SLT		GY/BK		Nill		
HB-002	121.80	124.00	2.20	SLT		GY/BR		Nill		HIGH OIL
HB-002	124.00	143.70	19.70			BK/GY		Nill		
HB-002	143.70	155.80	12.10	SLT		GY/BR		Nill		145-151 HIGH OIL
HB-002	155.80	158.10	2.30	SLT		BK/GY		Nill		MED OIL
HB-002	158.10	158.70	0.60	SLT		GY		Nill		
HB-002	158.70	162.50	3.80	SLT		GY/BR		Nill		LOW OIL
HB-002	162.50	163.00	0.50	AT		OR/BR		Nill		TUFF
HB-002	163.00	164.30	1.30	CAM		GY		Nill		
HB-002	164.30	165.10	0.80	SLT		GY/BR		Nill		LOW OIL
HB-002	165.10	166.50	1.40		SANDSTONE	BR		Nill		LOW OIL
HB-002	166.50	168.00	1.50	SLT		GY/BR		Nill		LOW OIL
HB-002	168.00	168.80	0.80	CRM		GY		Nill		
HB-002	168.80	171.30	2.50	SLT		GY		Nill		TAR VISIBLE
HB-002	171.30	171.60	0.30		SANDSTONE	RD/PR		Nill		
HB-002	171.60	172.60	1.00	SLT		GY		Nill		
HB-002	172.60	173.00	0.40	AT		BR/GY		Nill		TUFF
HB-002	173.00	179.60	6.60	SLT		GY		Nill		
HB-002	179.60	179.80	0.20		SANDSTONE	PR		Nill		
HB-002	179.80	180.00	0.20	SLT		GY		Nill		
HB-002	180.00	180.20	0.20		SANDSTONE	PR		Nill		
HB-002	180.20	181.40	1.20	SLT		GY		Nill		
HB-002	181.40	181.70	0.30	CRM		BK		Nill		
HB-002	181.70	181.90	0.20	SLT		GY		Nill		
HB-002	181.90	182.10	0.20	CRM		BK		Nill		TAR ON SURFACE OF CORE
HB-002	182.10	186.00	3.90	SLT		GY		Nill		B
HB-002	186.00	186.30	0.30	CRM		GY		Nill		
HB-002	186.30	189.40	3.10	SLT		GY/CR		Nill		
HB-002	189.40	190.00	0.60	CRM		GY		Nill		
HB-002	190.00	191.40	1.40	SLT		GY/CR		Nill		
HB-002	191.40	191.80	0.40	CRM		GY		Nill		
HB-002	191.80	193.00	1.20	SLT		GY/BR		Nill		
HB-002	193.00	195.00	2.00	CAM		CR		Nill		
HB-002	195.00	196.50	1.50	SLT		GY/BR		Nill		
HB-002	196.50	197.10	0.60	CRM		BR/RD		Nill		
HB-002	197.10	197.70	0.60	CAM		GY		Nill		
HB-002	197.70	212.90	15.20	CRM		BR		Nill		
HB-002	212.90	215.00	2.10	CRM		GY/CR		Nill		
HB-002	215.00	EOH								
HB-003	0.00	5.00	5.00		CASING					
HB-003	5.00	6.10	1.10	SLT		GY		Low		
HB-003	6.10	9.90	3.80	SLT		GY/BR		Nill		OIL SEEPAGE
HB-003	9.90	15.80	5.90	SLT		GY		Nill		
HB-003	15.80	16.90	1.10	SLT		GY/RD		Nill		
HB-003	16.90	23.20	6.30	SLT		GY/BR		Nill		LOW OIL SEEPAGE
HB-003	23.20	23.80	0.60	SLT		GY/BK		Nill		LOW OIL SEEPAGE
HB-003	23.80	24.10	0.30	CRM		BR/BK		Nill		
HB-003	24.10	27.90	3.80	SLT		GY/BR		Nill		OIL SEEPAGE
HB-003	27.90	28.60	0.70	CRM		GY		Nill		
HB-003	28.60	30.10	1.50	SLT		GY		Nill		
HB-003	30.10	35.00	4.90	CRM		GY		Nill		
HB-003	35.00	37.30	2.30	SLT		GY/BR		Nill		MED OIL
HB-003	37.30	43.50	6.20	SLT		GY		Nill		
HB-003	43.50	55.00	11.50	SLT		GY/BK		Nill		MAHZ - HIGH OIL YIELD VISIBLE - Water encountered
HB-003	55.00	56.60	1.60	SLT		GY		Nill		NO OIL

Borehole ID	From (ft)	To (ft)	Thickness	Lith Code	Lithology	Colour	Mineralisation	Weathering	Organic content	Description
HB-003	56.60	60.90	4.30	SLT		GY/BK		Nill		MAHZ - HIGH OIL YIELD VISIBLE
HB-003	60.90	63.30	2.40	SLT		GY/BR		Nill		NO OIL
HB-003	63.30	73.00	9.70	SLT		GY/BR		Nill		MAHZ - HIGH OIL YIELD VISIBLE
HB-003	73.00	79.50	6.50	SLT		GY/BR		Nill		high clay matrix, contains visible oil
HB-003	79.50	85.00	5.50	CRM		BR/CR		Nill		contains visble oil
HB-003	85.00	85.30	0.30	SLT		BK/CR		Nill		LOW OIL
HB-003	85.30	88.40	3.10	CRM		GY/BK		Nill		
HB-003	88.40	89.60	1.20	SLT		GY/BR		Nill		
HB-003	89.60	89.90	0.30	AT		BK/OR/GN		Nill		CURLY TUFF
HB-003	89.90	91.00	1.10	SLT		GY/BR		Nill		
HB-003	91.00	91.80	0.80	CAM		CR/WT		Nill		
HB-003	91.80	92.20	0.40	SLT		GY/BR		Nill		
HB-003	92.20	93.20	1.00	CAM		CR/GY		Nill		
HB-003	93.20	94.40	1.20	SLT		BK/BR		Nill		
HB-003	94.40	98.10	3.70	CRM		GY/BR		Nill		
HB-003	98.10	98.70	0.60		SANDSTONE	BK		Nill		
HB-003	98.70	100.10	1.40	CRM		PR		Nill		
HB-003	100.10	101.80	1.70	CRM		GY		Nill		
HB-003	101.80	108.00	6.20	CRM		PR		Nill		
HB-003	108.00	112.40	4.40	CRM		CM		Nill		
HB-003	112.40	115.20	2.80	CRM		GY		Nill		
HB-003	115.20	116.20	1.00		SANDSTONE	GY		Nill		
HB-003	116.20	145.00	28.80	CRM		GY		Nill		
	EOH									
HB-004	0.00	45.00	45.00		collar					
HB-004	45.00	47.00	2.00	CRM		BK/BR		Nill		
HB-004	47.00	53.00	6.00	SLT		BR/GY		Nill		
HB-004	53.00	58.60	5.60	SLT		GY/BR		Nill		
HB-004	58.60	65.60	7.00	SLT		BK/BR		Nill		
HB-004	65.60	69.10	3.50	SLT		GR/GY		Nill		
HB-004	69.10	70.10	1.00	CRM		GY		Nill		
HB-004	70.10	73.70	3.60	SLT		GY/BR		Nill		
HB-004	73.70	75.00	1.30	SLT		GY		Nill		
HB-004	75.00	81.90	6.90	SLT		BR/GY		Nill		
HB-004	81.90	84.90	3.00	SLT		BR/BK		Nill		
HB-004	84.90	85.90	1.00	SLT		BK/BR		Nill		
HB-004	85.90	90.20	4.30	SLT		BR/BK		Nill		
HB-004	90.20	93.50	3.30	SLT		BR/GY		Nill		
HB-004	93.50	94.10	0.60	SLT		BK/BR		Nill		
HB-004	94.10	98.60	4.50	SLT		GY/BR		Nill		
HB-004	98.60	104.00	5.40	SLT		GY/BR		Nill		
HB-004	104.00	104.30	0.30	SLT		BK/BR		Nill		
HB-004	104.30	109.80	5.50	SLT		CR/GY		Nill		
HB-004	109.80	111.40	1.60	SLT		BK/BR		Nill		
HB-004	111.40	113.10	1.70	SLT		GY/BK		Nill		
HB-004	113.10	117.80	4.70	SLT		BK/BR		Nill		
HB-004	117.80	119.10	1.30	SLT		GY/BR		Nill		
HB-004	119.10	120.40	1.30	SLT		BR/BK		Nill		
HB-004	120.40	122.80	2.40	SLT		GY/BR		Nill		
HB-004	122.80	123.90	1.10	CRM		BK/BR		Nill		
HB-004	123.90	132.90	9.00	SLT		BR/GY		Nill		
HB-004	132.90	133.40	0.50	SLT		GY		Nill		
HB-004	133.40	134.50	1.10	SLT		BR/GY		Nill		
HB-004	134.50	136.00	1.50	SLT		BK/BR		Nill		
HB-004	136.00	141.10	5.10	SLT		BR/GY		Nill		
HB-004	141.10	144.00	2.90	SLT		GY		Nill		
HB-004	144.00	145.60	1.60	AT		GY/PR		Nill		Curly Tuff
HB-004	145.60	146.60	1.00	SLT		BR/GY		Nill		
HB-004	146.60	147.90	1.30	SLT		CR/GY		Nill		
HB-004	147.90	155.00	7.10	CRM		GY		Nill		
HB-004	155.00	158.10	3.10	SLT		GY/BR		Nill		
HB-004	158.10	158.30	0.20		SANDSTONE	GY/BK		Nill		
HB-004	158.30	159.10	0.80	SLT		GY/BR		Nill		
HB-004	159.10	159.30	0.20		SANDSTONE	BR		Nill		
HB-004	159.30	160.90	1.60	SLT		GY		Nill		
HB-004	160.90	161.00	0.10		SANDSTONE	BK/GY		Nill		
HB-004	161.00	162.00	1.00	SLT		GY		Nill		
HB-004	162.00	162.30	0.30		SANDSTONE	GY/BK		Nill		
HB-004	162.30	165.00	2.70	SLT		GY/OR		Nill		
HB-004	165.00	166.20	1.20		SANDSTONE	GY		Nill		
HB-004	166.20	169.30	3.10	SLT		GY/BR		Nill		
HB-004	169.30	169.90	0.60	CRM		GY		Nill		
HB-004	169.90	172.00	2.10	SLT		BY/BR		Nill		
HB-004	172.00	175.50	3.50	CRM		CR/GY		Nill		
HB-004	175.50	177.30	1.80	SLT		BR/GY		Nill		
HB-004	177.30	181.00	3.70	CRM		GY		Nill		
HB-004	181.00	195.00	14.00		SANDSTONE	BR/RD		Nill		
HB-004	195.00	**EOH**								

SRK Exploration Services

Tomco Oil Shale

Geotech Sheet

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-007	SST	0.00	10.10	10.10	1.80	18%	1.00	10%		0%				0	0.0	#DIV/0!	
HB-007	SLT	10.10	26.30	16.20	13.90	86%	8.60	53%		0%				0	0.0	#DIV/0!	
HB-007	SST	26.30	30.00	3.70	3.70	100%	2.00	54%		0%				0	0.0	#DIV/0!	
HB-007	SLT	30.00	33.70	3.70	3.70	100%	1.80	49%		0%				0	0.0	#DIV/0!	
HB-007	SST	33.70	34.30	0.60	0.60	100%	0.60	100%		0%				0	0.0	#DIV/0!	
HB-007	SLT	34.30	41.50	7.20	7.20	100%	4.00	56%		0%				0	0.0	#DIV/0!	
HB-007	SST	41.50	49.50	8.00	8.00	100%	4.70	59%		0%				0	0.0	#DIV/0!	
HB-007	SST	49.50	51.90	2.40	2.40	100%	1.70	71%		0%				0	0.0	#DIV/0!	
HB-007	SLT	51.90	52.90	1.00	1.00	100%	1.00	100%		0%				0	0.0	#DIV/0!	
HB-007	SST	52.90	54.60	1.70	1.70	100%	1.50	88%		0%				0	0.0	#DIV/0!	
HB-007	SLT	54.60	62.00	7.40	7.40	100%	5.80	78%	0.20	3%	2			2	0.3	3.70	
HB-007	SST	62.00	66.10	4.10	4.10	100%	2.60	63%		0%				0	0.0	#DIV/0!	
HB-007	SLT	66.10	72.30	6.20	6.20	100%	5.40	87%		0%				0	0.0	#DIV/0!	
HB-007	SND	72.30	76.11	3.81	3.81	100%	2.40	63%		0%				0	0.0	#DIV/0!	
HB-007	SLT	76.11	80.30	4.19	4.19	100%	3.50	84%		0%				0	0.0	#DIV/0!	
HB-007	SND	80.30	81.30	1.00	1.00	100%	0.60	60%		0%				0	0.0	#DIV/0!	
HB-007	SLT	81.30	84.40	3.10	3.10	100%	1.80	58%		0%				0	0.0	#DIV/0!	
HB-007	SND	84.40	87.10	2.70	2.70	100%		0%		0%				0	0	#DIV/0!	
HB-007	SLT	87.10	94.60	7.50	7.50	100%	2.00	27%	0.10	1%	1			1	0	7.50	
HB-007	MDS	94.60	97.60	3.00	3.00	100%	1.00	33%		0%				0	0	#DIV/0!	
HB-007	SLT	97.60	114.60	17.00	17.00	100%	10.00	59%	0.40	2%	4			4	0	4.25	
HB-007	MDS	114.60	116.80	2.20	2.20	100%	0.60	27%		0%				0	0	#DIV/0!	
HB-007	SLT	116.80	135.60	18.80	18.80	100%	14.00	74%		0%				0	0	#DIV/0!	
HB-007	MDS	135.60	136.60	1.00	1.00	100%		0%		0%				0	0	#DIV/0!	
HB-007	SLT	136.60	142.00	5.40	5.40	100%	4.00	74%		0%				0	0	#DIV/0!	
HB-007	SND	142.00	142.90	0.90	0.90	100%	0.90	100%		0%				0	0	#DIV/0!	
HB-007	SLT	142.90	146.60	3.70	3.70	100%	1.60	43%		0%				0	0	#DIV/0!	
HB-007	SND	146.60	146.11	-0.49	0.49	-100%	0.49	-100%		0%				0	0	#DIV/0!	
HB-007	SLT	146.11	154.40	8.29	8.29	100%	3.00	36%		0%				0	0	#DIV/0!	
HB-007	MDS	154.40	156.60	2.20	2.20	100%	1.30	59%		0%				0	0	#DIV/0!	
HB-007	SLT	156.60	161.00	4.40	4.40	100%	2.00	45%		0%				0	0	#DIV/0!	
HB-007	SND	161.00	162.40	1.40	1.40	100%	1.30	93%		0%				0	0	#DIV/0!	
HB-007	MDS	162.40	166.20	3.80	2.40	63%	0.80	21%		0%				0	0	#DIV/0!	
HB-007	SLT	166.20	174.90	8.70	8.70	100%	8.00	92%	1.00	11%	6			6	1	1.45	
HB-007	MDS	174.90	179.11	4.21	4.00	95%	2.00	48%	0.80	19%	4			4	1	1.00	
HB-007	SLT	179.11	182.70	3.59	3.50	97%	3.00	84%		0%				0	0	#DIV/0!	
HB-007	SND	182.70	184.60	1.90	1.90	100%	1.80	95%		0%				0	0	#DIV/0!	
HB-007	MDS	184.60	186.60	2.00	2.00	100%	1.60	80%	0.10	5%	1			1	1	2.00	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-007	SLT	186.60	192.40	5.80	5.80	100%	4.90	84%	0.30	5%	3			3	1	1.93	
HB-007	MDS	192.40	194.80	2.40	2.40	100%	2.10	87%		0%				0	0	#DIV/0!	
HB-007	SLT	194.80	197.20	2.40	2.40	100%	1.30	54%		0%				0	0	#DIV/0!	
HB-007	SND	197.20	198.10	0.90	0.90	100%	0.75	83%		0%				0	0	#DIV/0!	
HB-007	SLT	198.10	200.50	2.40	2.40	100%	1.40	58%		0%				0	0	#DIV/0!	
HB-007	MDS	200.50	206.30	5.80	5.80	100%	4.40	76%		0%				0	0	#DIV/0!	
HB-007	SLT	206.30	206.10	-0.20	0.80	-400%	0.45	-225%		0%				0	0	#DIV/0!	
HB-007	SND	206.10	207.60	1.50	1.50	100%	1.30	87%		0%				0	0	#DIV/0!	
HB-007	SLT	207.60	212.60	5.00	5.00	100%	3.20	64%		0%				0	0	#DIV/0!	
HB-007	MDS	212.60	214.80	2.20	1.20	55%	1.00	45%		0%				0	0	#DIV/0!	
HB-007	SLT	214.80	216.00	1.20	1.20	100%	1.00	83%		0%				0	0	#DIV/0!	
HB-007	MB	216.00	220.70	4.70	4.70	100%	2.80	60%		0%				0	0	#DIV/0!	
HB-007	SLT	220.70	222.30	1.60	1.60	100%	1.10	69%		0%				0	0	#DIV/0!	
HB-007	MB	222.30	222.11	-0.19	0.80	-421%	0.40	-211%		0%				0	0	#DIV/0!	
HB-007	SLT	222.11	223.40	1.29	0.69	53%	0.50	39%		0%				0	0	#DIV/0!	
HB-007	MB	223.40	223.12	-0.28	0.80	-286%	0.30	-107%		0%				0	0	#DIV/0!	
HB-007	SLT	223.12	224.90	1.78	1.78	100%	1.20	67%		0%				0	0	#DIV/0!	
HB-007	MB	224.90	225.60	0.70	0.70	100%	0.30	43%		0%				0	0	#DIV/0!	
HB-007	SLT	225.60	226.10	0.50	0.50	100%	0.30	60%		0%				0	0	#DIV/0!	
HB-007	MB	226.10	226.90	0.80	0.80	100%	0.40	50%		0%				0	0	#DIV/0!	
HB-007	SLT	226.90	231.60	4.70	4.70	100%	3.60	77%		0%				0	0	#DIV/0!	
HB-007	MB	231.60	232.60	1.00	1.00	100%	0.40	40%		0%				0	0	#DIV/0!	
HB-007	SLT	232.60	244.60	12.00	11.40	95%	5.00	42%		0%				0	0	#DIV/0!	
HB-007	MAHZ	244.60	245.60	1.00	1.00	100%	0.45	45%		0%				0	0	#DIV/0!	
HB-007	SLT	245.60	254.60	9.00	9.00	100%	5.40	60%		0%				0	0	#DIV/0!	
HB-007	SND	254.60	256.80	2.20	2.20	100%	1.80	82%		0%				0	0	#DIV/0!	
HB-007	SLT	256.80	261.80	5.00	5.00	100%	3.90	78%		0%				0	0	#DIV/0!	
HB-007	SND	261.80	261.11	-0.69	0.30	-43%	0.30	-43%		0%				0	0	#DIV/0!	
HB-007	SLT	261.11	262.11	1.00	1.00	100%	0.70	70%		0%				0	0	#DIV/0!	
HB-007	SND	262.11	263.60	1.49	1.70	114%	1.60	107%		0%				0	0	#DIV/0!	
HB-007	SLT	263.60	271.40	7.80	7.80	100%	3.80	49%		0%				0	0	#DIV/0!	
HB-007	SST	271.40	271.10	-0.30	0.60	-200%	0.45	-150%		0%				0	0	#DIV/0!	
HB-007	SLT	271.10	281.80	10.70	10.70	100%	6.20	58%		0%				0	0	#DIV/0!	
HB-007	SST	281.80	282.20	0.40	0.60	150%	0.60	150%		0%				0	0	#DIV/0!	
HB-007	SLT	282.20	289.10	6.90	6.90	100%	4.10	59%		0%				0	0	#DIV/0!	
HB-007	SND	289.10	290.11	1.01	1.10	109%	1.10	109%		0%				0	0	#DIV/0!	
HB-007	SLT	290.11	294.60	4.49	4.49	100%	3.65	81%	1.60	36%			1	1	0	4.49	
HB-007	SND	294.60	304.60	10.00	10.00	100%	9.50	95%		0%				0	0	#DIV/0!	
HB-007		304.60	**EOH**														
HB-001	CASING	0.00	10.00	10.00		0%		0%		0%				0	0	#DIV/0!	
HB-001	SND	10.00	11.00	1.00	1.00	100%	0.90	90%	0.10	10%	1			1	1	1.00	
HB-001	SLT	11.00	22.90	11.90	11.90	100%	8.50	71%		0%				0	0	#DIV/0!	
HB-001	SND	22.90	25.80	2.90	2.90	100%	2.80	97%		0%				0	0	#DIV/0!	
HB-001	MDS	25.80	28.90	3.10	3.10	100%	3.00	97%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-001	SLT	28.90	29.80	0.90	0.90	100%	0.85	94%		0%				0	0	#DIV/0!	
HB-001	MDS	29.80	30.60	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB-001	SLT	30.60	32.40	1.80	1.80	100%	1.70	94%		0%				0	0	#DIV/0!	
HB-001	MDS	32.40	35.60	3.20	3.20	100%	3.00	94%		0%				0	0	#DIV/0!	
HB-001	SLT	35.60	37.30	1.70	1.70	100%	1.30	76%		0%				0	0	#DIV/0!	
HB-001	MDS	37.30	38.30	1.00	1.00	100%	0.90	90%		0%				0	0	#DIV/0!	
HB-001	SLT	38.30	39.60	1.30	1.30	100%	1.00	77%		0%				0	0	#DIV/0!	
HB-001	MDS	39.60	42.20	2.60	2.60	100%	2.00	77%		0%				0	0	#DIV/0!	
HB-001	SLT	42.20	47.20	5.00	4.00	80%	3.70	74%		0%				0	0	#DIV/0!	
HB-001	MDS	47.20	47.90	0.70	0.70	100%	0.65	93%		0%				0	0	#DIV/0!	
HB-001	SLT	47.90	50.10	2.20	2.20	100%	2.00	91%		0%				0	0	#DIV/0!	
HB-001	MDS	50.10	51.11	1.01	1.10	109%	1.00	99%		0%				0	0	#DIV/0!	
HB-001	SLT	51.11	54.10	2.99	2.99	100%	2.80	94%		0%				0	0	#DIV/0!	
HB-001	MDS	54.10	55.00	0.90	0.90	100%	0.75	83%		0%				0	0	#DIV/0!	
HB-001	SLT	55.00	57.20	2.20	2.20	100%	1.65	75%		0%				0	0	#DIV/0!	
HB-001	MDS	57.20	57.80	0.60	0.60	100%	0.50	83%		0%				0	0	#DIV/0!	
HB-001	SLT	57.80	60.10	2.30	2.30	100%	1.80	78%		0%				0	0	#DIV/0!	
HB-001	MDS	60.10	61.80	1.70	1.70	100%	1.40	82%		0%				0	0	#DIV/0!	
HB-001	SLT	61.80	61.11	-0.69	0.30	-43%	0.30	-43%		0%				0	0	#DIV/0!	
HB-001	MDS	61.11	64.20	3.09	2.30	74%	2.00	65%		0%				0	0	#DIV/0!	
HB-001	SLT	64.20	65.60	1.40	1.40	100%	1.20	86%		0%				0	0	#DIV/0!	
HB-001	MDS	65.60	66.50	0.90	0.90	100%	0.70	78%		0%				0	0	#DIV/0!	
HB-001	SLT	66.50	69.70	3.20	3.20	100%	3.00	94%		0%				0	0	#DIV/0!	
HB-001	MDS	69.70	70.20	0.50	0.50	100%	0.40	80%		0%				0	0	#DIV/0!	
HB-001	SLT	70.20	71.70	1.50	1.50	100%	1.30	87%		0%				0	0	#DIV/0!	
HB-001	MDS	71.70	72.70	1.00	1.00	100%	0.80	80%		0%				0	0	#DIV/0!	
HB-001	SLT	72.70	74.50	1.80	1.80	100%	1.50	83%		0%				0	0	#DIV/0!	
HB-001	MDS	74.50	76.00	1.50	1.50	100%	1.20	80%		0%				0	0	#DIV/0!	
HB-001	SLT	76.00	79.10	3.10	3.10	100%	2.80	90%		0%				0	0	#DIV/0!	
HB-001	MDS	79.10	82.10	3.00	3.00	100%	2.65	88%		0%				0	0	#DIV/0!	
HB-001	SLT	82.10	82.40	0.30	0.30	100%	0.25	83%		0%				0	0	#DIV/0!	
HB-001	MDS	82.40	82.70	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-001	SLT	82.70	83.10	0.40	0.40	100%	0.35	88%		0%				0	0	#DIV/0!	
HB-001	MDS	83.10	85.20	2.10	2.10	100%	1.60	76%		0%				0	0	#DIV/0!	
HB-001	SLT	85.20	91.50	6.30	6.30	100%	5.60	89%		0%				0	0	#DIV/0!	
HB-001	MDS	91.50	92.11	0.61	1.80	295%	1.50	246%		0%				0	0	#DIV/0!	
HB-001	SLT	92.11	94.10	1.99	1.90	95%	1.65	83%		0%				0	0	#DIV/0!	
HB-001	MDS	94.10	94.80	0.70	0.70	100%	0.60	86%		0%				0	0	#DIV/0!	
HB-001	SLT	94.80	96.80	2.00	2.00	100%	1.70	85%		0%				0	0	#DIV/0!	
HB-001	SLT	96.80	97.50	0.70	0.70	100%	0.50	71%		0%				0	0	#DIV/0!	
HB-001	SND	97.50	97.90	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB-001	SLT	97.90	102.10	4.20	4.20	100%	3.40	81%		0%				0	0	#DIV/0!	
HB-001	SLT	102.10	103.60	1.50	2.00	133%	1.50	100%		0%				0	0	#DIV/0!	
HB-001	SND	103.60	105.00	1.40	1.40	100%	1.40	100%		0%				0	0	#DIV/0!	
HB-001	SND	105.00	109.90	4.90	4.90	100%	4.80	98%		0%				0	0	#DIV/0!	
HB-001	SLT	109.90	110.70	0.80	0.80	100%	0.70	88%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-001	SND	110.70	110.90	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB-001	SLT	110.90	118.00	7.10	7.10	100%	6.40	90%		0%				0	0	#DIV/0!	
HB-001	AT	118.00	118.30	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-001	SLT	118.30	119.50	1.20	1.20	100%	1.20	100%		0%				0	0	#DIV/0!	
HB-001	SND	119.50	119.80	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-001	SLT	119.80	123.90	4.10	4.10	100%	3.40	83%		0%				0	0	#DIV/0!	
HB-001	SND	123.90	124.00	0.10	0.10	100%	0.10	100%		0%				0	0	#DIV/0!	
HB-001	SLT	124.00	125.90	1.90	1.90	100%	1.70	89%		0%				0	0	#DIV/0!	
HB-001	SLT	125.90	126.30	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB-001	SLT	126.30	127.50	1.20	1.20	100%	1.10	92%		0%				0	0	#DIV/0!	
HB-001	SST	127.50	127.80	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-001	SLT	127.80	128.90	1.10	1.10	100%	0.90	82%		0%				0	0	#DIV/0!	
HB-001	CLAY	128.90	129.40	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB-001	SST	129.40	130.00	0.60	0.60	100%	0.60	100%		0%				0	0	#DIV/0!	
HB-001	SLT	130.00	130.20	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB-001	CLAY	130.20	131.20	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-001	SST	131.20	140.11	8.91	8.91	100%	8.40	94%		0%	2			2	0	4.46	
HB-001	SST	140.11	145.40	5.29	5.29	100%	5.00	95%		0%				0	0	#DIV/0!	
HB-001	SLT	145.40	145.50	0.10	0.10	100%	0.10	100%		0%				0	0	#DIV/0!	
HB-001	SST	145.50	145.80	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-001	SLT	145.80	150.00	4.20	4.20	100%	4.00	95%		0%				0	0	#DIV/0!	
HB-001	CLAY	150.00	164.40	14.40	14.40	100%	14.00	97%		0%				0	0	#DIV/0!	
HB-001		164.40	**EOH**														
HB-005	CASING	0.00	3.00	3.00	0.00	0%		0%		0%				0	0	#DIV/0!	
HB-005	CAM	3.20	13.30	10.10	1.40	14%	1.00	10%		0%				0	0	#DIV/0!	
HB-005	SLT	13.30	17.20	3.90	3.60	92%	3.40	87%		0%				0	0	#DIV/0!	
HB-005	CAM	17.20	17.80	0.60	0.55	92%	0.50	83%		0%				0	0	#DIV/0!	
HB-005	SLT	17.80	18.40	0.60	0.60	100%	0.58	96%		0%				0	0	#DIV/0!	
HB-005	CAM	18.40	18.70	0.30	0.25	83%	0.25	83%		0%				0	0	#DIV/0!	
HB-005	SLT	18.70	19.60	0.90	0.85	94%	0.85	94%		0%				0	0	#DIV/0!	
HB-005	CAM	19.60	22.90	3.30	3.00	91%	2.80	85%		0%				0	0	#DIV/0!	
HB-005	SLT	22.90	23.90	1.00	1.00	100%	0.80	80%		0%				0	0	#DIV/0!	
HB-005	SLT	23.90	24.12	0.22	0.30	136%	0.27	123%		0%				0	0	#DIV/0!	
HB-005	CAM	24.12	25.70	1.58	0.70	44%	0.50	32%		0%				0	0	#DIV/0!	
HB-005	SLT	25.70	27.40	1.70	1.90	112%	1.00	59%		0%				0	0	#DIV/0!	
HB-005	SLT	27.40	27.11	-0.29	0.70	-241%	0.40	-138%		0%				0	0	#DIV/0!	
HB-005	SLT	27.11	29.10	1.99	1.90	95%	1.40	70%		0%				0	0	#DIV/0!	
HB-005	SLT	29.10	30.12	1.02	1.20	118%	0.60	59%		0%				0	0	#DIV/0!	
HB-005	CAM	30.12	31.50	1.38	0.60	43%	0.45	33%		0%				0	0	#DIV/0!	
HB-005	SLT	31.50	32.50	1.00	1.00	100%	0.70	70%		0%				0	0	#DIV/0!	
HB-005	SLT	32.50	36.30	3.80	3.80	100%	3.80	100%		0%				0	0	#DIV/0!	
HB-005	CAM	36.30	41.12	4.82	5.90	122%	5.85	121%		0%				0	0	#DIV/0!	
HB-005	SLT	41.12	42.12	1.00	1.00	100%	0.80	80%		0%				0	0	#DIV/0!	
HB-005	CAM	42.12	44.11	1.99	1.90	95%	1.00	50%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-005	SLT	44.11	48.11	4.00	4.00	100%	2.40	60%		0%				0	0	#DIV/0!	
HB-005	SLT	48.11	49.11	1.00	1.00	100%	0.60	60%		0%				0	0	#DIV/0!	
HB-005	SLT	49.11	51.50	2.39	1.60	67%	1.20	50%		0%				0	0	#DIV/0!	
HB-005	SLT	51.50	52.50	1.00	1.00	100%	0.80	80%		0%				0	0	#DIV/0!	
HB-005	AT	52.50	52.70	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB-005	CAM	52.70	54.90	2.20	2.20	100%	1.70	77%		0%				0	0	#DIV/0!	
HB-005	SLT	54.90	55.80	0.90	1.11	123%	0.90	100%		0%				0	0	#DIV/0!	
HB-005	CAM	55.80	56.80	1.00	1.00	100%	0.75	75%		0%				0	0	#DIV/0!	
HB-005	SLT	56.80	59.20	2.40	2.60	108%	1.30	54%		0%				0	0	#DIV/0!	
HB-005		59.20	59.70	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB-005	SLT	59.70	61.40	1.70	1.70	100%	1.00	59%		0%				0	0	#DIV/0!	
HB-005	SLT	61.40	63.40	2.00	2.00	100%	1.60	80%		0%				0	0	#DIV/0!	
HB-005	SLT	63.40	64.10	0.70	0.90	129%	0.65	93%		0%				0	0	#DIV/0!	
HB-005	CAM	64.10	65.70	1.60	1.60	100%	1.30	81%		0%				0	0	#DIV/0!	
HB-005	MB	65.70	67.50	1.80	1.80	100%	1.80	100%		0%				0	0	#DIV/0!	
HB-005	SLT	67.50	67.90	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB-005	MB	67.90	69.10	1.20	1.20	100%	1.20	100%		0%				0	0	#DIV/0!	
HB-005	SLT	69.10	71.90	2.80	0.80	29%	0.80	29%		0%				0	0	#DIV/0!	
HB-005	SLT	71.90	74.00	2.10	2.10	100%	2.10	100%	0.50	24%			1	1	0	2.10	
HB-005	SLT	74.00	75.00	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-005	MB	75.00	76.00	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-005	SLT	76.00	78.40	2.40	2.40	100%	2.40	100%		0%				0	0	#DIV/0!	
HB-005	SLT	78.40	79.50	1.10	1.10	100%	1.10	100%		0%				0	0	#DIV/0!	
HB-005	CAM	79.50	81.60	2.10	2.00	95%	1.80	86%		0%				0	0	#DIV/0!	
HB-005	SLT	81.60	82.20	0.60	0.60	100%	0.55	92%		0%				0	0	#DIV/0!	
HB-005	CAM	82.20	83.00	0.80	0.80	100%	0.70	88%		0%				0	0	#DIV/0!	
HB-005	SLT	83.00	84.30	1.30	1.30	100%	1.30	100%		0%				0	0	#DIV/0!	
HB-005	MB	84.30	85.80	1.50	1.50	100%	1.50	100%		0%				0	0	#DIV/0!	
HB-005	SLT	85.80	89.10	3.30	3.30	100%	3.20	97%		0%				0	0	#DIV/0!	
HB-005	CAM	89.10	90.10	1.00	0.95	95%	0.90	90%		0%				0	0	#DIV/0!	
HB-005	SLT	90.10	91.60	1.50	1.50	100%	1.50	100%		0%				0	0	#DIV/0!	
HB-005	CAM	91.60	91.90	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-005	SLT	91.90	92.60	0.70	0.70	100%	0.70	100%		0%				0	0	#DIV/0!	
HB-005	CAM	92.60	93.10	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB-005	SLT	93.10	93.60	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB-005	CAM	93.60	94.60	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-005	SLT	94.60	95.00	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB-005	SLT	95.00	96.00	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-005	SLT	96.00	96.80	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB-005	SLT	96.80	98.80	2.00	2.00	100%	1.90	95%		0%				0	0	#DIV/0!	
HB-005	CAM	98.80	99.80	1.00	0.90	90%	0.70	70%		0%				0	0	#DIV/0!	
HB-005	SLT	99.80	100.80	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB-005	CAM	100.80	101.30	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB-005	SLT	101.30	107.10	5.80	5.80	100%	5.50	95%		0%				0	0	#DIV/0!	
HB-005	SND	107.10	108.70	1.60	1.60	100%	1.60	100%		0%				0	0	#DIV/0!	
HB-005	AT	108.70	108.90	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB-005	SLT	108.90	113.30	4.40	4.40	100%	4.30	98%		0%				0	0	#DIV/0!	
HB-005	CAM	113.30	118.60	5.30	5.20	98%	4.00	75%		0%				0	0	#DIV/0!	
HB-005	SLT	118.60	121.50	2.90	2.90	100%	2.80	97%		0%				0	0	#DIV/0!	
HB-005	CAM	121.50	121.80	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-005	SLT	121.80	123.10	1.30	1.30	100%	1.30	100%		0%				0	0	#DIV/0!	
HB-005	SND	123.10	123.40	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-005	SLT	123.40	124.60	1.20	1.20	100%	1.10	92%		0%				0	0	#DIV/0!	
HB-005	CAM	124.60	124.90	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-005	AT	124.90	125.00	0.10	0.10	100%	0.10	100%		0%				0	0	#DIV/0!	
HB-005	SLT	125.00	127.90	2.90	2.90	100%	2.80	97%		0%				0	0	#DIV/0!	
HB-005	SND	127.90	128.00	0.10	0.10	100%	0.10	100%		0%				0	0	#DIV/0!	
HB-005	SLT	128.00	131.60	3.60	3.60	100%	3.40	94%		0%				0	0	#DIV/0!	
HB-005	SND	131.60	132.00	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB-005	SLT	132.00	132.60	0.60	0.60	100%	0.60	100%		0%				0	0	#DIV/0!	
HB-005	CRM	132.60	133.90	1.30	1.30	100%	1.00	77%		0%				0	0	#DIV/0!	
HB-005	CRM	133.90	134.20	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB-005	SLT	134.20	135.00	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB-005	CRM	135.00	137.30	2.30	2.20	96%	1.75	76%		0%				0	0	#DIV/0!	
HB-005	SLT	137.30	140.50	3.20	3.20	100%	2.90	91%		0%				0	0	#DIV/0!	
HB-005	CRM	140.50	143.90	3.40	3.20	94%	2.80	82%		0%				0	0	#DIV/0!	
HB-005	CRM	143.90	155.00	11.10	11.00	99%	10.60	95%		0%				0	0	#DIV/0!	
HB-005	CRM	155.00	163.70	8.70	8.30	95%	3.60	41%	0.40	5%	1		2	3	0	2.77	
HB-005	CRM	163.70	168.50	4.80	4.60	96%	2.40	50%		0%				0	0	#DIV/0!	
HB-005	CRM	168.50	175.00	6.50	6.20	95%	3.00	46%	0.50	8%	2		2	4	1	1.55	
HB-005		175.00	**EOH**														
HB008	CASING	0.00	16.90	16.90	0.00	0%		0%		0%				0	0	#DIV/0!	
HB008	SLT	16.90	19.30	2.40	2.40	100%	2.00	83%		0%				0	0	#DIV/0!	
HB008	SLT	19.30	20.80	1.50	1.50	100%	1.00	67%		0%				0	0	#DIV/0!	
HB008	SLT	20.80	26.00	5.20	5.20	100%	3.40	65%		0%				0	0	#DIV/0!	
HB008	SLT	26.00	30.00	4.00	4.00	100%	2.80	70%		0%				0	0	#DIV/0!	
HB008	MB	30.00	30.11	0.11	0.11	100%	0.11	100%		0%				0	0	#DIV/0!	
HB008	SLT	30.11	32.90	2.79	0.40	14%	0.35	13%		0%				0	0	#DIV/0!	
HB008	CRM	32.90	33.10	0.20	0.20	100%	0.15	75%		0%				0	0	#DIV/0!	
HB008	SLT	33.10	33.30	0.20	0.20	100%	0.18	90%		0%				0	0	#DIV/0!	
HB008	MB	33.30	35.50	2.20	2.10	95%	2.10	95%		0%				0	0	#DIV/0!	
HB008	SLT	35.50	40.30	4.80	4.80	100%	4.20	88%		0%				0	0	#DIV/0!	
HB008	MB	40.30	41.60	1.30	1.30	100%	0.90	69%		0%				0	0	#DIV/0!	
HB008	CRM	41.60	42.30	0.70	0.70	100%	0.70	100%		0%				0	0	#DIV/0!	
HB008	MB	42.30	43.80	1.50	1.50	100%	1.00	67%		0%				0	0	#DIV/0!	
HB008	CRM	43.80	45.00	1.20	1.20	100%	0.80	67%		0%				0	0	#DIV/0!	
HB008	MB	45.00	49.60	4.60	4.60	100%	2.80	61%		0%				0	0	#DIV/0!	
HB008	SLT	49.60	52.00	2.40	2.40	100%	1.60	67%		0%				0	0	#DIV/0!	
HB008	SLT	52.00	52.11	0.11	0.11	100%	0.10	91%		0%				0	0	#DIV/0!	
HB008	CRM	52.11	53.60	1.49	0.69	46%	0.90	60%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB008	SLT	53.60	56.10	2.50	2.50	100%	2.20	88%		0%				0	0	#DIV/0!	
HB008	SLT	56.10	57.10	1.00	1.00	100%	0.90	90%		0%				0	0	#DIV/0!	
HB008	CRM	57.10	58.90	1.80	1.80	100%	1.60	89%		0%				0	0	#DIV/0!	
HB008	SLT	58.90	58.11	-0.79	0.30	-38%	0.30	-38%		0%				0	0	#DIV/0!	
HB008	CRM	58.11	59.20	1.09	1.30	119%	1.20	110%		0%				0	0	#DIV/0!	
HB008	SLT	59.20	59.50	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB008	CRM	59.50	61.60	2.10	2.10	100%	1.70	81%		0%				0	0	#DIV/0!	
HB008	SLT	61.60	62.00	0.40	0.40	100%	0.35	88%		0%				0	0	#DIV/0!	
HB008	CRM	62.00	63.30	1.30	1.30	100%	1.20	92%		0%				0	0	#DIV/0!	
HB008	SLT	63.30	63.90	0.60	0.60	100%	0.50	83%		0%				0	0	#DIV/0!	
HB008	CRM	63.90	64.70	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB008	SLT	64.70	68.90	4.20	4.20	100%	3.70	88%		0%				0	0	#DIV/0!	
HB008	SND	68.90	69.10	0.20	0.40	200%	0.40	200%		0%				0	0	#DIV/0!	
HB008	SLT	69.10	72.40	3.30	3.30	100%	3.10	94%		0%				0	0	#DIV/0!	
HB008	AT	72.40	72.60	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB008	SLT	72.60	73.00	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB008	CRM	73.00	74.80	1.80	1.80	100%	1.70	94%		0%				0	0	#DIV/0!	
HB008	SLT	74.80	75.00	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB008	CRM	75.00	76.60	1.60	1.60	100%	1.10	69%		0%				0	0	#DIV/0!	
HB008	SLT	76.60	80.60	4.00	4.00	100%	3.40	85%		0%				0	0	#DIV/0!	
HB008	SLT	80.60	82.00	1.40	1.40	100%	1.10	79%		0%				0	0	#DIV/0!	
HB008	CRM	82.00	82.50	0.50	0.50	100%	0.50	100%	0.20	40%	1			1	2	0.50	
HB008	AT	82.50	82.70	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB008	SLT	82.70	86.00	3.30	3.30	100%	3.10	94%		0%				0	0	#DIV/0!	
HB008	SLT	86.00	89.30	3.30	3.30	100%	3.00	91%	0.10	3%	1			1	0	3.30	
HB008	CRM	89.30	89.90	0.60	0.60	100%	0.50	83%	0.10	17%				0	0	#DIV/0!	
HB008	SLT	89.90	90.90	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB008	SND	90.90	91.20	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB008	SLT	91.20	105.30	14.10	14.10	100%	13.00	92%		0%				0	0	#DIV/0!	
HB008	CAM	105.30	105.90	0.60	0.60	100%	0.55	92%		0%				0	0	#DIV/0!	
HB008	SLT	105.90	108.60	2.70	2.70	100%	2.60	96%		0%				0	0	#DIV/0!	
HB008	CRM	108.60	108.12	-0.48	0.60	-125%	0.50	-104%		0%				0	0	#DIV/0!	
HB008	SLT	108.12	109.30	1.18	1.18	100%	1.10	93%		0%				0	0	#DIV/0!	
HB008	CRM	109.30	113.80	4.50	4.50	100%	4.00	89%		0%				0	0	#DIV/0!	
HB008	SND	113.80	123.11	9.31	9.30	100%	7.80	84%		0%				0	0	#DIV/0!	
HB008	CRM	123.11	124.70	1.59	1.80	113%	1.50	94%		0%				0	0	#DIV/0!	
HB008	SND	124.70	125.20	0.50	0.70	140%	0.70	140%		0%				0	0	#DIV/0!	
HB008	CRM	125.20	128.20	3.00	3.00	100%	2.60	87%		0%				0	0	#DIV/0!	
HB008	CRM	128.20	128.90	0.70	0.70	100%	0.60	86%		0%				0	0	#DIV/0!	
HB008	CRM	128.90	130.90	2.00	2.00	100%	1.60	80%		0%				0	0	#DIV/0!	
HB008	SLT	130.90	131.90	1.00	1.00	100%	0.90	90%		0%				0	0	#DIV/0!	
HB008	CRM	131.90	132.10	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB008	SLT	132.10	133.00	0.90	0.11	12%	0.10	11%		0%				0	0	#DIV/0!	
HB008	CRM	133.00	133.30	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB008	SLT	133.30	136.20	2.90	3.10	107%	2.70	93%		0%				0	0	#DIV/0!	
HB008	CRM	136.21	144.20	7.99	8.10	101%	6.00	75%	0.20	3%	1			1	0	8.10	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB008	SLT	147.60	148.00	0.40	0.60	150%	0.55	137%		0%				0	0	#DIV/0!	
HB008	CRM	148.00	151.00	3.00	3.00	100%	3.00	100%		0%				0	0	#DIV/0!	
HB008	CRM	151.00	151.30	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB008	CRM	151.80	152.70	0.90	1.10	122%	1.00	111%		0%				0	0	#DIV/0!	
HB008	CRM	152.70	153.10	0.40	0.60	150%	0.60	150%		0%				0	0	#DIV/0!	
HB008	CRM	153.10	155.00	1.90	2.10	111%	2.00	105%		0%				0	0	#DIV/0!	
HB008		155.00	**EOH**														
HB009	casing	0.00	17.20	17.20	0.00	0%	0.00	0%		0%				0	0	#DIV/0!	
HB009	CRM	17.20	20.00	2.80	2.80	100%	1.00	36%		0%				0	0	#DIV/0!	
HB009	SLT	20.00	30.90	10.90	10.90	100%	3.60	33%		0%				0	0	#DIV/0!	
HB009	CRM	30.90	34.10	3.20	2.80	87%	0.80	25%		0%				0	0	#DIV/0!	
HB009	SLT	34.10	34.70	0.60	0.60	100%	0.50	83%		0%				0	0	#DIV/0!	
HB009	CRM	34.70	35.50	0.80	0.80	100%	0.60	75%		0%				0	0	#DIV/0!	
HB009	SLT	35.50	37.00	1.50	1.50	100%	1.30	87%		0%				0	0	#DIV/0!	
HB009	CRM	37.00	41.00	4.00	4.00	100%	6.30	158%		0%				0	0	#DIV/0!	
HB009	SLT	41.00	48.00	7.00	7.00	100%	4.20	60%		0%				0	0	#DIV/0!	
HB009	CRM	48.00	48.30	0.30	0.30	100%	0.60	200%		0%				0	0	#DIV/0!	
HB009	SLT	48.30	53.80	5.50	4.60	84%	3.80	69%		0%				0	0	#DIV/0!	
HB009	SLT	53.80	58.20	4.40	4.40	100%	4.10	93%		0%				0	0	#DIV/0!	
HB009	SLT	58.20	58.90	0.70	0.70	100%	0.60	86%		0%				0	0	#DIV/0!	
HB009	SLT	58.90	59.20	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB009	CRM	59.20	59.90	0.70	0.70	100%	0.60	86%		0%				0	0	#DIV/0!	
HB009	SLT	59.90	62.50	2.60	2.60	100%	2.40	92%		0%				0	0	#DIV/0!	
HB009	CRM	62.50	62.90	0.40	0.40	100%	0.30	75%		0%				0	0	#DIV/0!	
HB009	SLT	62.90	64.50	1.60	1.60	100%	1.55	97%		0%				0	0	#DIV/0!	
HB009	CRM	64.50	65.00	0.50	0.50	100%	0.40	80%		0%				0	0	#DIV/0!	
HB009	SLT	65.00	69.20	4.20	4.20	100%	3.90	93%		0%				0	0	#DIV/0!	
HB009	CRM	69.20	71.80	2.60	2.60	100%	2.30	88%		0%				0	0	#DIV/0!	
HB009	CRM	71.80	72.40	0.60	0.60	100%	0.60	100%		0%				0	0	#DIV/0!	
HB009	SLT	72.40	72.90	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB009	CRM	72.90	75.10	2.20	2.20	100%	2.00	91%		0%				0	0	#DIV/0!	
HB009	MB	75.10	79.30	4.20	4.20	100%	4.20	100%	0.20	5%		1		1	0	4.20	
HB009	CRM	79.30	80.30	1.00	1.00	100%	0.90	90%		0%				0	0	#DIV/0!	
HB009	MB	80.30	82.50	2.20	2.20	100%	2.10	95%		0%				0	0	#DIV/0!	
HB009	CRM	82.50	85.00	2.50	2.50	100%	2.30	92%		0%				0	0	#DIV/0!	
HB009	MB	85.00	86.40	1.40	1.40	100%	1.20	86%		0%				0	0	#DIV/0!	
HB009	CRM	86.40	86.90	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB009	MB	86.90	88.60	1.70	1.70	100%	1.60	94%		0%				0	0	#DIV/0!	
HB009	CRM	88.60	90.60	2.00	2.00	100%	1.90	95%		0%				0	0	#DIV/0!	
HB009	MB	90.60	91.60	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB009	CRM	91.60	93.90	2.30	2.30	100%	2.30	100%		0%				0	0	#DIV/0!	
HB009	SLT	93.90	94.60	0.70	0.70	100%	0.60	86%		0%				0	0	#DIV/0!	
HB009	MB	94.60	97.50	2.90	2.90	100%	2.60	90%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB009	SLT	97.50	101.30	3.80	3.80	100%	3.60	95%		0%				0	0	#DIV/0!	
HB009	CRM	101.30	101.80	0.50	0.50	100%	0.45	90%		0%				0	0	#DIV/0!	
HB009	SLT	101.80	102.80	1.00	1.00	100%	0.85	85%		0%				0	0	#DIV/0!	
HB009	MB	102.80	108.60	5.80	5.60	97%	3.20	55%	0.40	7%			1	1	0	5.60	
HB009	SLT	108.60	109.00	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB009	SND	109.00	110.00	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB009	SLT	110.00	113.30	3.30	3.30	100%	3.10	94%		0%				0	0	#DIV/0!	
HB009	SND	113.30	113.80	0.50	0.40	80%	0.40	80%		0%				0	0	#DIV/0!	
HB009	SLT	113.80	114.80	1.00	1.00	100%	1.00	100%		0%				0	0	#DIV/0!	
HB009	CRM	114.80	115.00	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB009	SLT	115.00	117.20	2.20	2.10	95%	1.90	86%		0%				0	0	#DIV/0!	
HB009	CRM	117.20	117.80	0.60	0.55	92%	0.45	75%		0%				0	0	#DIV/0!	
HB009	SLT	117.80	120.10	2.30	2.30	100%	2.00	87%		0%				0	0	#DIV/0!	
HB009	SLT	120.10	127.10	7.00	6.60	94%	5.60	80%	0.80	11%			2	2	0	3.30	
HB009	SND	127.10	129.70	2.60	2.50	96%	2.00	77%		0%				0	0	#DIV/0!	
HB009	SND	129.70	130.40	0.70	0.70	100%	0.70	100%		0%				0	0	#DIV/0!	
HB009	SLT	130.40	133.90	3.50	3.50	100%	3.20	91%		0%				0	0	#DIV/0!	
HB009	SND	133.90	134.10	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB009	SLT	134.10	138.00	3.90	3.90	100%	3.70	95%		0%				0	0	#DIV/0!	
HB009	SND	138.00	138.20	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB009	SLT	138.20	141.40	3.20	3.20	100%	3.00	94%		0%				0	0	#DIV/0!	
HB009	SND	141.40	141.90	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB009	SLT	141.90	142.70	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB009	CAM	142.70	142.90	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB009	SLT	142.90	145.30	2.40	2.40	100%	2.00	83%		0%				0	0	#DIV/0!	
HB009	CAM	145.30	145.90	0.60	0.60	100%	0.60	100%	0.60	100%			1	1	2	0.60	
HB009	SLT	145.90	146.11	0.21	1.20	571%	1.20	571%		0%				0	0	#DIV/0!	
HB009	CAM	146.11	147.90	1.79	1.20	67%	1.20	67%		0%				0	0	#DIV/0!	
HB009	CAM	147.90	149.50	1.60	1.60	100%	1.50	94%		0%				0	0	#DIV/0!	
HB009	CRM	149.50	153.90	4.40	4.40	100%	4.20	95%		0%				0	0	#DIV/0!	
HB009	CRM	153.90	155.90	2.00	2.00	100%	1.90	95%		0%				0	0	#DIV/0!	
HB009	CRM	155.90	156.70	0.80	0.80	100%	0.80	100%		0%				0	0	#DIV/0!	
HB009	CRM	156.70	164.60	7.90	7.90	100%	7.90	100%		0%				0	0	#DIV/0!	
HB009	SND	164.60	167.60	3.00	3.00	100%	2.90	97%		0%				0	0	#DIV/0!	
HB009	CRM	167.60	168.10	0.50	0.50	100%	0.50	100%		0%				0	0	#DIV/0!	
HB009	SND	168.10	171.11	3.01	3.10	103%	2.70	90%		0%				0	0	#DIV/0!	
HB009	CRM	171.11	172.40	1.29	1.50	116%	1.20	93%		0%				0	0	#DIV/0!	
HB009	CRM	172.40	180.00	7.60	7.60	100%	7.20	95%		0%				0	0	#DIV/0!	
HB009		180.00	EOH														
HB006		0.00	14.80	14.80	0.00	0%	0.00	0%		0%				0	0	#DIV/0!	
HB006	SLT	14.80	17.10	2.30	2.30	100%	0.60	26%		0%				0	0	#DIV/0!	
HB006	SLT	17.10	18.10	1.00	1.00	100%	0.30	30%		0%				0	0	#DIV/0!	
HB006	SND	18.10	18.30	0.20	0.20	100%	0.20	100%		0%				0	0	#DIV/0!	
HB006	SLT	18.30	22.70	4.40	3.30	75%	2.60	59%		0%				0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB006	CRM	22.70	23.90	1.20	1.20	100%	0.80	67%		0%				0	0	#DIV/0!	
HB006	SLT	23.90	25.90	2.00	2.00	100%	1.65	83%		0%				0	0	#DIV/0!	
HB006	CRM	25.90	27.00	1.10	1.10	100%	0.60	55%		0%				0	0	#DIV/0!	
HB006	SLT	27.00	30.00	3.00	3.00	100%	2.20	73%		0%				0	0	#DIV/0!	
HB006	SND	30.00	31.00	1.00	1.00	100%	0.70	70%	0.60	60%			1	1	1	1.00	
HB006	SLT	31.00	34.80	3.80	3.40	89%	3.00	79%		0%				0	0	#DIV/0!	
HB006	SLT	34.80	35.40	0.60	0.60	100%	0.50	83%		0%				0	0	#DIV/0!	
HB006	CRM	35.40	37.20	1.80	1.80	100%	1.00	56%		0%				0	0	#DIV/0!	
HB006	SLT	37.20	47.60	10.40	9.80	94%	4.20	40%		0%				0	0	#DIV/0!	
HB006	SLT	47.60	48.00	0.40	0.40	100%	0.30	75%		0%				0	0	#DIV/0!	
HB006	SLT	48.00	52.90	4.90	4.40	90%	2.40	49%		0%				0	0	#DIV/0!	
HB006	CRM	52.90	55.00	2.10	2.10	100%	1.95	93%		0%				0	0	#DIV/0!	
HB006	SLT	55.00	55.50	0.50	0.50	100%	0.45	90%		0%				0	0	#DIV/0!	
HB006	SLT	55.50	60.40	4.90	4.90	100%	3.40	69%		0%				0	0	#DIV/0!	
HB006	CRM	60.40	61.90	1.50	1.50	100%	1.30	87%		0%				0	0	#DIV/0!	
HB006	SLT	61.90	62.90	1.00	1.00	100%	0.60	60%		0%				0	0	#DIV/0!	
HB006	CRM	62.90	63.20	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB006	SLT	63.20	63.60	0.40	0.40	100%	0.25	63%		0%				0	0	#DIV/0!	
HB006	CRM	63.60	65.00	1.40	1.40	100%	1.30	93%		0%				0	0	#DIV/0!	
HB006	SLT	65.00	67.00	2.00	1.70	85%	1.20	60%		0%				0	0	#DIV/0!	
HB006	SLT	67.00	67.30	0.30	0.30	100%	0.30	100%		0%				0	0	#DIV/0!	
HB006	CRM	67.30	67.90	0.60	0.60	100%	0.60	100%		0%				0	0	#DIV/0!	
HB006	SLT	67.90	68.40	0.50	0.50	100%	0.40	80%		0%				0	0	#DIV/0!	
HB006	CRM	68.40	68.80	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB006	SLT	68.80	69.60	0.80	0.80	100%	0.70	88%		0%				0	0	#DIV/0!	
HB006	SND	69.60	70.00	0.40	0.40	100%	0.40	100%		0%				0	0	#DIV/0!	
HB006	SLT	70.00	74.60	4.60	4.60	100%	3.00	65%		0%				0	0	#DIV/0!	
HB006	CRM	74.60	76.50	1.90	1.90	100%	1.40	74%		0%				0	0	#DIV/0!	
HB006	SLT	76.50	77.20	0.70	0.70	100%	0.50	71%		0%				0	0	#DIV/0!	
HB006	SND	77.20	77.70	0.50	0.50	100%	0.50	100%						0	0	#DIV/0!	
HB006	SLT	77.70	78.50	0.80	0.80	100%	0.65	81%						0	0	#DIV/0!	
HB006	CRM	78.50	78.90	0.40	0.40	100%	0.40	100%						0	0	#DIV/0!	
HB006	SLT	78.90	82.90	4.00	4.00	100%	3.10	78%						0	0	#DIV/0!	
HB006	SND	82.90	83.00	0.10	0.10	100%	0.10	100%						0	0	#DIV/0!	
HB006	CRM	83.00	84.90	1.90	1.90	100%	1.60	84%						0	0	#DIV/0!	
HB006	SLT	84.90	87.90	3.00	3.00	100%	1.40	47%						0	0	#DIV/0!	
HB006	SLT	87.90	90.90	3.00	3.00	100%	1.30	43%						0	0	#DIV/0!	
HB006	CRM	90.90	92.30	1.40	1.40	100%	1.00	71%	0.30	21	1			1	1	1.40	
HB006	SLT	92.30	93.20	0.90	0.90	100%	0.70	78%						0	0	#DIV/0!	
HB006	SND	93.20	93.50	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB006	SLT	93.50	94.60	1.10	1.10	100%	0.90	82%						0	0	#DIV/0!	
HB006	SND	94.60	94.90	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB006	SLT	94.90	96.00	1.10	1.10	100%	0.80	73%						0	0	#DIV/0!	
HB006	SND	96.00	96.30	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB006	SLT	96.30	98.10	1.80	1.80	100%	1.20	67%						0	0	#DIV/0!	
HB006	CRM	98.10	99.70	1.60	1.60	100%	1.30	81%						0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB006	SLT	99.70	101.10	1.40	1.40	100%	1.00	71%						0	0	#DIV/0!	
HB006	CRM	101.10	101.40	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB006	SLT	101.40	103.20	1.80	1.80	100%	1.10	61%						0	0	#DIV/0!	
HB006	CAM	103.20	107.00	3.80	3.80	100%	3.10	82%						0	0	#DIV/0!	
HB006	SLT	107.00	107.90	0.90	0.90	100%	0.80	89%						0	0	#DIV/0!	
HB006	CRM	107.90	111.10	3.20	3.20	100%	3.10	97%						0	0	#DIV/0!	
HB006	AT	111.10	111.70	0.60	0.60	100%	0.60	100%						0	0	#DIV/0!	
HB006	CRM	111.70	112.00	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB006	SND	112.00	118.70	6.70	6.70	100%	6.50	97%						0	0	#DIV/0!	
HB006	CRM	118.70	119.90	1.20	1.20	100%	1.10	92%						0	0	#DIV/0!	
HB006	SLT	119.90	120.60	0.70	0.70	100%	0.60	86%						0	0	#DIV/0!	
HB006	CRM	120.60	121.40	0.80	0.80	100%	0.75	94%						0	0	#DIV/0!	
HB006	SLT	121.40	123.90	2.50	2.50	100%	1.70	68%	0.50	20			1	1	0	2.50	
HB006	SND	123.90	124.70	0.80	0.80	100%	0.80	100%	0.80	100			1	1	1	0.80	
HB006	CAM	124.70	126.60	1.90	1.90	100%	1.80	95%						0	0	#DIV/0!	
HB006	CRM	126.60	128.80	2.20	2.20	100%	2.10	95%	1.20	55			1	1	0	2.20	
HB006	CAM	128.80	131.60	2.80	2.80	100%	2.40	86%						0	0	#DIV/0!	
HB006	SND	131.60	138.90	7.30	7.30	100%	6.30	86%						0	0	#DIV/0!	
HB006	CRM	138.90	142.10	3.20	3.20	100%	3.00	94%						0	0	#DIV/0!	
HB006	SLT	142.10	145.90	3.80	3.80	100%	3.00	79%						0	0	#DIV/0!	
HB006	CRM	145.90	146.90	1.00	1.00	100%	1.00	100%						0	0	#DIV/0!	
HB006	SLT	146.90	147.90	1.00	1.00	100%	1.00	100%						0	0	#DIV/0!	
HB006	CRM	147.90	148.90	1.00	1.00	100%	1.00	100%						0	0	#DIV/0!	
HB006	SLT	148.90	149.80	0.90	1.00	111%	1.00	111%						0	0	#DIV/0!	
HB006	CRM	149.80	151.50	1.70	1.70	100%	1.70	100%						0	0	#DIV/0!	
HB006	SLT	151.50	153.20	1.70	1.70	100%	1.40	82%						0	0	#DIV/0!	
HB006	CRM	153.20	154.10	0.90	0.90	100%	0.90	100%						0	0	#DIV/0!	
HB006	SLT	154.10	155.00	0.90	0.90	100%	0.80	89%						0	0	#DIV/0!	
HB006		155.00	**EOH**											0	#DIV/0!	#DIV/0!	
														0			
														0			
HB002	SLT	0.00	6.30	6.30	0.00	0								0	0	#DIV/0!	
HB002	CRM	6.30	11.30	5.00	5.00	100%	2.00	40%						0	0	#DIV/0!	
HB002	SLT	11.30	18.30	7.00	7.00	100%	3.00	43%						0	0	#DIV/0!	
HB002	SLT	18.30	18.90	0.60	0.60	100%	0.40	67%						0	0	#DIV/0!	
HB002	SLT	18.90	20.20	1.30	1.30	100%	0.80	62%						0	0	#DIV/0!	
HB002	SLT	20.20	24.60	4.40	4.40	100%	2.00	45%						0	0	#DIV/0!	
HB002	SLT	24.60	26.40	1.80	1.50	83%	1.20	67%						0	0	#DIV/0!	
HB002	SLT	26.40	26.90	0.50	0.50	100%	0.40	80%						0	0	#DIV/0!	
HB002	SLT	26.90	28.10	1.20	1.20	100%	1.00	83%						0	0	#DIV/0!	
HB002	SLT	28.10	36.60	8.50	8.50	100%	6.00	71%						0	0	#DIV/0!	
HB002	SLT	36.60	39.20	2.60	2.60	100%	1.80	69%						0	0	#DIV/0!	
HB002	SLT	39.20	42.90	3.70	2.90	78%	3.00	81%						0	0	#DIV/0!	
HB002	CRM	42.90	44.30	1.40	1.40	100%	1.20	86%						0	0	#DIV/0!	
HB002	SLT	44.30	48.00	3.70	3.70	100%	2.60	70%						0	0	#DIV/0!	
HB002	CRM	48.00	48.90	0.90	0.90	100%	0.70	78%						0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB002	SLT	48.90	52.10	3.20	3.20	100%	2.40	75%						0	0	#DIV/0!	
HB002	CRM	52.10	53.40	1.30	1.30	100%	0.90	69%						0	0	#DIV/0!	
HB002	SLT	53.40	57.11	3.71	3.71	100%		0%						0	0	#DIV/0!	
HB002	CRM	57.11	58.10	0.99	0.99	100%		0%						0	0	#DIV/0!	
HB002	SLT	58.10	60.30	2.20	2.20	100%		0%						0	0	#DIV/0!	
HB002	CRM	60.30	60.70	0.40	0.40	100%		0%						0	0	#DIV/0!	
HB002	SLT	60.70	68.10	7.40	7.40	100%		0%						0	0	#DIV/0!	
HB002	SLT	68.10	73.00	4.90	3.90	80%		0%						0	0	#DIV/0!	
HB002	CRM	73.00	74.90	1.90	1.90	100%		0%						0	0	#DIV/0!	
HB002	SLT	74.90	81.20	6.30	6.30	100%		0%						0	0	#DIV/0!	
HB002	CRM	81.20	81.50	0.30	0.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	81.50	97.30	15.80	15.80	100%	9.00	57%	0.60	4			1	1	0	15.80	
HB002	SLT	97.30	104.30	7.00	7.00	100%	5.10	73%						0	0	#DIV/0!	
HB002		104.30	105.00	0.70	0.70	100%	0.50	71%						0	0	#DIV/0!	
HB002	SLT	105.00	108.30	3.30	3.30	100%	1.60	48%						0	0	#DIV/0!	
HB002	SLT	108.30	110.60	2.30	2.30	100%	2.10	91%						0	0	#DIV/0!	
HB002	SLT	110.60	120.60	10.00	9.90	99%	4.80	48%						0	0	#DIV/0!	
HB002	SLT	120.60	121.80	1.20	1.20	100%	0.80	67%						0	0	#DIV/0!	
HB002	SLT	121.80	124.00	2.20	2.20	100%	1.80	82%						0	0	#DIV/0!	
HB002	SLT	124.00	143.70	19.70	19.70	100%		0%						0	0	#DIV/0!	
HB002	SLT	143.70	155.80	12.10	12.10	100%		0%						0	0	#DIV/0!	
HB002	SLT	155.80	158.10	2.30	2.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	158.10	158.70	0.60	0.60	100%		0%						0	0	#DIV/0!	
HB002	SLT	158.70	162.50	3.80	3.80	100%		0%						0	0	#DIV/0!	
HB002	AT	162.50	163.00	0.50	0.50	100%		0%						0	0	#DIV/0!	
HB002	CAM	163.00	164.30	1.30	1.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	164.30	165.10	0.80	0.80	100%		0%						0	0	#DIV/0!	
HB002		165.10	166.50	1.40	1.40	100%		0%						0	0	#DIV/0!	
HB002	SLT	166.50	168.00	1.50	1.50	100%		0%						0	0	#DIV/0!	
HB002	CRM	168.00	168.80	0.80	0.80	100%		0%						0	0	#DIV/0!	
HB002	SLT	168.80	171.30	2.50	2.50	100%		0%						0	0	#DIV/0!	
HB002		171.30	171.60	0.30	0.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	171.60	172.60	1.00	1.00	100%		0%						0	0	#DIV/0!	
HB002	AT	172.60	173.00	0.40	0.40	100%		0%						0	0	#DIV/0!	
HB002	SLT	173.00	179.60	6.60	6.60	100%		0%						0	0	#DIV/0!	
HB002		179.60	179.80	0.20	0.20	100%		0%						0	0	#DIV/0!	
HB002	SLT	179.80	180.00	0.20	0.20	100%		0%						0	0	#DIV/0!	
HB002		180.00	180.20	0.20	0.20	100%		0%						0	0	#DIV/0!	
HB002	SLT	180.20	181.40	1.20	1.20	100%		0%						0	0	#DIV/0!	
HB002	CRM	181.40	181.70	0.30	0.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	181.70	181.90	0.20	0.20	100%		0%						0	0	#DIV/0!	
HB002	CRM	181.90	182.10	0.20	0.20	100%		0%						0	0	#DIV/0!	
HB002	SLT	182.10	186.00	3.90	3.90	100%		0%						0	0	#DIV/0!	
HB002	CRM	186.00	186.30	0.30	0.30	100%		0%						0	0	#DIV/0!	
HB002	SLT	186.30	189.40	3.10	3.10	100%		0%						0	0	#DIV/0!	
HB002	CRM	189.40	190.00	0.60	0.60	100%		0%						0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB002	SLT	190.00	191.40	1.40	1.40	100%		0%						0	0	#DIV/0!	
HB002	CRM	191.40	191.80	0.40	0.40	100%		0%						0	0	#DIV/0!	
HB002	SLT	191.80	193.00	1.20	1.20	100%		0%						0	0	#DIV/0!	
HB002	CAM	193.00	195.00	2.00	2.00	100%		0%						0	0	#DIV/0!	
HB002	SLT	195.00	196.50	1.50	1.50	100%		0%						0	0	#DIV/0!	
HB002	CRM	196.50	197.10	0.60	0.60	100%		0%						0	0	#DIV/0!	
HB002	CAM	197.10	197.70	0.60	0.60	100%		0%						0	0	#DIV/0!	
HB002	CRM	197.70	212.90	15.20	15.20	100%		0%						0	0	#DIV/0!	
HB002	CRM	212.90	215.00	2.10	2.10	100%		0%						0	0	#DIV/0!	
HB002		215.00	**EOH**											0	#DIV/0!	#DIV/0!	
														0			
														0			
HB003		0.00	5.00	5.00	0.00	0%		0%						0	0	#DIV/0!	
HB003	SLT	5.00	6.10	1.10	1.10	100%	0.45	41%						0	0	#DIV/0!	
HB003	SLT	6.10	9.90	3.80	3.80	100%	2.00	53%						0	0	#DIV/0!	
HB003	SLT	9.90	15.80	5.90	5.90	100%	3.10	53%						0	0	#DIV/0!	
HB003	SLT	15.80	16.90	1.10	1.10	100%	0.60	55%						0	0	#DIV/0!	
HB003	SLT	16.90	23.20	6.30	6.30	100%	2.70	43%						0	0	#DIV/0!	
HB003	SLT	23.20	23.80	0.60	0.60	100%	0.40	67%						0	0	#DIV/0!	
HB003	CRM	23.80	24.10	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB003	SLT	24.10	27.90	3.80	3.80	100%	2.80	74%						0	0	#DIV/0!	
HB003	CRM	27.90	28.60	0.70	0.70	100%	0.50	71%						0	0	#DIV/0!	
HB003	SLT	28.60	30.10	1.50	1.50	100%	1.00	67%						0	0	#DIV/0!	
HB003	CRM	30.10	35.00	4.90	4.90	100%	1.00	20%						0	0	#DIV/0!	
HB003	SLT	35.00	37.30	2.30	2.00	87%	1.00	43%						0	0	#DIV/0!	
HB003	SLT	37.30	43.50	6.20	6.40	103%	6.20	100%						0	0	#DIV/0!	
HB003	SLT	43.50	55.00	11.50	11.10	97%	10.20	89%						0	0	#DIV/0!	
HB003	SLT	55.00	56.60	1.60	1.60	100%	1.30	81%						0	0	#DIV/0!	
HB003	SLT	56.60	60.90	4.30	4.30	100%	4.10	95%						0	0	#DIV/0!	
HB003	SLT	60.90	63.30	2.40	2.40	100%	2.30	96%						0	0	#DIV/0!	
HB003	SLT	63.30	73.00	9.70	9.70	100%	9.20	95%	0.40	4			1	1	0	9.70	
HB003	SLT	73.00	79.50	6.50	6.50	100%	6.20	95%	1.30	20			1	1	0	6.50	
HB003	CRM	79.50	85.00	5.50	5.50	100%	5.20	95%	0.40	7		2		2	0	2.75	
HB003	SLT	85.00	85.30	0.30	0.30	100%	0.25	83%						0	0	#DIV/0!	
HB003	CRM	85.30	88.40	3.10	3.10	100%	3.00	97%						0	0	#DIV/0!	
HB003	SLT	88.40	89.60	1.20	1.20	100%	1.00	83%						0	0	#DIV/0!	
HB003	AT	89.60	89.90	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB003	SLT	89.90	91.00	1.10	1.10	100%	1.00	91%						0	0	#DIV/0!	
HB003	CAM	91.00	91.80	0.80	0.80	100%	0.80	100%						0	0	#DIV/0!	
HB003	SLT	91.80	92.20	0.40	0.40	100%	0.40	100%						0	0	#DIV/0!	
HB003	CAM	92.20	93.20	1.00	1.00	100%	1.00	100%						0	0	#DIV/0!	
HB003	SLT	93.20	94.40	1.20	1.20	100%	1.10	92%						0	0	#DIV/0!	
HB003	CRM	94.40	98.10	3.70	3.70	100%	3.60	97%						0	0	#DIV/0!	
HB003	SND	98.10	98.70	0.60	0.60	100%	0.60	100%						0	0	#DIV/0!	
HB003	CRM	98.70	100.10	1.40	1.40	100%	1.40	100%						0	0	#DIV/0!	
HB003	CRM	100.10	101.80	1.70	1.70	100%	1.60	94%						0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB003	CRM	101.80	108.00	6.20	6.20	100%	5.80	94%						0	0	#DIV/0!	
HB003	CRM	108.00	112.40	4.40	4.40	100%	4.00	91%	0.90	20		1		1	0	4.40	
HB003	CRM	112.40	115.20	2.80	2.80	100%	1.80	64%						0	0	#DIV/0!	
HB003	SND	115.20	116.20	1.00	1.00	100%	1.00	100%						0	0	#DIV/0!	
HB003	CRM	116.20	**EOH**											0	#DIV/0!	#DIV/0!	
														0			
														0			
HB004		0.00	45.00	45.00	0.00	0%		0%						0	0	#DIV/0!	
HB004	CRM	45.00	47.00	2.00	2.00	100%	1.30	65%						0	0	#DIV/0!	
HB004	SLT	47.00	53.00	6.00	6.00	100%	3.70	62%						0	0	#DIV/0!	
HB004	SLT	53.00	58.60	5.60	5.60	100%	3.30	59%						0	0	#DIV/0!	
HB004	SLT	58.60	65.60	7.00	7.00	100%	4.30	61%						0	0	#DIV/0!	
HB004	SLT	65.60	69.10	3.50	3.50	100%	2.80	80%						0	0	#DIV/0!	
HB004	CRM	69.10	70.10	1.00	1.00	100%	0.70	70%						0	0	#DIV/0!	
HB004	SLT	70.10	73.70	3.60	3.60	100%	3.00	83%						0	0	#DIV/0!	
HB004	SLT	73.70	75.00	1.30	1.30	100%	0.90	69%						0	0	#DIV/0!	
HB004	SLT	75.00	81.90	6.90	6.90	100%	5.80	84%						0	0	#DIV/0!	
HB004	SLT	81.90	84.90	3.00	3.00	100%	2.30	77%						0	0	#DIV/0!	
HB004	SLT	84.90	85.90	1.00	1.00	100%	0.80	80%						0	0	#DIV/0!	
HB004	SLT	85.90	90.20	4.30	4.30	100%	4.00	93%						0	0	#DIV/0!	
HB004	SLT	90.20	93.50	3.30	3.30	100%	2.90	88%						0	0	#DIV/0!	
HB004	SLT	93.50	94.10	0.60	0.60	100%	0.50	83%						0	0	#DIV/0!	
HB004	SLT	94.10	98.60	4.50	4.50	100%	2.00	44%						0	0	#DIV/0!	
HB004	SLT	98.60	104.00	5.40	5.40	100%	3.60	67%						0	0	#DIV/0!	
HB004	SLT	104.00	104.30	0.30	0.30	100%	0.30	100%						0	0	#DIV/0!	
HB004	SLT	104.30	109.80	5.50	5.50	100%	5.20	95%						0	0	#DIV/0!	
HB004	SLT	109.80	111.40	1.60	1.60	100%	1.30	81%						0	0	#DIV/0!	
HB004	SLT	111.40	113.10	1.70	1.70	100%	1.60	94%						0	0	#DIV/0!	
HB004	SLT	113.10	117.80	4.70	4.70	100%	3.50	74%						0	0	#DIV/0!	
HB004	SLT	117.80	119.10	1.30	1.30	100%	1.00	77%						0	0	#DIV/0!	
HB004	SLT	119.10	120.40	1.30	1.30	100%	1.10	85%						0	0	#DIV/0!	
HB004	SLT	120.40	122.80	2.40	2.40	100%	2.00	83%						0	0	#DIV/0!	
HB004	CRM	122.80	123.90	1.10	1.10	100%	1.10	100%						0	0	#DIV/0!	
HB004	SLT	123.90	132.90	9.00	9.00	100%	8.00	89%						0	0	#DIV/0!	
HB004	SLT	132.90	133.40	0.50	0.50	100%	0.45	90%						0	0	#DIV/0!	
HB004	SLT	133.40	134.50	1.10	1.10	100%	0.85	77%	0.60	55			1	1	1	1.10	
HB004	SLT	134.50	136.00	1.50	1.50	100%	1.10	73%	#	#VALUE!				0	0	#DIV/0!	
HB004	SLT	136.00	141.10	5.10	5.10	100%	4.40	86%						0	0	#DIV/0!	
HB004	SLT	141.10	144.00	2.90	2.90	100%	2.80	97%						0	0	#DIV/0!	
HB004	AT	144.00	145.60	1.60	1.60	100%	1.60	100%						0	0	#DIV/0!	
HB004	SLT	145.60	146.60	1.00	1.00	100%	0.70	70%						0	0	#DIV/0!	
HB004	SLT	146.60	147.90	1.30	1.30	100%	1.00	77%						0	0	#DIV/0!	
HB004	CRM	147.90	155.00	7.10	7.10	100	5.60	79%						0	0	#DIV/0!	
HB004	SLT	155.00	158.10	3.10	3.10	100	2.80	90%						0	0	#DIV/0!	
HB004	SND	158.10	158.30	0.20	0.20	100	0.20	100%						0	0	#DIV/0!	
HB004	SLT	158.30	159.10	0.80	0.80	100	0.60	75%						0	0	#DIV/0!	

Borehole ID	Lithology	From (ft)	To (ft)	Length (ft)	TCR (in)	TCR %	SCR (in)	SCR %	RQD (in)	RQD %	Open Fractures			Total	(FF/in)	Spacing (in)	Number Joint Sets
											J1 0-30	J2 30-60	J3 60-90				
HB004	SND	159.10	159.30	0.20	0.20	100	0.20	100%						0	0	#DIV/0!	
HB004	SLT	159.30	160.90	1.60	1.60	100	1.20	75%						0	0	#DIV/0!	
HB004	SND	160.90	161.00	0.10	0.10	100	0.10	100%						0	0	#DIV/0!	
HB004	SLT	161.00	162.00	1.00	1.00	100	0.85	85%						0	0	#DIV/0!	
HB004	SND	162.00	162.30	0.30	0.30	100	0.30	100%						0	0	#DIV/0!	
HB004	SLT	162.30	165.00	2.70	2.10	78	1.60	59%						0	0	#DIV/0!	
HB004	SND	165.00	166.20	1.20	1.20	100	1.10	92%						0	0	#DIV/0!	
HB004	SLT	166.20	169.30	3.10	3.10	100	2.80	90%	0.90	29			2	2	1	1.55	
HB004	CRM	169.30	169.90	0.60	0.60	100	0.55	92%						0	0	#DIV/0!	
HB004	SLT	169.90	172.00	2.10	2.10	100	2.00	95%						0	0	#DIV/0!	
HB004	CRM	172.00	175.50	3.50	3.50	100	3.50	100%						0	0	#DIV/0!	
HB004	SLT	175.50	177.30	1.80	1.80	100	1.60	89%						0	0	#DIV/0!	
HB004	CRM	177.30	181.00	3.70	3.70	100	3.70	100%						0	0	#DIV/0!	
HB004	SND	181.00	195.00	14.00	14.00	100	13.60	97%						0	0	#DIV/0!	
HB004		195.00	**EOH**														

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-001	HB-001-1	25	27	6.52	17.34	4SEN
HB-001	HB-001-2	27	29	7.05	18.76	4SEN
HB-001	HB-001-3	29	31	0.63	1.69	AGR
HB-001	HB-001-4	31	33	0.21	0.57	AGR
HB-001	HB-001-5	33	35	1.25	3.25	AGR
HB-001	HB-001-6	35	37	1.25	3.26	AGR
HB-001	HB-001-7	37	39	1.75	4.52	AGR
HB-001	HB-001-8	39	41	2.8	7.43	AGR
HB-001	HB-001-9	41	43	7.03	18.85	MAHZA
HB-001	HB-001-10	43	45	5.33	14.18	MAHZA
HB-001	HB-001-11	45	47	7.78	20.78	MAHZA
HB-001	HB-001-12	47	49	8.54	22.7	MAHZA
HB-001	HB-001-13	49	51	12.55	33.84	MAHZA
HB-001	HB-001-14	51	53	5.08	13.55	MAHZA
HB-001	HB-001-15	53	55	5.22	13.89	MAHZA
HB-001	HB-001-16	55	57	3.9	10.32	MAHZA
HB-001	HB-001-17	57	59	2.95	7.85	MAHZA
HB-001	HB-001-18	59	61	6.41	17.06	MAHZA
HB-001	HB-001-19	61	63	8.03	21.6	MAHZA
HB-001	HB-001-20	63	65	14.67	39.31	MAHZA
HB-001	HB-001-21	65	66	18.47	49.55	MAHZA
HB-001	HB-001-22	66	67	28.81	76.77	MAHBED
HB-001	HB-001-23	67	68	24.53	65.9	MAHBED
HB-001	HB-001-24	68	69	15.59	41.77	MAHZB
HB-001	HB-001-25	69	70	14.8	39.93	MAHZB
HB-001	HB-001-26	70	71	16.99	45.45	MAHZB
HB-001	HB-001-27	71	72	9.04	23.9	MAHZB
HB-001	HB-001-28	72	73	6.48	17.2	MAHZB
HB-001	HB-001-29	73	74	16.07	43.11	MAHZB
HB-001	HB-001-30	74	75	16.15	43.27	MAHZB
HB-001	HB-001-31	75	76	9.8	26.3	MAHZB
HB-001	HB-001-32	76	77	14.01	37.84	MAHZB
HB-001	HB-001-33	77	78	7.24	19.57	MAHZB
HB-001	HB-001-34	78	79	7.95	21.21	MAHZB
HB-001	HB-001-35	79	80	6.36	16.95	MAHZB
HB-001	HB-001-36	80	81	7.26	19.37	MAHZB
HB-001	HB-001-37	81	82	10.28	27.13	MAHZB
HB-001	HB-001-38	82	83	3.06	8.13	MAHZB
HB-001	HB-001-39	83	84	3.58	9.45	MAHZB
HB-001	HB-001-40	84	85	3.28	8.73	MAHZB
HB-001	HB-001-41	85	86	7.02	18.76	MAHZB
HB-001	HB-001-42	86	87	11.33	30.34	MAHZB
HB-001	HB-001-43	87	88	9.47	25.71	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-001	HB-001-44	88	89	8.7	23.27	MAHZB
HB-001	HB-001-45	89	90	8.95	24.1	MAHZB
HB-001	HB-001-46	90	91	4.18	11.07	MAHZB
HB-001	HB-001-47	91	92	3.08	8.13	MAHZB
HB-001	HB-001-48	92	93	4.44	11.76	MAHZB
HB-001	HB-001-49	93	94	5.99	15.75	MAHZB
HB-001	HB-001-50	94	96	1.33	3.5	MAHZB
HB-001	HB-001-51	96	98	3.06	8.12	MAHZB
HB-001	HB-001-52	98	100	6.34	16.82	MAHZB
HB-001	HB-001-53	100	102	3.21	8.52	MAHZB
HB-001	HB-001-54	102	104	2.59	6.84	MAHZB
HB-001	HB-001-55	104	106	3.34	8.78	MAHZB
HB-001	HB-001-56	106	108	1.04	2.78	BGR
HB-001	HB-001-57	108	110	0.89	2.38	BGR
HB-001	HB-001-58	110	112	0.31	0.82	BGR
HB-001	HB-001-59	112	114	1.87	4.98	BGR
HB-001	HB-001-60	114	116	3.34	8.92	BGR
HB-001	HB-001-61	116	118	3.74	10.09	BGR
HB-001	HB-001-62	118	120	0.53	1.44	BGR
HB-001	HB-001-63	120	122	1.62	4.31	BGR
HB-001	HB-001-64	122	124	2.24	6.01	BGR
HB-002	HB-002-1	68	69	6.96	18.56	B3
HB-002	HB-002-2	69	70	6.7	17.95	B3
HB-002	HB-002-3	70	71	6.58	17.61	B3
HB-002	HB-002-4	71	72	2.81	7.42	
HB-002	HB-002-5	72	73	2.64	6.95	
HB-002	HB-002-6	73	74	3.67	9.71	
HB-002	HB-002-7	74	75	2.64	6.95	
HB-002	HB-002-8	75	76	2.2	5.8	
HB-002	HB-002-9	76	77	1.28	3.38	
HB-002	HB-002-10	77	78	1.98	5.24	
HB-002	HB-002-11	78	79	5.17	13.78	
HB-002	HB-002-12	79	80	3.18	8.42	
HB-002	HB-002-13	80	81	3.05	8.05	
HB-002	HB-002-14	81	82	2.79	7.39	
HB-002	HB-002-15	82	83	3.01	7.97	
HB-002	HB-002-16	83	84	4.09	10.82	
HB-002	HB-002-17	84	85	5.74	15.24	4SEN
HB-002	HB-002-18	85	86	8.61	22.87	4SEN
HB-002	HB-002-19	86	87	5.89	15.7	4SEN
HB-002	HB-002-20	87	88	12.37	32.98	4SEN
HB-002	HB-002-21	88	89	3.42	9	AGR
HB-002	HB-002-22	89	90	1.57	4.11	AGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-002	HB-002-23	90	91	1.51	3.94	AGR
HB-002	HB-002-24	91	92	0.68	1.82	AGR
HB-002	HB-002-25	92	93	2.42	6.35	AGR
HB-002	HB-002-26	93	94	1.66	4.38	AGR
HB-002	HB-002-27	94	95	1.05	2.79	AGR
HB-002	HB-002-28	95	96	0.66	1.76	AGR
HB-002	HB-002-29	96	97	1.04	2.76	AGR
HB-002	HB-002-30	97	98	0.66	1.75	AGR
HB-002	HB-002-31	98	99	3.81	10.18	MAHZA
HB-002	HB-002-32	99	100	4.98	13.32	MAHZA
HB-002	HB-002-33	100	102	8.93	23.92	MAHZA
HB-002	HB-002-34	102	104	4.6	12.3	MAHZA
HB-002	HB-002-35	104	106	7.26	19.29	MAHZA
HB-002	HB-002-36	106	108	12.17	32.78	MAHZA
HB-002	HB-002-37	108	110	11.03	29.71	MAHZA
HB-002	HB-002-38	110	112	4.59	12.18	MAHZA
HB-002	HB-002-39	112	114	6.33	16.83	MAHZA
HB-002	HB-002-40	114	116	3.53	9.38	MAHZA
HB-002	HB-002-41	116	118	3.32	8.75	MAHZA
HB-002	HB-002-42	118	120	4.32	11.54	MAHZA
HB-002	HB-002-43	120	122	8.07	21.48	MAHZA
HB-002	HB-002-44	122	124	7.17	19.26	MAHZA
HB-002	HB-002-45	124	126	13.28	35.38	MAHZA
HB-002	HB-002-46	126	128	14.66	39.27	MAHZA
HB-002	HB-002-47	128	130	28.45	75.78	MAHBED
HB-002	HB-002-48	130	132	18.89	50.48	MAHBED
HB-002	HB-002-49	132	134	9.4	24.96	MAHZB
HB-002	HB-002-50	134	136	10.91	28.95	MAHZB
HB-002	HB-002-51	136	138	15.88	42.65	MAHZB
HB-002	HB-002-52	138	140	9.56	25.9	MAHZB
HB-002	HB-002-53	140	142	10.39	27.75	MAHZB
HB-002	HB-002-54	142	144	7.92	20.99	MAHZB
HB-002	HB-002-55	144	146	5.81	15.5	MAHZB
HB-002	HB-002-56	146	148	12.72	34.21	MAHZB
HB-002	HB-002-57	148	150	12.77	34.42	MAHZB
HB-002	HB-002-58	150	152	5.48	14.61	MAHZB
HB-002	HB-002-59	152	154	5.33	14.08	MAHZB
HB-002	HB-002-60	154	156	5.9	15.55	MAHZB
HB-002	HB-002-61	156	158	1.92	5.07	MAHZB
HB-002	HB-002-62	158	160	4.78	12.58	MAHZB
HB-002	HB-002-63	160	162	5.92	15.68	MAHZB
HB-002	HB-002-64	162	164	3.89	10.32	MAHZB
HB-002	HB-002-65	164	166	3.73	9.75	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-002	HB-002-66	166	168	2.1	5.57	BGR
HB-002	HB-002-67	168	170	1.71	4.47	BGR
HB-002	HB-002-68	170	172	0.81	2.16	BGR
HB-002	HB-002-69	172	174	0.68	1.8	BGR
HB-002	HB-002-70	174	176	0.84	2.22	BGR
HB-002	HB-002-71	176	178	2.98	7.88	BGR
HB-002	HB-002-72	178	180	4.15	11.11	BGR
HB-002	HB-002-73	180	182	3.41	9.07	BGR
HB-003	HB-003-1	36	37	3.02	8.03	MAHZA
HB-003	HB-003-2	37	38	2.71	7.18	MAHZA
HB-003	HB-003-3	38	39	4.01	10.65	MAHZA
HB-003	HB-003-4	39	40	9.07	24.12	MAHZA
HB-003	HB-003-5	40	41	9.91	26.49	MAHZA
HB-003	HB-003-6	41	42	9.71	26.17	MAHZA
HB-003	HB-003-7	42	43	8.62	23.11	MAHZA
HB-003	HB-003-8	43	44	16	42.56	MAHZA
HB-003	HB-003-9	44	45	10.45	27.93	MAHZA
HB-003	HB-003-10	45	46	22.65	61.27	MAHBED
HB-003	HB-003-11	46	47	19.18	51.66	MAHBED
HB-003	HB-003-12	47	48	31.21	83.22	MAHBED
HB-003	HB-003-13	48	49	27.36	72.87	MAHBED
HB-003	HB-003-14	49	50	16.97	45.46	MAHZB
HB-003	HB-003-15	50	51	20.68	55.02	MAHZB
HB-003	HB-003-16	51	52	14.93	39.45	MAHZB
HB-003	HB-003-17	52	53	6.37	16.74	MAHZB
HB-003	HB-003-18	53	54	7.33	19.48	MAHZB
HB-003	HB-003-19	54	55	12.53	33.47	MAHZB
HB-003	HB-003-20	55	56	8.58	22.78	MAHZB
HB-003	HB-003-21	56	57	9.89	26.38	MAHZB
HB-003	HB-003-22	57	58	16.67	44.72	MAHZB
HB-003	HB-003-23	58	59	17.87	47.61	MAHZB
HB-003	HB-003-24	59	60	5.43	14.66	MAHZB
HB-003	HB-003-25	60	61	15.08	40.34	MAHZB
HB-003	HB-003-26	61	62	6.8	18.13	MAHZB
HB-003	HB-003-27	62	63	5.85	15.54	MAHZB
HB-003	HB-003-28	63	64	10.46	27.58	MAHZB
HB-003	HB-003-29	64	65	13.77	36.35	MAHZB
HB-003	HB-003-30	65	66	5.62	14.79	MAHZB
HB-003	HB-003-31	66	67	6.61	17.44	MAHZB
HB-003	HB-003-32	67	68	6.24	16.56	MAHZB
HB-003	HB-003-33	68	69	11.21	29.78	MAHZB
HB-003	HB-003-34	69	70	13.05	34.93	MAHZB
HB-003	HB-003-35	70	71	8.94	23.77	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-003	HB-003-36	71	72	11.15	29.77	MAHZB
HB-003	HB-003-37	72	73	6.8	17.97	MAHZB
HB-003	HB-003-38	73	74	4.92	12.95	MAHZB
HB-003	HB-003-39	74	75	5.41	14.27	MAHZB
HB-003	HB-003-40	75	76	5.79	15.25	MAHZB
HB-003	HB-003-41	76	77	5.52	14.48	MAHZB
HB-003	HB-003-42	77	78	8.12	21.26	MAHZB
HB-003	HB-003-43	78	79	7.03	18.54	MAHZB
HB-003	HB-003-44	79	80	7.38	19.3	MAHZB
HB-003	HB-003-45	80	81	4.87	12.86	MAHZB
HB-003	HB-003-46	81	82	6.26	16.45	MAHZB
HB-003	HB-003-47	82	83	7.74	20.44	MAHZB
HB-003	HB-003-48	83	84	8.19	21.7	MAHZB
HB-003	HB-003-49	84	85	5.9	15.61	MAHZB
HB-003	HB-003-50	85	86	4.45	11.72	MAHZB
HB-003	HB-003-51	86	87	4.25	11.25	MAHZB
HB-003	HB-003-52	87	88	3.69	9.73	MAHZB
HB-003	HB-003-53	88	89	4.95	13.09	MAHZB
HB-003	HB-003-54	89	90	4.61	12.14	MAHZB
HB-003	HB-003-55	90	91	5.81	15.44	MAHZB
HB-003	HB-003-56	91	92	1.96	5.2	
HB-003	HB-003-57	92	93	3.1	8.16	
HB-003	HB-003-58	93	94	1.66	4.43	
HB-004	HB-004-1	45	46	7.18	19.17	B3
HB-004	HB-004-2	46	47	6.98	18.7	B3
HB-004	HB-004-3	47	48	3.46	9.13	
HB-004	HB-004-4	48	49	2.17	5.69	
HB-004	HB-004-5	49	50	2.53	6.63	
HB-004	HB-004-6	50	51	4.23	11.12	
HB-004	HB-004-7	51	52	2.3	6.03	
HB-004	HB-004-8	52	53	1.13	2.96	
HB-004	HB-004-9	53	54	2.93	7.69	
HB-004	HB-004-10	54	55	2.3	6.05	
HB-004	HB-004-11	55	56	2.85	7.51	
HB-004	HB-004-12	56	57	4.68	12.34	
HB-004	HB-004-13	57	58	2.87	7.53	
HB-004	HB-004-14	58	59	5.18	13.68	
HB-004	HB-004-15	59	60	4.07	10.71	
HB-004	HB-004-16	60	61	4.09	10.77	
HB-004	HB-004-17	61	62	4.12	10.96	
HB-004	HB-004-18	62	63	11.23	29.77	4SEN
HB-004	HB-004-19	63	64	5.22	13.85	4SEN
HB-004	HB-004-20	64	65	6.46	17.16	4SEN

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-004	HB-004-21	65	66	11.05	29.39	4SEN
HB-004	HB-004-22	66	67	2.35	6.15	AGR
HB-004	HB-004-23	67	68	1.23	3.22	AGR
HB-004	HB-004-24	68	69	1.96	5.17	AGR
HB-004	HB-004-25	69	70	2.45	6.42	AGR
HB-004	HB-004-26	70	71	3.05	8.11	AGR
HB-004	HB-004-27	71	72	0.96	2.55	AGR
HB-004	HB-004-28	72	73	0.27	0.72	AGR
HB-004	HB-004-29	73	74	0.21	0.56	AGR
HB-004	HB-004-30	74	75	0.78	2.08	AGR
HB-004	HB-004-31	75	76	4.31	11.51	AGR
HB-004	HB-004-32	76	77	3.68	9.83	AGR
HB-004	HB-004-33	77	78	10.28	27.49	MAHZA
HB-004	HB-004-34	78	79	5.39	14.36	MAHZA
HB-004	HB-004-35	79	80	4.13	10.94	MAHZA
HB-004	HB-004-36	80	81	3.91	10.43	MAHZA
HB-004	HB-004-37	81	82	5.26	13.98	MAHZA
HB-004	HB-004-38	82	83	8.86	23.54	MAHZA
HB-004	HB-004-39	83	84	8.91	23.73	MAHZA
HB-004	HB-004-40	84	85	15.35	41.59	MAHZA
HB-004	HB-004-41	85	86	12.67	33.91	MAHZA
HB-004	HB-004-42	86	87	7.02	18.83	MAHZA
HB-004	HB-004-43	87	88	5.71	15.22	MAHZA
HB-004	HB-004-44	88	89	3.33	8.81	MAHZA
HB-004	HB-004-45	89	90	7.22	19.26	MAHZA
HB-004	HB-004-46	90	91	5.24	13.96	MAHZA
HB-004	HB-004-47	91	92	2.8	7.44	MAHZA
HB-004	HB-004-48	92	93	4.31	11.47	MAHZA
HB-004	HB-004-49	93	94	4.64	12.31	MAHZA
HB-004	HB-004-50	94	95	3.51	9.33	MAHZA
HB-004	HB-004-51	95	96	2.73	7.28	MAHZA
HB-004	HB-004-52	96	97	4.72	12.59	MAHZA
HB-004	HB-004-53	97	98	3.24	8.59	MAHZA
HB-004	HB-004-54	98	99	6.11	16.24	MAHZA
HB-004	HB-004-55	99	100	13.3	35.3	MAHZA
HB-004	HB-004-56	100	101	6.52	17.57	MAHZA
HB-004	HB-004-57	101	102	7.55	20.28	MAHZA
HB-004	HB-004-58	102	103	8.46	22.27	MAHZA
HB-004	HB-004-59	103	104	17.03	45.21	MAHZA
HB-004	HB-004-60	104	105	10.54	28	MAHZA
HB-004	HB-004-61	105	106	17.59	47.15	MAHBED
HB-004	HB-004-62	106	107	24.29	63.99	MAHBED
HB-004	HB-004-63	107	108	26.53	71.04	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-004	HB-004-64	108	109	14.3	38.09	MAHZB
HB-004	HB-004-65	109	110	20.75	55.5	MAHZB
HB-004	HB-004-66	110	111	7.43	19.62	MAHZB
HB-004	HB-004-67	111	112	7.4	19.72	MAHZB
HB-004	HB-004-68	112	113	9.11	24.17	MAHZB
HB-004	HB-004-69	113	114	7.58	20.32	MAHZB
HB-004	HB-004-70	114	115	19.63	52.21	MAHZB
HB-004	HB-004-71	115	116	16.03	42.89	MAHZB
HB-004	HB-004-72	116	117	5.56	15.21	MAHZB
HB-004	HB-004-73	117	118	15.91	42.57	MAHZB
HB-004	HB-004-74	118	119	5.5	14.72	MAHZB
HB-004	HB-004-75	119	120	5.78	15.43	MAHZB
HB-004	HB-004-76	120	122	14.33	38.03	MAHZB
HB-004	HB-004-77	122	124	4.39	11.64	MAHZB
HB-004	HB-004-78	124	126	4.11	10.92	MAHZB
HB-004	HB-004-79	126	128	7.84	21.21	MAHZB
HB-004	HB-004-80	128	130	9.95	26.67	MAHZB
HB-004	HB-004-81	130	132	4.46	11.81	MAHZB
HB-004	HB-004-82	132	134	5.19	13.79	MAHZB
HB-004	HB-004-83	134	136	2.5	6.58	MAHZB
HB-004	HB-004-84	136	138	1.51	3.97	MAHZB
HB-004	HB-004-85	138	140	4.87	12.91	MAHZB
HB-004	HB-004-86	140	141	5.72	15.14	MAHZB
HB-005	HB-005-1	32	34	2	5.18	
HB-005	HB-005-2	34	36	1.05	2.78	
HB-005	HB-005-3	36	38	2.12	5.52	
HB-005	HB-005-4	38	40	0.51	1.37	
HB-005	HB-005-5	40	42	0.43	1.14	
HB-005	HB-005-6	42	44	4.51	12.02	MAHZA
HB-005	HB-005-7	44	46	7.49	19.89	MAHZA
HB-005	HB-005-8	46	48	4.34	11.56	MAHZA
HB-005	HB-005-9	48	50	7.48	19.76	MAHZA
HB-005	HB-005-10	50	52	11.57	30.95	MAHZA
HB-005	HB-005-11	52	54	10.9	29.16	MAHZA
HB-005	HB-005-12	54	56	4.71	12.47	MAHZA
HB-005	HB-005-13	56	58	5.97	15.8	MAHZA
HB-005	HB-005-14	58	60	3.75	9.9	MAHZA
HB-005	HB-005-15	60	62	3.14	8.3	MAHZA
HB-005	HB-005-16	62	64	8.15	21.7	MAHZA
HB-005	HB-005-17	65	66	7.32	19.57	MAHZA
HB-005	HB-005-18	66	67	7.35	19.67	MAHZA
HB-005	HB-005-19	67	68	13.53	36.11	MAHZA
HB-005	HB-005-20	68	69	23.09	62.68	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-005	HB-005-21	69	70	20.68	55.71	MAHBED
HB-005	HB-005-22	70	71	11.21	30.02	MAHZB
HB-005	HB-005-23	71	72	17.03	46.02	MAHZB
HB-005	HB-005-24	72	73	19.04	50.88	MAHZB
HB-005	HB-005-25	73	74	17.16	45.31	MAHZB
HB-005	HB-005-26	74	75	5.88	15.44	MAHZB
HB-005	HB-005-27	75	76	15.45	40.56	MAHZB
HB-005	HB-005-28	76	77	5.23	13.77	MAHZB
HB-005	HB-005-29	77	78	5.86	15.48	MAHZB
HB-005	HB-005-30	78	79	8.77	23.44	MAHZB
HB-005	HB-005-31	79	80	16.48	44.29	MAHZB
HB-005	HB-005-32	80	81	12.02	32.12	MAHZB
HB-005	HB-005-33	81	82	11.77	31.68	MAHZB
HB-005	HB-005-34	82	83	6.86	18.35	MAHZB
HB-005	HB-005-35	83	84	5.48	14.64	MAHZB
HB-005	HB-005-36	84	85	9.27	24.6	MAHZB
HB-005	HB-005-37	85	86	13.63	35.82	MAHZB
HB-005	HB-005-38	86	87	3.64	9.63	MAHZB
HB-005	HB-005-39	87	88	4.91	13.07	MAHZB
HB-005	HB-005-40	88	89	10.83	28.81	MAHZB
HB-006	HB-006-4	18	19	2.98	7.9	MAHZA
HB-006	HB-006-5	19	20	12.08	32.07	MAHZA
HB-006	HB-006-6	20	21	10.81	28.73	MAHZA
HB-006	HB-006-7	21	22	11.48	30.97	MAHZA
HB-006	HB-006-8	22	23	14.22	38.28	MAHZA
HB-006	HB-006-9	23	24	3.68	9.73	MAHZA
HB-006	HB-006-10	24	25	6.37	17.02	MAHZA
HB-006	HB-006-11	25	26	7.86	20.89	MAHZA
HB-006	HB-006-12	26	27	2.38	6.28	MAHZA
HB-006	HB-006-13	27	28	3.52	9.35	MAHZA
HB-006	HB-006-14	28	29	4.68	12.43	MAHZA
HB-006	HB-006-15	29	30	4.56	12.03	MAHZA
HB-006	HB-006-16	30	31	3.3	8.69	MAHZA
HB-006	HB-006-17	31	32	2.56	6.75	MAHZA
HB-006	HB-006-18	32	33	2.84	7.5	MAHZA
HB-006	HB-006-19	33	34	15.9	42.42	MAHZA
HB-006	HB-006-20	34	35	10.19	26.96	MAHZA
HB-006	HB-006-21	35	36	7.23	19.25	MAHZA
HB-006	HB-006-22	36	37	8.21	22.23	MAHZA
HB-006	HB-006-23	37	38	19.2	51.53	MAHZA
HB-006	HB-006-24	38	39	13.17	34.98	MAHZA
HB-006	HB-006-25	39	40	25.85	68.9	MAHBED
HB-006	HB-006-26	40	41	23.45	62.8	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-006	HB-006-27	41	42	21.35	56.73	MAHBED
HB-006	HB-006-28	42	43	27.62	73.63	MAHBED
HB-006	HB-006-29	43	44	13.65	35.92	MAHZB
HB-006	HB-006-30	44	45	20.08	54.09	MAHZB
HB-006	HB-006-31	45	46	16.03	43.03	MAHZB
HB-006	HB-006-32	46	47	8.36	22.23	MAHZB
HB-006	HB-006-33	47	48	6.07	16.01	MAHZB
HB-006	HB-006-34	48	49	21.42	57.49	MAHZB
HB-006	HB-006-35	49	50	8.98	23.98	MAHZB
HB-006	HB-006-36	50	51	6.05	16.58	MAHZB
HB-006	HB-006-37	51	52	16.91	45.28	MAHZB
HB-006	HB-006-38	52	53	5.95	15.89	MAHZB
HB-006	HB-006-39	53	54	8.94	24.22	MAHZB
HB-006	HB-006-40	54	55	11.65	30.87	MAHZB
HB-006	HB-006-41	55	56	4.87	13.03	MAHZB
HB-006	HB-006-42	56	57	3.71	9.89	MAHZB
HB-006	HB-006-43	57	58	10.46	27.53	MAHZB
HB-006	HB-006-44	58	59	9.05	24.06	MAHZB
HB-006	HB-006-45	59	60	4.99	13.27	MAHZB
HB-006	HB-006-46	60	61	7.32	19.54	MAHZB
HB-006	HB-006-47	61	62	13.38	35.73	MAHZB
HB-006	HB-006-48	62	63	7.18	19.19	MAHZB
HB-006	HB-006-49	63	64	14.21	38.07	MAHZB
HB-006	HB-006-50	64	65	2.99	7.93	MAHZB
HB-006	HB-006-51	65	66	3.34	8.83	MAHZB
HB-006	HB-006-52	66	67	6.86	18.16	MAHZB
HB-006	HB-006-53	67	68	7.59	19.96	MAHZB
HB-006	HB-006-54	68	69	0.17	0.45	MAHZB
HB-006	HB-006-55	69	70	2.13	5.6	MAHZB
HB-006	HB-006-56	70	71	3.13	8.26	MAHZB
HB-006	HB-006-57	71	72	1.95	5.16	MAHZB
HB-006	HB-006-58	72	73	2.25	5.98	MAHZB
HB-006	HB-006-59	73	74	8.51	22.5	MAHZB
HB-006	HB-006-60	74	75	0.84	2.22	MAHZB
HB-006	HB-006-61	75	76	8.3	22.06	MAHZB
HB-006	HB-006-62	76	77	5.22	13.65	MAHZB
HB-006	HB-006-63	77	78	1.24	3.28	
HB-006	HB-006-64	78	79	1.27	3.37	
HB-006	HB-006-65	79	80	3.48	9.01	
HB-006	HB-006-66	80	81	1.04	2.75	
HB-006	HB-006-67	81	82	1.3	3.42	
HB-006	HB-006-68	82	83	0.24	0.64	
HB-006	HB-006-69	83	84	1.17	3.1	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-006	HB-006-70	84	85	0.17	0.46	
HB-006	HB-006-71	85	86	2.17	5.7	
HB-006	HB-006-72	86	87	1.51	3.97	
HB-006	HB-006-73	87	88	0.82	2.18	
HB-006	HB-006-74	88	89	3.21	8.59	
HB-006	HB-006-75	89	90	3.54	9.41	
HB-006	HB-006-76	90	91	2.03	5.41	
HB-006	HB-006-77	91	92	4.64	12.47	
HB-006	HB-006-78	92	93	1.82	4.83	
HB-006	HB-006-79	93	94	2.96	7.87	
HB-006	HB-006-80	94	95	2.17	5.75	
HB-006	HB-006-82	96	97	0.95	2.52	
HB-006	HB-006-83	97	98	2.16	5.8	
HB-006	HB-006-84	98	99	1.64	4.36	
HB-006	HB-006-85	99	100	1.65	4.47	
HB-006	HB-006-86	100	101	1.72	4.66	
HB-006	HB-006-87	101	102	1.39	3.69	
HB-006	HB-006-88	102	103	0.86	2.28	
HB-006	HB-006-89	103	104	3.1	8.38	
HB-006	HB-006-90	104	105	1.65	4.38	
HB-006	HB-006-91	105	106	0.98	2.59	
HB-006	HB-006-92	106	107	3.21	8.49	
HB-006	HB-006-93	107	108	4.06	10.78	
HB-006	HB-006-94	108	109	1.11	2.95	
HB-006	HB-006-95	109	110	5.55	14.66	
HB-006	HB-006-96	110	111	0.33	0.88	
HB-006	HB-006-97	111	112	6.52	17.23	
HB-006	HB-006-98	112	113	1.26	3.31	
HB-006	HB-006-99	113	114	3.2	8.4	
HB-006	HB-006-10(	114	115	2.56	6.69	
HB-006	HB-006-10:	115	116	2.5	6.53	
HB-007	HB-007-1	122	124	2	5.26	
HB-007	HB-007-2	124	126	5.48	14.46	
HB-007	HB-007-3	126	128	2.99	7.9	
HB-007	HB-007-4	128	130	8.93	23.51	B3
HB-007	HB-007-5	130	132	2.14	5.62	
HB-007	HB-007-6	132	134	3.98	10.47	
HB-007	HB-007-7	134	136	6.01	15.95	
HB-007	HB-007-8	136	138	1.5	3.98	
HB-007	HB-007-9	138	140	2.77	7.33	
HB-007	HB-007-10	140	142	5	13.29	
HB-007	HB-007-11	142	144	3.47	9.12	
HB-007	HB-007-12	144	146	4.07	10.69	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-007	HB-007-13	146	148	3.52	9.21	
HB-007	HB-007-14	148	150	3.77	9.95	
HB-007	HB-007-15	150	152	4.26	11.3	
HB-007	HB-007-16	152	154	1.82	4.77	
HB-007	HB-007-17	154	156	3.5	9.24	
HB-007	HB-007-18	156	158	3.15	8.36	
HB-007	HB-007-19	158	160	5.58	14.89	
HB-007	HB-007-20	160	162	4.63	12.26	
HB-007	HB-007-21	162	164	2.33	6.11	
HB-007	HB-007-22	164	166	2.84	7.44	
HB-007	HB-007-23	166	168	2.76	7.27	
HB-007	HB-007-24	168	170	3.6	9.51	
HB-007	HB-007-25	170	172	5.35	14.12	
HB-007	HB-007-26	172	174	4.34	11.47	
HB-007	HB-007-27	174	176	7.83	20.73	4SEN
HB-007	HB-007-28	176	178	6.16	16.4	4SEN
HB-007	HB-007-29	178	180	5.62	14.92	
HB-007	HB-007-30	180	182	0.37	0.97	
HB-007	HB-007-31	182	184	1.43	3.79	
HB-007	HB-007-32	184	186	2.09	5.51	
HB-007	HB-007-33	186	188	0.82	2.18	
HB-007	HB-007-34	188	190	2.5	6.56	
HB-007	HB-007-35	190	192	10.72	28.74	MAHZA
HB-007	HB-007-36	192	194	7.23	19.15	MAHZA
HB-007	HB-007-37	194	196	3.5	9.3	MAHZA
HB-007	HB-007-38	196	198	7.45	19.87	MAHZA
HB-007	HB-007-39	198	200	3.23	8.61	MAHZA
HB-007	HB-007-40	200	202	3.53	9.36	MAHZA
HB-007	HB-007-41	202	204	3.34	8.82	MAHZA
HB-007	HB-007-42	204	206	6.07	16.11	MAHZA
HB-007	HB-007-43	206	208	4.15	10.95	MAHZA
HB-007	HB-007-44	208	210	7.98	21.3	MAHZA
HB-007	HB-007-1	210	211	9.3	24.84	MAHZA
HB-007	HB-007-2	211	212	6.26	16.66	MAHZA
HB-007	HB-007-3	212	213	6.53	17.42	MAHZA
HB-007	HB-007-4	213	214	7.19	19.32	MAHZA
HB-007	HB-007-5	214	215	11.77	31.26	MAHZA
HB-007	HB-007-6	215	216	15.65	41.84	MAHZA
HB-007	HB-007-7	216	217	21.65	58.12	MAHBED
HB-007	HB-007-8	217	218	18.15	48.66	MAHBED
HB-007	HB-007-9	218	219	26.06	69.68	MAHBED
HB-007	HB-007-10	219	220	10	26.45	MAHZB
HB-007	HB-007-11	220	221	17.1	46.33	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-007	HB-007-12	221	222	13.7	36.05	MAHZB
HB-007	HB-007-13	222	223	6.93	18.29	MAHZB
HB-007	HB-007-14	223	224	5.86	15.5	MAHZB
HB-007	HB-007-15	224	225	4.43	11.59	MAHZB
HB-007	HB-007-16	225	226	18.58	49.6	MAHZB
HB-007	HB-007-17	226	227	17.22	45.92	MAHZB
HB-007	HB-007-18	227	228	9.1	24.34	MAHZB
HB-007	HB-007-19	228	229	6.81	18.46	MAHZB
HB-007	HB-007-20	229	230	6.33	17.14	MAHZB
HB-007	HB-007-21	230	231	5.05	13.43	MAHZB
HB-007	HB-007-22	231	232	4.65	12.33	MAHZB
HB-007	HB-007-23	232	233	15.33	40.3	MAHZB
HB-007	HB-007-24	233	234	5.71	15.13	MAHZB
HB-007	HB-007-25	234	235	3.47	9.2	MAHZB
HB-007	HB-007-26	235	236	5.55	14.94	MAHZB
HB-007	HB-007-27	236	237	3.53	9.31	MAHZB
HB-007	HB-007-28	237	238	5.84	15.63	MAHZB
HB-007	HB-007-29	238	239	5.38	14.34	MAHZB
HB-007	HB-007-30	239	240	7.82	20.89	MAHZB
HB-007	HB-007-45	240	242	9.42	25.49	MAHZB
HB-007	HB-007-46	242	244	3.49	9.22	MAHZB
HB-007	HB-007-47	244	246	3.82	10.09	MAHZB
HB-007	HB-007-48	246	248	2.01	5.28	MAHZB
HB-007	HB-007-49	248	250	2.72	7.19	MAHZB
HB-007	HB-007-50	250	252	3.69	9.72	MAHZB
HB-007	HB-007-51	252	254	4.16	10.99	MAHZB
HB-007	HB-007-52	254	256	1.47	3.9	BGR
HB-007	HB-007-53	256	258	0.99	2.63	BGR
HB-007	HB-007-54	258	260	1.14	3.03	BGR
HB-007	HB-007-55	260	262	3.57	9.4	BGR
HB-007	HB-007-56	262	264	0.89	2.37	BGR
HB-007	HB-007-57	264	266	3.16	8.33	BGR
HB-007	HB-007-58	266	268	1.52	4.01	BGR
HB-007	HB-007-59	268	270	2.65	7.09	BGR
HB-008	HB-008-1	26	28	3.23	8.59	MAHZA
HB-008	HB-008-2	28	30	3.47	9.28	MAHZA
HB-008	HB-008-3	30	31	9.27	24.81	MAHZA
HB-008	HB-008-4	31	32	9.06	24.14	MAHZA
HB-008	HB-008-5	32	33	5.85	15.64	MAHZA
HB-008	HB-008-6	33	34	7.1	19.15	MAHZA
HB-008	HB-008-7	34	35	13.19	35.2	MAHZA
HB-008	HB-008-8	35	36	27.23	73.07	MAHBED
HB-008	HB-008-9	36	37	11.73	31.41	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-008	HB-008-10	37	38	25.56	68.37	MAHBED
HB-008	HB-008-11	38	39	16.56	44.18	MAHZB
HB-008	HB-008-12	39	40	21.26	56.98	MAHZB
HB-008	HB-008-13	40	41	18.52	49.52	MAHZB
HB-008	HB-008-14	41	42	13.55	36.44	MAHZB
HB-008	HB-008-15	42	43	20.05	53.05	MAHZB
HB-008	HB-008-16	43	44	7.92	20.9	MAHZB
HB-008	HB-008-17	44	45	7.68	20.45	MAHZB
HB-008	HB-008-18	45	46	7.01	18.55	MAHZB
HB-008	HB-008-19	46	47	17.79	47.87	MAHZB
HB-008	HB-008-20	47	48	20.51	54.86	MAHZB
HB-008	HB-008-21	48	49	11.89	32.16	MAHZB
HB-008	HB-008-22	49	50	8.15	22.14	MAHZB
HB-008	HB-008-23	50	51	5.68	15.17	MAHZB
HB-008	HB-008-24	51	52	7.33	19.53	MAHZB
HB-008	HB-008-25	52	53	3.42	9.05	MAHZB
HB-008	HB-008-26	53	54	12.71	33.62	MAHZB
HB-008	HB-008-27	54	55	5.08	13.6	MAHZB
HB-008	HB-008-28	55	56	3.63	9.64	MAHZB
HB-008	HB-008-29	56	57	11.87	32.24	MAHZB
HB-008	HB-008-30	57	58	10.33	27.71	MAHZB
HB-008	HB-008-31	58	59	10.72	28.97	MAHZB
HB-008	HB-008-32	59	60	7.91	21.28	MAHZB
HB-008	HB-008-33	60	61	3.97	10.52	MAHZB
HB-008	HB-008-34	61	62	8.27	22.31	MAHZB
HB-008	HB-008-35	62	63	3.87	10.29	MAHZB
HB-008	HB-008-36	63	64	2.9	7.68	MAHZB
HB-008	HB-008-37	64	65	3.38	8.95	MAHZB
HB-008	HB-008-39	66	67	5.05	13.36	MAHZB
HB-008	HB-008-40	67	68	1.91	5.05	MAHZB
HB-008	HB-008-41	68	69	1.1	2.94	MAHZB
HB-008	HB-008-42	69	70	7.35	19.48	MAHZB
HB-008	HB-008-43	70	71	4.1	10.82	MAHZB
HB-008	HB-008-44	71	72	2.21	5.91	MAHZB
HB-008	HB-008-45	72	73	5.29	13.97	MAHZB
HB-008	HB-008-46	73	74	0.71	1.9	MAHZB
HB-008	HB-008-47	74	75	9.35	24.89	MAHZB
HB-008	HB-008-48	75	76	1.58	4.1	BGR
HB-008	HB-008-49	76	77	2.07	5.46	BGR
HB-008	HB-008-50	77	78	1.15	3.08	BGR
HB-008	HB-008-51	78	79	2.33	6.15	BGR
HB-008	HB-008-52	79	80	1.41	3.76	BGR
HB-008	HB-008-53	80	82	0.99	2.63	BGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-008	HB-008-54	82	84	2.15	5.65	BGR
HB-008	HB-008-55	84	86	0.54	1.43	BGR
HB-008	HB-008-56	86	88	1.48	3.93	BGR
HB-008	HB-008-57	88	90	3.13	8.39	
HB-008	HB-008-58	90	92	2.92	7.85	
HB-008	HB-008-59	92	94	2.31	6.18	
HB-008	HB-008-60	94	96	2.67	7.12	
HB-008	HB-008-61	96	98	1.8	4.8	
HB-008	HB-008-62	98	100	2.45	6.57	
HB-008	HB-008-63	100	102	2.48	6.63	
HB-008	HB-008-64	102	104	1.66	4.41	
HB-009	HB-009-1	30	32	6.7	17.9	4SEN
HB-009	HB-009-2	32	34	4.4	11.6	4SEN
HB-009	HB-009-3	34	36	5	13.2	4SEN
HB-009	HB-009-4	36	38	7.5	20.1	4SEN
HB-009	HB-009-5	38	40	1.1	2.9	
HB-009	HB-009-6	40	42	1.4	3.8	
HB-009	HB-009-7	42	44	1.3	3.4	
HB-009	HB-009-8	44	46	0.6	1.6	
HB-009	HB-009-9	46	48	0.6	1.6	
HB-009	HB-009-10	48	50	4.6	12.3	MAHZA
HB-009	HB-009-11	50	52	6.8	18	MAHZA
HB-009	HB-009-12	52	54	7.3	19.2	MAHZA
HB-009	HB-009-13	54	56	10.5	28.3	MAHZA
HB-009	HB-009-14	56	58	7.2	19.2	MAHZA
HB-009	HB-009-15	58	60	8.4	22.4	MAHZA
HB-009	HB-009-16	60	62	5.9	15.6	MAHZA
HB-009	HB-009-17	62	64	4.7	12.5	MAHZA
HB-009	HB-009-18	64	66	4.2	11.3	MAHZA
HB-009	HB-009-19	66	68	2.7	7.1	MAHZA
HB-009	HB-009-20	68	70	8	21.3	MAHZA
HB-009	HB-009-21	70	71	6.2	16.6	MAHZA
HB-009	HB-009-22	71	72	8.6	23.1	MAHZA
HB-009	HB-009-23	72	73	10.1	27	MAHZA
HB-009	HB-009-24	73	74	12.9	34.4	MAHZA
HB-009	HB-009-25	74	75	16.8	44.9	MAHZA
HB-009	HB-009-26	75	76	16.5	44.5	MAHZA
HB-009	HB-009-27	76	77	19	50.8	MAHBED
HB-009	HB-009-28	77	78	24	64.1	MAHBED
HB-009	HB-009-29	78	79	28	74.4	MAHBED
HB-009	HB-009-30	79	80	21.5	57.5	MAHBED
HB-009	HB-009-31	80	81	15.5	41	MAHZB
HB-009	HB-009-32	81	82	7.2	19	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-009	HB-009-33	82	83	7.1	18.7	MAHZB
HB-009	HB-009-34	83	84	6.2	16.2	MAHZB
HB-009	HB-009-35	84	85	13.6	35.8	MAHZB
HB-009	HB-009-36	85	86	6.6	17.8	MAHZB
HB-009	HB-009-37	86	87	5.9	15.6	MAHZB
HB-009	HB-009-38	87	88	14.6	39.1	MAHZB
HB-009	HB-009-39	88	89	15.1	40.4	MAHZB
HB-009	HB-009-40	89	90	7.4	20	MAHZB
HB-009	HB-009-41	90	91	9.3	25.1	MAHZB
HB-009	HB-009-42	91	92	6.1	16.1	MAHZB
HB-009	HB-009-43	92	93	9.31	24.78	MAHZB
HB-009	HB-009-44	93	94	12.39	32.67	MAHZB
HB-009	HB-009-45	94	95	8.82	23.42	MAHZB
HB-009	HB-009-46	95	96	3.58	9.51	MAHZB
HB-009	HB-009-47	96	97	3.01	7.99	MAHZB
HB-009	HB-009-48	97	98	13.41	35.9	MAHZB
HB-009	HB-009-49	98	99	9.53	25.43	MAHZB
HB-009	HB-009-50	99	100	8.31	22.33	MAHZB
HB-009	HB-009-51	100	101	8.66	23.45	MAHZB
HB-009	HB-009-52	101	102	6	16.02	MAHZB
HB-009	HB-009-53	102	103	9.94	26.82	MAHZB
HB-009	HB-009-54	103	104	2.69	7.08	MAHZB
HB-009	HB-009-55	104	105	2.67	7.03	MAHZB
HB-009	HB-009-56	105	106	7.35	19.35	MAHZB
HB-009	HB-009-57	106	107	4.78	12.75	MAHZB
HB-009	HB-009-58	107	108	1.44	3.77	MAHZB
HB-009	HB-009-59	108	109	2.9	7.66	MAHZB
HB-009	HB-009-60	109	110	3.65	9.59	MAHZB
HB-009	HB-009-61	110	111	2.07	5.49	MAHZB
HB-009	HB-009-62	111	112	5.17	13.65	MAHZB
HB-009	HB-009-63	112	113	9.11	24.12	MAHZB
HB-009	HB-009-64	113	114	7.91	20.9	MAHZB
HB-009	HB-009-65	114	115	1.84	4.91	MAHZB
HB-009	HB-009-66	115	116	3.14	8.34	MAHZB
HB-009	HB-009-67	116	117	0.72	1.93	MAHZB
HB-009	HB-009-68	117	118	7.06	18.44	MAHZB
HB-009	HB-009-69	118	119	6.12	15.98	MAHZB
HB-009	HB-009-70	119	120	0.73	1.94	BGR
HB-009	HB-009-71	120	121	1.2	3.19	BGR
HB-009	HB-009-72	121	122	2.17	5.73	BGR
HB-009	HB-009-73	122	123	1.27	3.33	BGR
HB-009	HB-009-74	123	124	0.88	2.35	BGR
HB-009	HB-009-75	124	125	0.49	1.3	BGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
HB-009	HB-009-76	125	126	0.46	1.23	BGR
HB-009	HB-009-77	126	127	0.65	1.74	BGR
HB-009	HB-009-78	127	128	0.5	1.34	BGR
HB-009	HB-009-79	128	129	0.92	2.41	BGR
HB-009	HB-009-80	129	130	2.99	7.96	BGR
HB-009	HB-009-81	130	131	2.47	6.54	BGR
HB-009	HB-009-82	131	132	3.07	8.26	BGR
HB-009	HB-009-83	132	133	5.05	13.61	BGR
HB-009	HB-009-84	133	134	3.6	9.57	BGR
HB-009	HB-009-85	134	135	2.24	5.98	BGR
HB-009	HB-009-86	135	136	0.36	0.96	BGR
HB-009	HB-009-87	136	137	1.77	4.76	BGR
HB-009	HB-009-88	137	138	1.96	5.24	BGR
HB-009	HB-009-89	138	139	2.72	7.26	BGR
HB-009	HB-009-90	139	140	1.92	5.14	BGR
U026	591397	150	152	0.9	2.4	
U026	591398	152	153.4	2.1	5.5	
U026	591399	153.4	155	5.3	13.8	MAHZA
U026	591400	155	156	7	18.3	MAHZA
U026	591401	156	157	9.2	24.1	MAHZA
U026	591402	157	158	6.6	17.4	MAHZA
U026	591403	158	159	4.4	11.3	MAHZA
U026	591404	159	160.2	6.4	16.6	MAHZA
U026	591405	160.2	161.5	9.9	26	MAHZA
U026	591406	161.5	162.5	11.2	29.6	MAHZA
U026	591407	162.5	163.5	17.3	45.8	MAHZA
U026	591408	163.5	164.5	8.6	22.8	MAHZA
U026	591409	164.5	165.5	6.8	17.7	MAHZA
U026	591410	165.5	166.5	4	10.4	MAHZA
U026	591411	166.5	167.5	6.3	16.4	MAHZA
U026	591412	167.5	168.5	6.3	16.4	MAHZA
U026	591413	168.5	170	4.2	10.8	MAHZA
U026	591414	170	170.5	4.2	11	MAHZA
U026	591415	170.5	172	3.6	9.3	MAHZA
U026	591416	172	173	3.3	8.7	MAHZA
U026	591417	173	174	5.3	13.8	MAHZA
U026	591418	174	175.4	14	36.9	MAHZA
U026	591419	175.4	176.4	7.8	20.8	MAHZA
U026	591420	176.4	177.5	6.6	17.3	MAHZA
U026	591421	177.5	178.5	11.9	31.7	MAHZA
U026	591422	178.5	179.5	14	36.8	MAHZA
U026	591423	179.5	180.5	23.2	61.7	MAHBED
U026	591424	180.5	181.5	21.7	57.5	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U026	591425	181.5	182.5	30	79.7	MAHBED
U026	591426	182.5	183.5	25	66.2	MAHBED
U026	591427	183.5	184.4	14.6	38.7	MAHBED
U026	591428	184.4	185.4	23.5	61.8	MAHBED
U026	591429	185.4	186.4	8.7	22.6	MAHZB
U026	591430	186.4	187.5	20.2	52.4	MAHZB
U026	591431	187.5	188.5	6.9	18	MAHZB
U026	591432	188.5	189.5	24.3	63.8	MAHZB
U026	591433	189.5	190.8	18.3	47.7	MAHZB
U026	591434	190.8	192	7.8	21.1	MAHZB
U026	591435	192	192.8	19.7	52.1	MAHZB
U026	591436	192.8	194	6.1	16.1	MAHZB
U026	591437	194	194.9	5.8	15.3	MAHZB
U026	591438	194.9	196	18.8	48.9	MAHZB
U026	591439	196	197	4.3	11.2	MAHZB
U026	591440	197	198	3.8	9.8	MAHZB
U026	591441	198	199.2	6.8	17.8	MAHZB
U026	591442	199.2	200.2	11.2	29.4	MAHZB
U026	591443	200.2	201	13.7	36.6	MAHZB
U026	591444	201	202	9.5	25.5	MAHZB
U026	591445	202	203	8.2	21.7	MAHZB
U026	591446	203	204	11.3	30.4	MAHZB
U026	591447	204	205	7.3	19.3	MAHZB
U026	591448	205	206	3.5	9.2	MAHZB
U026	591449	206	207	3.3	8.6	MAHZB
U026	591450	207	208	5.3	13.9	MAHZB
U026	591451	208	209.2	8.3	21.4	MAHZB
U026	591452	209.2	210.2	3.5	9	MAHZB
U026	591453	210.2	211.8	1.8	4.7	MAHZB
U026	591454	211.8	213	4.5	11.8	MAHZB
U026	591455	213	214	3.1	8.1	MAHZB
U026	591456	214	215	9.9	25.8	MAHZB
U026	591457	215	216.2	2.3	6.1	MAHZB
U026	591458	216.2	217.2	8.6	22.5	MAHZB
U026	591459	217.2	218.8	1.4	3.6	MAHZB
U026	591460	218.8	219.8	4.4	11.4	MAHZB
U026	591461	219.8	221.5	1.1	2.9	
U026	591462	221.5	223	2.7	6.9	
U026	591463	223	224.9	2	5.1	
U026	591464	224.9	226.7	1.8	4.7	
U026	591465	226.7	228.4	1	2.7	
U026	591466	228.4	230	4.5	11.6	
U026	591467	230	231.7	0.6	1.5	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U026	591468	231.7	233.1	2.2	5.6	
U026	591469	233.1	234	8.4	21.9	
U026	591470	234	235	2.8	7.4	
U026	591471	235	236	3.6	9.6	
U026	591472	236	238	4	10.6	
U026	591473	238	240	3.6	9.4	
U026	591474	240	242	1.8	4.8	
U026	591475	242	243.5	2.3	6.1	
U026	591476	243.5	244.6	2.8	7.2	
U026	591477	244.6	245.6	2.1	5.6	
U026	591478	245.6	246.7	2.5	6.5	
U026	591479	246.7	248	2.5	6.5	
U026	591480	248	250	1.8	4.7	
U026	591481	250	251.7	5.5	14.5	
U026	591482	251.7	253.6	5.2	13.6	
U026	591483	253.6	255.2	3.9	10.2	
U026	591484	255.2	256.2	6.2	16.1	
U026	591485	256.2	258	4.2	11	
U026	591486	258	260	1	2.6	
U026	591487	260	261.3	0.6	1.6	
U026	591488	261.3	263.6	3.5	9.1	
U026	591489	263.6	264.8	0.4	1.2	
U026	591490	264.8	266.1	2.8	7.3	
U026	591491	266.1	268	3	7.9	
U027	591493	30	32	3.8	9.9	
U027	591494	32	33.5	3.6	9.3	
U027	591495	33.5	35.4	4.7	12.2	
U027	591496	35.4	37.4	3.1	8.1	
U027	591497	37.4	39.2	5.2	13.4	
U027	591498	39.2	41	3.9	9.9	
U027	591499	41	43	3.8	9.8	
U027	591500	43	45	3.7	9.6	
U027	591501	45	47	3.4	8.9	
U027	591502	47	49	3.6	9.2	
U027	591503	49	51	1.8	4.6	
U027	591504	51	53	3.6	9.3	
U027	591505	53	55	3.4	8.8	
U027	591506	55	56	4.4	11.3	
U027	591507	56	58	5	12.8	
U027	591508	58	59.5	5.3	13.8	
U027	591509	59.5	61.5	2.8	7.3	
U027	591510	61.5	63.5	3.8	9.7	
U027	591511	63.5	65	2.4	6.3	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U027	591512	65	66	2.9	7.6	
U027	591513	66	67.7	2.4	6.2	
U027	591514	67.7	69.5	4.3	11.2	
U027	591515	69.5	71.4	3.6	9.4	
U027	591516	71.4	72.4	14.6	37.7	4SEN
U027	591517	72.4	73.7	4.2	10.8	4SEN
U027	591518	73.7	75	4.5	11.7	4SEN
U027	591519	75	76.3	5.3	13.8	4SEN
U027	591520	76.3	77	15	38.8	4SEN
U027	591521	77	78	5.3	13.8	4SEN
U027	591522	78	79.3	5.1	13.3	4SEN
U027	591523	79.3	80	14.9	39.1	4SEN
U027	591524	80	81	5.6	14.5	4SEN
U027	591525	81	82.9	1.8	4.6	AGR
U027	591526	82.9	84.4	1.2	3.2	AGR
U027	591527	84.4	86.2	2	5.1	AGR
U027	591528	86.2	88	1	2.6	AGR
U027	591529	88	89.9	0.8	2	AGR
U027	591530	89.9	91	5.2	13.6	MAHZA
U027	591531	91	92	4.6	12	MAHZA
U027	591532	92	92.8	14.6	38.2	MAHZA
U027	591533	92.8	93.8	6.2	16.1	MAHZA
U027	591534	93.8	94.8	5.1	13.3	MAHZA
U027	591535	94.8	96.2	3.5	9.1	MAHZA
U027	591536	96.2	97.2	6.9	17.8	MAHZA
U027	591537	97.2	98.2	12.5	32.3	MAHZA
U027	591538	98.2	99.2	8.9	23.2	MAHZA
U027	591539	99.2	100.3	17	45.2	MAHZA
U027	591540	100.3	101.3	15.7	41.2	MAHZA
U027	591541	101.3	102.3	8.1	21.5	MAHZA
U027	591542	102.3	104.3	5.5	14.2	MAHZA
U027	591543	104.3	106	6.4	16.5	MAHZA
U027	591544	106	108	4.6	11.9	MAHZA
U027	591545	108	109.2	3.8	9.9	MAHZA
U027	591546	109.2	110.2	3	7.6	MAHZA
U027	591547	110.2	111.5	3.3	8.5	MAHZA
U027	591548	111.5	112.5	4.1	10.8	MAHZA
U027	591549	112.5	113.6	16.3	42.5	MAHZA
U027	591550	113.6	114.6	8.6	22.6	MAHZA
U027	591551	114.6	115.6	7.2	19	MAHZA
U027	591552	115.6	116.6	13.9	36.2	MAHZA
U027	591553	116.6	117.6	14.4	37.4	MAHZA
U027	591554	117.6	118.6	10.9	28.6	MAHZA

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U027	591555	118.6	119.6	18.5	49	MAHZA
U027	591556	119.6	120.6	26.4	69.7	MAHBED
U027	591557	120.6	121.6	28.6	75.6	MAHBED
U027	591558	121.6	122.8	18.1	47.7	MAHBED
U027	591559	122.8	123.9	23.1	60.3	MAHBED
U027	591560	123.9	124.9	7.8	20	MAHZB
U027	591561	124.9	126.3	6.9	17.9	MAHZB
U027	591562	126.3	127.3	12.4	32.2	MAHZB
U027	591563	127.3	128.5	5.9	15.2	MAHZB
U027	591564	128.5	129.7	7	18.3	MAHZB
U027	591565	129.7	131.2	19.3	50.7	MAHZB
U027	591566	131.2	132.8	7.2	19.3	MAHZB
U027	591567	132.8	133.8	12.5	32.9	MAHZB
U027	591568	133.8	135	5.5	14.3	MAHZB
U027	591569	135	136	5.7	14.7	MAHZB
U027	591570	136	137	14	36.5	MAHZB
U027	591571	137	138	3.7	9.6	MAHZB
U027	591572	138	139	4.7	12.3	MAHZB
U027	591573	139	140	5.2	13.5	MAHZB
U027	591574	140	141	12.5	32.8	MAHZB
U027	591575	141	142	10.3	27.6	MAHZB
U027	591576	142	143	8.2	21.5	MAHZB
U027	591577	143	144	10.7	28.2	MAHZB
U027	591578	144	145	5.4	14.2	MAHZB
U027	591579	145	146	3.4	8.9	MAHZB
U027	591580	146	147.5	4.1	10.8	MAHZB
U027	591581	147.5	148.8	7.1	18.4	MAHZB
U027	591582	148.8	150	2.5	6.4	MAHZB
U027	591583	150	151.2	2	5.3	MAHZB
U027	591584	151.2	153	3.4	8.8	MAHZB
U027	591585	153	154	11.8	30.7	MAHZB
U027	591586	154	155.6	2.6	6.9	MAHZB
U027	591587	155.6	156.8	8.7	22.5	MAHZB
U027	591588	156.8	157.8	1	2.5	BGR
U027	591589	157.8	158.8	4.3	11.2	BGR
U027	591590	158.8	160.4	1.7	4.3	BGR
U027	591591	160.4	162	1.7	4.4	BGR
U027	591592	162	163.3	1.9	5	BGR
U027	591593	163.3	164.6	6.6	17.5	BGR
U027	591594	164.6	165.7	0.9	2.4	BGR
U027	591595	165.7	166.6	6.5	16.9	
U027	591596	166.6	167.8	2.7	7.1	
U027	591597	167.8	168.8	5.7	15.3	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U027	591598	168.8	170	2.5	6.6	
U027	591599	170	171	2.5	6.6	
U027	591600	171	172	1.5	4	
U027	591601	172	173	2.4	6.3	
U027	591602	173	174	1.4	3.8	
U027	591603	174	175	1.8	4.6	
U027	591604	175	176	0.9	2.3	
U027	591605	176	177	1.8	4.6	
U027	591606	177	178	5.8	15.3	
U040	575283	0	5	6.6	17.4	MAHZA
U040	575284	5	10	4.5	11.6	MAHZA
U040	575285	10	13	5.4	14.2	MAHZA
U040	575286	13	13.5	2.5	6.6	MAHZA
U040	575287	13.5	15.5	3.9	10.3	MAHZA
U040	575288	15.5	17	12.6	32.9	MAHZA
U040	575289	17	20.5	7.6	20.1	MAHZA
U040	575290	20.5	26	18	47.6	MAHZA
U040	575291	26	26.5	11.6	31.2	MAHZA
U040	575292	26.5	28	21.8	57	MAHBED
U040	575293	28	30.5	7.7	20.1	MAHZB
U040	575294	30.5	31	14.6	38.1	MAHZB
U040	575295	31	32	6.2	16.2	MAHZB
U040	575296	32	33.5	19.6	51.2	MAHZB
U040	575297	33.5	34.5	5.6	15	MAHZB
U040	575298	34.5	35	16.1	41.9	MAHZB
U040	575299	35	37	6.4	16.6	MAHZB
U040	575300	37	38	17.3	44.8	MAHZB
U040	575301	38	40.5	5.2	13.5	MAHZB
U040	575302	40.5	41.5	16.2	42.8	MAHZB
U040	575303	41.5	44	9.7	25.9	MAHZB
U040	575304	44	48	5	13.1	MAHZB
U040	575305	48	48.5	11.2	29	MAHZB
U040	575306	48.5	52	2.5	6.4	MAHZB
U040	575307	52	53	12.5	32.5	MAHZB
U040	575308	53	54	2.6	6.7	MAHZB
U040	575309	54	55	8.4	22	MAHZB
U040	575310	55	57.5	2.4	6.3	
U040	1E+10	57.5	59			
U040	575311	59	62.2	1.7	4.4	
U090	4100298	20.5	21	2.3	6.1	
U090	4100299	21	22	4.3	11.3	
U090	4100300	22	23	3.5	9.1	
U090	4100301	23	24	3	7.9	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U090	4100302	24	25	8.3	21.8	4SEN
U090	4100303	25	26	6.6	17.2	4SEN
U090	4100304	26	27	5.2	13.6	4SEN
U090	4100305	27	28	4.8	12.4	4SEN
U090	4100306	28	29	4.5	11.8	4SEN
U090	4100307	29	30	10.3	26.9	4SEN
U090	4100308	30	31	5.3	13.8	4SEN
U090	4100309	31	32	6.3	16.7	4SEN
U090	4100310	32	33	12.4	33.1	4SEN
U090	4100311	33	34	3.9	10.4	4SEN
U090	4100312	34	35	2.1	5.5	AGR
U090	4100313	35	36	2.2	5.7	AGR
U090	4100314	36	37	1.5	4	AGR
U090	4100315	37	38	1.1	2.7	AGR
U090	4100316	38	39	2.6	6.7	AGR
U090	4100317	39	40	1.2	3.2	AGR
U090	4100318	40	41	1.1	2.8	AGR
U090	4100319	41	42	0.6	1.5	AGR
U090	4100320	42	43	0.6	1.6	AGR
U090	4100321	43	44	1.3	3.4	AGR
U090	4100322	44	45	5.3	13.9	MAHZA
U090	4100323	45	46	4.7	12.5	MAHZA
U090	4100324	46	47	12	31.8	MAHZA
U090	4100325	47	48	4.5	12	MAHZA
U090	4100326	48	49	4.4	11.6	MAHZA
U090	4100327	49	50	3.5	9.3	MAHZA
U090	4100328	50	51	5.7	14.9	MAHZA
U090	4100329	51	52	10.4	27.2	MAHZA
U090	4100330	52	53	8.4	22.2	MAHZA
U090	4100331	53	54	13.6	36.4	MAHZA
U090	4100332	54	55	16.2	43.1	MAHZA
U090	4100333	55	56	8.1	21.6	MAHZA
U090	4100334	56	57	6.5	17.2	MAHZA
U090	4100335	57	58	4.3	11.3	MAHZA
U090	4100336	58	59	6.8	17.7	MAHZA
U090	4100337	59	60	6.9	18.1	MAHZA
U090	4100338	60	61	3.8	10	MAHZA
U090	4100339	61	62	4.6	12.2	MAHZA
U090	4100340	62	63	3.8	10.1	MAHZA
U090	4100341	63	64	3.6	9.5	MAHZA
U090	4100342	64	65	3.9	10.2	MAHZA
U090	4100343	65	66	6.6	17.4	MAHZA
U090	4100344	66	67	17.1	45	MAHZA

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U090	4100345	67	68	7.3	19.5	MAHZA
U090	4100346	68	69	7.2	19.2	MAHZA
U090	4100347	69	70	9	24	MAHZA
U090	4100348	70	71	15	39.7	MAHZA
U090	4100349	71	72	24.3	65.7	MAHBED
U090	4100350	72	73	19	51.4	MAHBED
U090	4100351	73	74	26.6	70.6	MAHBED
U090	4100352	74	75	23.1	61.8	MAHBED
U090	4100353	75	76	18.3	49	MAHZB
U090	4100354	76	77	17	45.1	MAHZB
U090	4100355	77	78	17.5	45.7	MAHZB
U090	4100356	78	79	14.9	39	MAHZB
U090	4100357	79	80	8.5	22.3	MAHZB
U090	4100358	80	81	5.7	15	MAHZB
U090	4100359	81	82	6.3	16.7	MAHZB
U090	4100360	82	83	17.5	46.7	MAHZB
U090	4100361	83	84	15.4	41	MAHZB
U090	4100362	84	85	6.3	16.9	MAHZB
U090	4100363	85	86	14.6	38.8	MAHZB
U090	4100364	86	87	6.7	17.8	MAHZB
U090	4100365	87	88	6.8	17.7	MAHZB
U090	4100366	88	89	18.3	47.9	MAHZB
U090	4100367	89	90	4.4	11.5	MAHZB
U090	4100368	90	91	4.2	11	MAHZB
U090	4100369	91	92	9.9	26.4	MAHZB
U090	4100370	92	93	11.6	31.1	MAHZB
U090	4100371	93	94	8	21.4	MAHZB
U090	4100372	94	95	11.9	31.8	MAHZB
U090	4100373	95	96	7.3	19.5	MAHZB
U090	4100374	96	97	4.2	11	MAHZB
U090	4100375	97	98	3.5	9.2	MAHZB
U090	4100376	98	99	4.8	12.6	MAHZB
U090	4100377	99	100	7.7	20.2	MAHZB
U090	4100378	100	101	2.7	7.1	BGR
U090	4100379	101	102	1.9	4.9	BGR
U090	4100380	102	103	1.5	3.9	BGR
U090	4100381	103	104	4	10.5	BGR
U090	4100382	104	105	3.6	9.3	BGR
U090	4100383	105	106	9.2	24	BGR
U090	4100384	106	107	2.2	5.8	BGR
U090	4100385	107	108	5.4	14.2	
U090	4100386	108	109	3.6	9.4	
U090	4100387	109	110	2.9	7.5	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U134	735399	80	81	2.8	7.2	
U134	735400	81	82	4.3	11.1	
U134	735401	82	83	2.7	7	
U134	735402	83	84	2.4	6.2	
U134	735403	84	85	2.9	7.5	
U134	735404	85	86	1.9	4.9	
U134	735405	86	87	4.7	12.2	
U134	735406	87	88	3.3	8.6	
U134	735407	88	89	3.3	8.6	
U134	735408	89	90	12.1	31.4	4SEN
U134	735409	90	91	4.2	10.9	4SEN
U134	735410	91	92	4.6	11.9	4SEN
U134	735411	92	93	4.6	11.9	4SEN
U134	735412	93	94	9.4	24.5	4SEN
U134	735413	94	95	6.7	17.5	4SEN
U134	735414	95	96	5.3	13.9	4SEN
U134	735415	96	97	13.8	36.3	4SEN
U134	735416	97	98	3.6	9.4	AGR
U134	735417	98	99	2.9	7.5	AGR
U134	735418	99	100	2.4	6.2	AGR
U134	735419	100	101	2.4	6.3	AGR
U134	735420	101	102	3.1	8	AGR
U134	735421	102	103	3.3	8.6	AGR
U134	735422	103	104	1.5	3.9	AGR
U134	735423	104	105	0.9	2.3	AGR
U134	735424	105	106	1	2.6	AGR
U134	735425	106	107	1.6	4.2	AGR
U134	735426	107	108	3.6	9.5	AGR
U134	735427	108	109	5.6	14.8	MAHZA
U134	735428	109	110	6	15.8	MAHZA
U134	735429	110	111	11.9	31.5	MAHZA
U134	735430	111	112	5.2	13.6	MAHZA
U134	735431	112	113	5.8	15.3	MAHZA
U134	735432	113	114	4.4	11.5	MAHZA
U134	735433	114	115	7.7	20.2	MAHZA
U134	735434	115	116	12.4	32.5	MAHZA
U134	735435	116	117	8.3	21.8	MAHZA
U134	735436	117	118	16.3	43.6	MAHZA
U134	735437	118	119	15.8	42.1	MAHZA
U134	735438	119	120	16.4	43.3	MAHZA
U134	735439	120	121	8.6	22.9	MAHZA
U134	735440	121	122	6.3	16.4	MAHZA
U134	735441	122	123	4.1	10.6	MAHZA

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U134	735442	123	124.1	5.3	13.8	MAHZA
U134	735443	124.1	125.2	7.7	20.2	MAHZA
U134	735444	125.2	126.3	4.1	10.6	MAHZA
U134	735445	126.3	127.3	4.3	11.2	MAHZA
U134	735446	127.3	128.3	4.1	10.6	MAHZA
U134	735447	128.3	129.3	3.7	9.6	MAHZA
U134	735448	129.3	130.3	3	7.8	MAHZA
U134	735449	130.3	131.3	3.5	9.2	MAHZA
U134	735450	131.3	132.3	4.4	11.6	MAHZA
U134	735451	132.3	133.3	5.9	15.5	MAHZA
U134	735452	133.3	134.4	14.2	37.2	MAHZA
U134	735453	134.4	135.4	8.8	23.4	MAHZA
U134	735454	135.4	136.5	6.9	18.2	MAHZA
U134	735455	136.5	137.6	13.7	36.2	MAHZA
U134	735456	137.6	138.8	24.9	66.2	MAHBED
U134	735457	138.8	139.8	30.1	79.9	MAHBED
U134	735458	139.8	140.8	29.9	79.4	MAHBED
U134	735459	140.8	141.8	22.7	60	MAHBED
U134	735460	141.8	142.3	11.9	31.7	MAHZB
U134	735461	142.3	143.4	23.4	61.7	MAHZB
U134	735462	143.4	144.8	7.8	20.3	MAHZB
U134	735463	144.8	146	16.5	42.9	MAHZB
U134	735464	146	147.1	6.5	17	MAHZB
U134	735465	147.1	148.2	19.3	51.2	MAHZB
U134	735466	148.2	149.2	18	47.5	MAHZB
U134	735467	149.2	150.2	6.8	18.3	MAHZB
U134	735468	150.2	151.5	13.6	35.8	MAHZB
U134	735469	151.5	152.6	5.6	14.7	MAHZB
U134	735470	152.6	153.8	5.5	14.4	MAHZB
U134	735471	153.8	155.1	16.1	41.7	MAHZB
U134	735472	155.1	156.3	4.5	11.8	MAHZB
U134	735473	156.3	157.4	4	10.4	MAHZB
U134	735474	157.4	158.4	5.6	14.7	MAHZB
U134	735475	158.4	159.4	13.6	35.7	MAHZB
U134	1E+10	159.4	159.7			MAHZB
U134	735476	159.7	160.7	10.6	28.4	MAHZB
U134	735477	160.7	161.7	8.1	22.1	MAHZB
U134	735478	161.7	162.9	12	31.9	MAHZB
U134	735479	162.9	164.1	6	15.7	MAHZB
U134	735480	164.1	165.2	3.2	8.3	MAHZB
U134	735481	165.2	166.4	4.3	11.2	MAHZB
U134	735482	166.4	167.4	8.8	22.8	MAHZB
U134	735483	167.4	168.5	3.1	8	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U134	735484	168.5	169.5	1.7	4.4	MAHZB
U134	735485	169.5	170.5	1.8	4.7	MAHZB
U134	735486	170.5	171.5	5.1	13.4	MAHZB
U134	735487	171.5	172.5	3	7.8	MAHZB
U134	735488	172.5	173.5	3.6	9.4	MAHZB
U134	735489	173.5	174.5	10.3	26.8	MAHZB
U134	735490	174.5	175.8	2.7	7.1	MAHZB
U134	735491	175.8	177.1	7.4	19.4	MAHZB
U134	735492	177.1	178.3	1.5	3.9	
U134	735493	178.3	179.4	4.5	11.7	
U134	735494	179.4	180.4	3.6	9.3	
U134	735495	180.4	181.5	2.9	7.5	
U134	735496	181.5	182.6	1.5	3.9	
U134	735497	182.6	183.6	1.7	4.4	
U134	735498	183.6	184.6	1.9	4.9	
U135	735294	277.7	279	6.9	18.1	MAHZA
U135	735295	279	280	5.5	14.4	MAHZA
U135	735296	280	281	4.3	11.2	MAHZA
U135	735297	281	282	3.5	9.1	MAHZA
U135	735298	282	283	5.7	14.8	MAHZA
U135	735299	283	284	9.3	24.2	MAHZA
U135	735300	284	285	9.2	24.2	MAHZA
U135	735301	285	286	16.2	42.9	MAHZA
U135	735302	286	287	7.4	19.6	MAHZA
U135	735303	287	288	6.4	16.8	MAHZA
U135	735304	288	289	3.8	9.9	MAHZA
U135	735305	289	290	7	18.3	MAHZA
U135	735306	290	291	5.4	14.1	MAHZA
U135	735307	291	292	4.1	10.7	MAHZA
U135	735308	292	293	3.5	9.1	MAHZA
U135	735309	293	294	3.5	9.1	MAHZA
U135	735310	294	295.1	3.2	8.4	MAHZA
U135	735311	295.1	296.2	5.1	13.4	MAHZA
U135	735312	296.2	297.2	15.4	40.2	MAHZA
U135	735313	297.2	298.3	7.4	19.6	MAHZA
U135	735314	298.3	299.4	6.3	16.6	MAHZA
U135	735315	299.4	300.5	11.4	29.9	MAHZA
U135	735316	300.5	301.6	12	31.5	MAHZA
U135	735317	301.6	302.6	19.9	52.8	MAHBED
U135	735318	302.6	303.6	28.1	74.3	MAHBED
U135	735319	303.6	304.6	23.4	62.2	MAHBED
U135	735320	304.6	305.1	12.9	34.3	MAHZB
U135	735321	305.1	306.1	22	58	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U135	735322	306.1	307.1	9	23.4	MAHZB
U135	735323	307.1	308.1	6.7	17.4	MAHZB
U135	735324	308.1	309	18.2	47.2	MAHZB
U135	735325	309	310	5.7	14.8	MAHZB
U135	735326	310	311	5.9	15.4	MAHZB
U135	735327	311	312	9.6	25.2	MAHZB
U135	735328	312	313	18.4	48.6	MAHZB
U135	735329	313	314	11.9	31.4	MAHZB
U135	735330	314	315.1	11.6	30.5	MAHZB
U135	735331	315.1	316.1	6.3	16.4	MAHZB
U135	735332	316.1	317.2	5.3	13.8	MAHZB
U135	735333	317.2	318.2	16	41.5	MAHZB
U135	735334	318.2	319.2	4.2	10.9	MAHZB
U135	735335	319.2	320.3	5.9	15.4	MAHZB
U135	735336	320.3	321.3	12.9	33.8	MAHZB
U135	735337	321.3	322.3	12.6	33.5	MAHZB
U135	735338	322.3	323.3	7.5	19.8	MAHZB
U135	735339	323.3	324.3	11	29.1	MAHZB
U135	735340	324.3	325.4	5.8	15.2	MAHZB
U135	735341	325.4	326.5	3.7	9.6	MAHZB
U135	735342	326.5	327.5	5.1	13.3	MAHZB
U135	735343	327.5	328.6	6.6	17.1	MAHZB
U135	735344	328.6	329.7	2	5.2	MAHZB
U135	735345	329.7	330.7	2.7	7	MAHZB
U135	735346	330.7	331.8	3.8	9.9	MAHZB
U135	735347	331.8	332.8	9.3	24.3	MAHZB
U135	735348	332.8	333.8	2.6	6.8	MAHZB
U135	735349	333.8	334.8	6.1	16	MAHZB
U135	735350	334.8	335.8	6.7	17.4	MAHZB
U135	735351	335.8	336.8	1.2	3.1	BGR
U135	735352	336.8	337.9	3.3	8.6	BGR
U135	735353	337.9	339	4.6	11.8	BGR
U135	735354	339	340	3	7.8	BGR
U135	735355	340	341	1.7	4.4	BGR
U135	735356	341	342	2	5.2	BGR
U135	735357	342	343	1.9	4.9	BGR
U135	735358	343	344	1	2.6	BGR
U135	735359	344	345	0.8	2.1	BGR
U135	735360	345	346	2.1	5.5	BGR
U135	735361	346	347	1	2.6	BGR
U135	735362	347	348	0.3	0.8	BGR
U135	735363	348	348.9	1.4	3.6	BGR
U135	735364	348.9	350	0.6	1.6	BGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U135	735365	350	351.2	3.1	8.1	BGR
U135	735366	351.7	353	2.4	6.3	BGR
U135	735367	353	354	6.2	16.4	
U135	735368	354	355	4.7	12.4	
U135	735369	355	356	2.3	6	
U135	735370	356	357	4.3	11.4	
U135	735371	357	358	3.6	9.6	
U135	735372	358	359	1.2	3.1	
U135	735373	359	360	3	7.9	
U135	735374	360	361	2.2	5.8	
U135	735375	361	362	2.8	7.4	
U135	735376	362	363	2.2	5.8	
U135	735377	363	364	2.4	6.4	
U135	735378	364	365	2.4	6.3	
U135	735379	365	366	1.4	3.6	
U135	735380	366	367	3.1	8.1	
U135	735381	367	368	6.6	17.4	
U135	735382	368	369	4.7	12.3	
U135	735383	369	370	2	5.2	
U135	735384	370	371	3.2	8.4	
U135	735385	371	371.8	4.4	11.4	
U135	735386	371.8	373.1	2.1	5.4	
U135	735387	373.1	374.4	1.2	3.1	
U135	735392	380.4	381.4	1.2	3.1	
U135	735393	381.4	382.7	5.5	14.3	
U135	735394	382.7	384	4.2	10.9	
U135	735395	384	386	4.4	11.4	
U135	735396	386	388	3.1	8	
U135	735397	388	390	3.3	8.5	
U135	735398	390	392	2.5	6.5	
U141	735594	59.4	60.3	6.6	17.2	4SEN
U141	735595	60.3	61	2.3	6	AGR
U141	735596	61	62	1.7	4.4	AGR
U141	735597	62	63	1.3	3.4	AGR
U141	735598	63	64	1	2.6	AGR
U141	735599	64	65	2.5	6.4	AGR
U141	735600	65	66	1.1	2.9	AGR
U141	735601	66	67	1	2.6	AGR
U141	735602	67	68	0.6	1.6	AGR
U141	735603	68	69	0.7	1.8	AGR
U141	735604	69	70	2.7	7.1	AGR
U141	735605	70	71	4.5	11.7	MAHZA
U141	735606	71	72	8.1	21.4	MAHZA

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U141	735607	72	73	9.4	24.7	MAHZA
U141	735608	73	74	4.9	12.8	MAHZA
U141	735609	74	75	4.5	11.8	MAHZA
U141	735610	75	76	3.1	8.1	MAHZA
U141	735611	76	77	8.2	21.3	MAHZA
U141	735612	77	78	11.9	31	MAHZA
U141	735613	78	79	8.9	23.3	MAHZA
U141	735614	79	80	13.3	35.5	MAHZA
U141	735615	80	81	17.8	46.9	MAHZA
U141	735616	81	82	10.8	28.8	MAHZA
U141	735617	82	83	6.6	17.4	MAHZA
U141	735618	83	84	5.5	14.3	MAHZA
U141	735619	84	85	4	10.4	MAHZA
U141	735620	85	86	7.9	20.7	MAHZA
U141	735621	86	87	5.8	15.2	MAHZA
U141	735622	87	88	3.8	9.9	MAHZA
U141	735623	88	89	4.2	10.9	MAHZA
U141	735624	89	90	3.3	8.7	MAHZA
U141	735625	90	91	3.6	9.4	MAHZA
U141	735626	91	92	2.8	7.4	MAHZA
U141	735627	92	93	7.1	18.6	MAHZA
U141	735628	93	94	16.6	43.5	MAHZA
U141	735629	94	95	7.8	20.6	MAHZA
U141	735630	95	96	6.6	17.5	MAHZA
U141	735631	96	97	10.8	28.4	MAHZA
U141	735632	97	98	13.9	36.4	MAHZA
U141	735633	98	99	23.6	63	MAHBED
U141	735634	99	100	25.1	65.9	MAHBED
U141	735635	100	101	30	79.8	MAHBED
U141	735636	101	102	25.1	67.1	MAHBED
U141	735637	102	103	16.3	43.2	MAHBED
U141	735638	103	104	21.7	57	MAHBED
U141	735639	104	105	8.8	22.9	MAHZB
U141	735640	105	106	6.2	16.2	MAHZB
U141	735641	106	107	14	36.9	MAHZB
U141	735642	107	108	8.2	21.2	MAHZB
U141	735643	108	109	6.4	16.7	MAHZB
U141	735644	109	110	19.1	49.9	MAHZB
U141	735645	110	111	18.8	49.6	MAHZB
U141	735646	111	112	6.9	18.6	MAHZB
U141	735647	112	113	7.3	20	MAHZB
U141	735648	113	114	12.1	32.3	MAHZB
U141	735649	114	115	6.1	16	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U141	735650	115	115.9	4.9	12.8	MAHZB
U141	1E+10	115.9	116.3			MAHZB
U141	735651	116.3	117	11	28.7	MAHZB
U141	735652	117	118	15	39.2	MAHZB
U141	735653	118	119	4	10.5	MAHZB
U141	735654	119	120	4	10.4	MAHZB
U141	735655	120	121	5.6	14.6	MAHZB
U141	735656	121	122	8	21	MAHZB
U141	735657	122	123	13.1	35.1	MAHZB
U141	735658	123	124	8.1	21.4	MAHZB
U141	735659	124	125	11.2	29.6	MAHZB
U141	735660	125	126	8.1	21.5	MAHZB
U141	735661	126	127	4.6	12	MAHZB
U141	735662	127	128	3.3	8.5	MAHZB
U141	735663	128	129	4.4	11.5	MAHZB
U141	735664	129	130	11	28.6	MAHZB
U141	735665	130	131	3.6	9.4	
U141	735666	131	132	2.4	6.2	
U141	735667	132	133	1.4	3.6	
U141	735668	133	134	3.6	9.5	
U141	735669	134	135	4	10.6	
U141	735670	135	136.3	2.3	6	
U142	4100388	0	2	4.4	11.3	MAHZB
U142	4100389	2	4	16.8	44.1	MAHZB
U142	4100390	4	6	10.8	28.5	MAHZB
U142	4100391	6	8	11	28.5	MAHZB
U142	4100392	8	10	5.8	15.1	MAHZB
U142	4100393	10	12	7.2	18.8	MAHZB
U142	4100394	12	14	6.9	17.9	MAHZB
U142	4100395	14	16	7.4	19.3	MAHZB
U142	4100396	16	18	5.1	13.2	MAHZB
U142	4100397	18	20	2.3	5.9	MAHZB
U142	4100398	20	21	2.2	5.7	MAHZB
U142	4100399	21	21.6	4.1	10.8	MAHZB
U142	4100400	21.6	22.1	1.8	4.5	MAHZB
U142	4100401	22.1	22.6	3.1	8.2	MAHZB
U142	4100402	22.6	23.1	13.5	35.3	MAHZB
U142	4100403	23.1	24	3.2	8.3	MAHZB
U142	4100404	24	25.1	4.9	12.7	MAHZB
U142	4100405	25.1	25.4	10.6	27.6	MAHZB
U142	4100406	25.4	26	1.2	3.1	
U142	4100407	26	27	1.5	3.8	
U142	4100408	27	27.5	4.7	12.5	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U142	4100409	27.5	28	3.7	9.6	
U142	4100410	28	29	4.2	10.8	
U142	4100411	29	30	2.5	6.7	
U142	4100412	30	30.4	0.6	1.6	
U142	4100413	30.4	31	1.6	4.2	
U142	4100414	31	32	1.6	4.3	
U142	4100415	32	32.5	1.4	3.7	
U142	4100416	32.5	32.7	4	10.6	
U142	4100417	32.7	33.4	0.5	1.3	
U142	4100418	33.4	33.8	3.1	8.1	
U142	4100419	33.8	34.6	0.4	1.1	
U142	4100420	34.6	35.5	0.9	2.4	
U142	4100421	35.5	36	2.8	7.4	
U142	4100422	36	37	2.6	7	
U142	4100423	37	38	3.9	10.5	
U142	4100424	38	38.5	5.1	13.8	
U142	4100425	38.5	39	3.9	10.4	
U142	4100426	39	40	2.2	5.9	
U142	4100427	40	41	2.5	6.6	
U142	4100428	41	42	1.1	2.9	
U142	4100429	42	43	1.9	5	
U142	4100430	43	44	2.2	5.9	
U142	4100431	44	45	1.4	3.8	
U142	4100432	45	46	1.7	4.5	
U142	4100433	46	47	1	2.6	
U142	4100434	47	48	2.8	7.4	
U142	4100435	48	49	2.8	7.4	
U142	4100436	49	50	0.5	1.3	
U142	4100437	50	51	3	7.8	
U142	4100438	51	52	2.8	7.2	
U142	4100439	52	53	6.9	17.9	
U142	4100440	53	54	3.8	10	
U142	4100441	54	55	3	7.9	
U142	4100442	55	56	7.3	19.1	
U142	4100443	56	57	8.4	21.9	
U142	4100444	57	58	6.5	17	
U142	4100445	58	59	7.9	20.5	
U142	4100446	59	60	6.5	16.8	
U142	4100447	60	61	2.3	6.1	
U142	4100448	61	62	3.5	9.1	
U142	4100449	62	63	2	5.1	
U142	4100450	63	64	1.5	3.8	
U142	4100451	64	65	2.1	5.4	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U142	4100452	65	66	0.6	1.6	
U142	4100453	66	67	5.3	13.9	
U142	4100454	67	68	7.8	20.5	
U142	4100455	68	69	8.5	22.1	
U142	4100456	69	69.6	5.6	14.6	
U142	4100457	69.6	71	0.1	0.2	
U142	4100458	71	72	6.2	16.4	
U142	4100459	72	73	3.6	9.5	
U142	4100460	73	74	0.1	0.2	
U142	4100461	74	75	0	0	
U142	4100462	75	76	0	0	
U142	4100463	76	77	0	0	
U142	4100464	77	78	0	0	
U142	4100465	78	79.3	0	0	
U142	4100466	79.3	80	4.1	10.8	
U142	4100467	80	81	7.8	20.5	
U142	4100468	81	82	7.3	19.2	
U142	4100469	82	83	7.1	18.8	
U142	4100470	83	84	3	7.8	
U142	4100471	84	85.5	0	0	
U142	4100472	85.5	87	0	0	
U142	4100473	87	88.5	0	0	
U142	4100474	88.5	90	0	0	
U142	4100475	90	91.5	0	0	
U142	4100476	91.5	93	0	0	
U142	4100477	93	94.5	0	0	
U142	4100478	94.5	96	0	0	
U142	4100479	96	97.5	0	0	
U142	4100480	97.5	99	0	0	
U142	4100481	99	100	0	0	
U143	4100482	138.5	139	4.1	10.8	
U143	4100483	139	140.5	2.8	7.3	
U143	4100484	140.5	142	2.9	7.7	
U143	4100485	142	143.5	2.2	5.7	
U143	4100486	143.5	145	4.2	11.1	
U143	4100487	145	146.5	3.1	8.1	
U143	4100488	146.5	147.5	11.6	30.4	4SEN
U143	4100489	147.5	149	3.7	9.7	4SEN
U143	4100490	149	150.5	4.3	11.2	4SEN
U143	4100491	150.5	152	7.5	19.7	4SEN
U143	4100492	152	153	4.5	11.9	4SEN
U143	4100493	153	154	11	28.4	4SEN
U143	4100494	154	155.5	2.1	5.4	AGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U143	4100495	155.5	157	1.6	4.3	AGR
U143	4100496	157	158.5	2	5.1	AGR
U143	4100497	158.5	160	1.9	5.1	AGR
U143	4100498	160	161	1.7	4.5	AGR
U143	4100499	161	162.5	0.6	1.5	AGR
U143	4100500	162.5	164	1.6	4.4	AGR
U143	4100501	164	165.5	5	13.4	AGR
U143	4100502	165.5	167	8.4	22.2	MAHZA
U143	4100503	167	168.5	4.8	12.5	MAHZA
U143	4100504	168.5	170	4.1	10.7	MAHZA
U143	4100505	170	171.5	8.6	22.3	MAHZA
U143	4100506	171.5	173	9	23.9	MAHZA
U143	4100507	173	174	16	42.3	MAHZA
U143	4100508	174	175.5	7	18.5	MAHZA
U143	4100509	175.5	177	5.2	13.5	MAHZA
U143	4100510	177	178.5	7	18.3	MAHZA
U143	4100511	178.5	180	4.3	11.2	MAHZA
U143	4100512	180	181.5	4.6	11.9	MAHZA
U143	4100513	181.5	183	3.6	9.5	MAHZA
U143	4100514	183	184	3.7	9.6	MAHZA
U143	4100515	184	185	4.1	10.9	MAHZA
U143	4100516	185	186	15.6	40.9	MAHZA
U143	4100517	186	187.5	8.3	22.1	MAHZA
U143	4100518	187.5	189	7	18.6	MAHZA
U143	4100519	189	190	13.2	34.9	MAHZA
U143	4100520	190	191	12.8	33.4	MAHZA
U143	4100521	191	192	11.3	30.1	MAHZA
U143	4100522	192	193.5	21.7	57.7	MAHBED
U143	4100523	193.5	195	3.5	9.1	MAHBED
U143	4100524	195	196	15.4	50	MAHBED
U143	4100525	196	197	19.2	50.2	MAHBED
U143	4100526	197	198.5	6.9	17.9	MAHZB
U143	4100527	198.5	200	11.1	29	MAHZB
U143	4100528	200	201.5	13.2	35	MAHZB
U143	4100529	201.5	203	12.2	32.3	MAHZB
U143	4100530	203	204.5	10.7	28.2	MAHZB
U143	4100531	204.5	206	5.4	14.1	MAHZB
U143	4100532	206	207	10.5	27.3	MAHZB
U143	4100533	207	208	9.5	24.7	MAHZB
U143	4100534	208	209.5	4.1	10.7	MAHZB
U143	4100535	209.5	211	11.3	29.8	MAHZB
U143	4100536	211	212.5	8.7	22.9	MAHZB
U143	4100537	212.5	214	8.5	22.3	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U143	4100538	214	215.5	5.7	14.7	MAHZB
U143	4100539	215.5	217	4.2	10.7	MAHZB
U143	4100540	217	218.5	6.7	17.4	MAHZB
U143	4100541	218.5	220	2.6	6.7	MAHZB
U143	4100542	220	221.5	2	5.1	MAHZB
U143	4100543	221.5	222.5	3.6	9.3	MAHZB
U143	4100544	222.5	224	7.5	19.6	MAHZB
U143	4100545	224	225.5	2.4	6.4	MAHZB
U143	4100546	225.5	227	6.6	17.3	MAHZB
U143	4100547	227	228	0.8	2.2	BGR
U143	4100548	228	229	3.3	8.5	BGR
U143	4100549	229	230.5	4.8	12.3	BGR
U143	4100550	230.5	232	1.5	3.8	BGR
U143	4100551	232	233.5	1.9	5	BGR
U143	4100552	233.5	235	1.6	4.2	BGR
U143	4100553	235	236	4.1	10.6	BGR
U143	4100554	236	237.5	0.8	2	BGR
U143	4100555	237.5	239	4.3	11.1	BGR
U143	4100556	239	240.5	2.7	7	BGR
U143	4100557	240.5	242	5.9	15.7	BGR
U143	4100558	242	243.5	2.4	6.4	BGR
U143	4100559	243.5	245	2.9	7.6	BGR
U143	4100560	245	246.5	1.7	4.4	BGR
U143	4100561	246.5	248	2.1	5.3	BGR
U143	4100562	248	249.5	2.8	7.3	BGR
U143	4100563	249.5	251	1.8	4.9	BGR
U143	4100564	251	252	1.8	4	BGR
U143	4100565	252	253	1	2.6	BGR
U143	4100566	253	254.5	4.3	11.3	BGR
U143	4100567	254.5	256	2.7	7.2	BGR
U143	4100568	256	257	2.1	5.5	BGR
U143	4100569	257	258.5	2.3	5.9	BGR
U143	4100570	258.5	260	5.7	15	
U143	4100571	260	261	6.2	16.2	
U143	4100572	261	262	1.7	4.5	
U143	4100573	262	263	2.4	6.3	
U143	4100574	263	264	1.3	3.5	
U143	4100575	264	265.5	4.6	11.9	
U143	4100576	265.5	266.5	4.3	11.3	
U143	4100579	269	270	0.9	2.4	
U143	4100580	270	271.5	8	20.9	
U143	4100581	271.5	273	11.8	30.8	
U143	4100582	273	274.5	6.6	17.3	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U143	4100583	274.5	276	7	18.4	
U143	4100584	276	277.5	6	15.7	
U143	4100585	277.5	279	5.4	14.1	
U143	4100586	279	280	7.3	18.8	
U143	4100587	280	281	3.9	10.2	
U143	4100588	281	282	3.8	9.8	
U143	4100589	282	283.5	4.7	12.2	
U143	4100590	283.5	285	6.9	18.2	
U143	4100591	285	286.5	0.7	1.9	
U143	4100592	286.5	288	0.7	1.7	
U144	4100607	269.4	270.9	3.2	8.3	
U144	4100608	270.9	271.6	1.6	4.2	
U144	4100609	271.6	273	1.1	2.8	
U144	4100610	273	274.5	2.1	5.4	
U144	4100611	274.5	275.5	1.2	3.1	
U144	4100612	275.5	276.4	1.2	3.1	
U144	4100613	276.4	277.3	0.8	2.1	
U144	4100614	277.3	278.5	0.7	1.9	
U144	4100615	278.5	280.3	3	7.8	
U144	4100616	280.3	281	8.4	22.3	MAHZA
U144	4100617	281	282.5	4.9	12.9	MAHZA
U144	4100618	282.5	284	3.6	9.5	MAHZA
U144	4100619	284	285.5	9	23.7	MAHZA
U144	4100620	285.5	287.2	12	32.3	MAHZA
U144	4100621	287.2	287.8	7.6	19.4	MAHZA
U144	4100622	287.8	288.5	16.4	43.8	MAHZA
U144	4100623	288.5	289.5	7.2	19	MAHZA
U144	4100624	289.5	291.3	5.7	14.9	MAHZA
U144	4100625	291.3	292.1	4.2	10.5	MAHZA
U144	4100626	292.1	293.5	4.5	11.8	MAHZA
U144	4100627	293.5	295	4.1	10.8	MAHZA
U144	4100628	295	296	3.2	8.5	MAHZA
U144	4100629	296	296.7	2.6	6.9	MAHZA
U144	4100630	296.7	298.5	4.2	11	MAHZA
U144	4100631	298.5	299.5	16.2	42.6	MAHZA
U144	4100632	299.5	300.5	7.1	18.9	MAHZA
U144	4100633	300.5	302	8.6	23	MAHZA
U144	4100634	302	303	12.8	33.8	MAHZA
U144	4100635	303	304.5	17.4	46.9	MAHZA
U144	4100636	304.5	306	28.2	75.6	MAHBED
U144	4100637	306	307	24.3	64.3	MAHBED
U144	4100638	307	308.2	17.2	45.2	MAHZB
U144	4100639	308.2	309	13	34.9	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U144	4100640	309	310.5	7.7	20.1	MAHZB
U144	4100641	310.5	312	11.6	30.7	MAHZB
U144	4100642	312	313.5	9.5	25.1	MAHZB
U144	4100643	313.5	315	17.1	45.4	MAHZB
U144	4100644	315	316.2	8.3	22.6	MAHZB
U144	4100645	316.2	317.1	12.3	32.7	MAHZB
U144	4100646	317.1	318.5	8.6	22.5	MAHZB
U144	4100647	318.5	319.5	5.2	13.7	MAHZB
U144	4100648	319.5	321	14	36.1	MAHZB
U144	4100649	321	322.5	3.5	9.2	MAHZB
U144	4100650	322.5	324	5.6	14.8	MAHZB
U144	4100651	324	325.6	13.3	35.8	MAHZB
U144	4100652	325.6	326.2	11.3	30	MAHZB
U144	4100653	326.2	327.5	8.4	22.6	MAHZB
U144	4100654	327.5	329	10.8	28.8	MAHZB
U144	4100655	329	330	4.7	12.4	MAHZB
U144	4100656	330	331	3.8	10.1	MAHZB
U144	4100657	331	332.5	6.4	16.7	MAHZB
U144	4100658	332.5	334	2	5.3	MAHZB
U144	4100659	334	335.5	2.2	5.8	MAHZB
U144	4100660	335.5	337	7	18.5	MAHZB
U144	4100661	337	337.5	3.9	10.3	
U144	4100662	337.5	339	3.7	9.8	
U144	4100663	339	340.5	3.9	10.3	
U144	4100664	340.5	342	1.5	4	
U144	4100665	342	343.5	4.4	11.4	
U144	4100666	343.5	345	2.3	6	
U144	4100667	345	346.5	1.5	3.8	
U144	4100668	346.5	348	2.1	5.5	
U144	4100669	348	348.5	1.7	4.4	
U144	4100670	348.5	349.4	1.8	4.8	
U144	4100671	349.4	351	1.8	4.8	
U144	4100672	351	352	5	13.3	
U144	4100673	352	353	0.5	1.4	
U144	4100674	353	354.5	1.1	2.8	
U144	4100675	354.5	355.6	1.9	4.9	
U144	4100676	355.6	356.4	1.2	3.2	
U144	4100677	356.4	358	3.5	9.3	
U144	4100678	358	359.5	3.6	9.6	
U144	4100679	359.5	361	4.9	12.9	
U144	4100680	361	362.5	3.4	8.9	
U144	4100681	362.5	364	2.3	6	
U144	4100682	364	365.5	2.2	5.7	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U144	4100683	365.5	367	2.3	6.2	
U144	4100684	367	368.5	2.4	6.3	
U144	4100685	368.5	370	2	5.4	
U144	4100686	370	371.5	2.1	5.7	
U144	4100687	371.5	373	1.8	4.7	
U144	4100688	373	374.5	6.1	16.1	
U144	4100689	374.5	376	3.5	9.1	
U144	4100690	376	377.5	3.5	9.2	
U144	4100691	377.5	379	4	10.4	
U144	4100692	379	380.5	1.5	3.8	
U144	4100693	380.5	382	1.8	4.6	
U144	4100694	382	383.5	0.1	0.1	
U144	4100699	389.5	391	2.8	7.3	
U144	4100700	391	392	5	13.2	
U144	4100701	392	393	0.4	1.1	
U144	4100702	393	394.5	2.2	5.7	
U144	4100703	394.5	396	1.2	3	
U144	4100704	396	397.5	1	2.7	
U144	4100706	398.5	399.5	5	13.1	
U144	4100707	399.5	401	3.3	8.6	
U144	4100708	401	402	4.7	12.4	
U144	4100709	402	403	0.3	0.8	
U144	4100710	403	404.5	0.4	1.1	
U144	4100711	404.5	406	0.1	0.3	
U153	4101171	40	41	7.6	19.7	B3
U153	4101172	41	42	7.5	19.4	B3
U153	4101173	42	43	4.2	10.7	
U153	4101174	43	44	2.8	7	
U153	4101175	44	45	2.9	7.4	
U153	4101176	45	46	3.3	8.3	
U153	4101177	46	47	2.8	7.1	
U153	4101178	47	48	2.7	6.8	
U153	4101179	48	49	2.9	7.3	
U153	4101180	49	50	2	5	
U153	4101181	50	51	5.1	12.9	
U153	4101182	51	52	3.3	8.4	
U153	4101183	52	53	3.1	7.9	
U153	4101184	53	54	11.5	29.3	4SEN
U153	4101185	54	55	5.5	13.8	4SEN
U153	4101186	55	56	4.5	11.5	4SEN
U153	4101187	56	57	4.8	12.2	4SEN
U153	4101188	57	58	7.4	18.9	4SEN
U153	4101189	58	59	6.6	17	4SEN

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U153	4101190	59	60	5	12.9	4SEN
U153	4101191	60	61	13.3	34.1	4SEN
U153	4101192	61	62	4.5	11.5	4SEN
U153	4101193	62	63	1.8	4.8	AGR
U153	4101194	63	64	1.5	4	AGR
U153	4101195	64	65	0.9	2.3	AGR
U153	4101196	65	66	2.2	5.8	AGR
U153	4101197	66	67	1.3	3.4	AGR
U153	4101198	67	68	1.3	3.4	AGR
U153	4101199	68	69	0.8	2	AGR
U153	4101200	69	70	0.7	1.9	AGR
U153	4101201	70	71	0.7	1.8	AGR
U153	4101202	71	72	1.9	4.9	AGR
U153	4101203	72	73	6.3	16.4	MAHZA
U153	4101204	73	74	3.8	9.8	MAHZA
U153	4101205	74	75	10.7	27.3	MAHZA
U153	4101206	75	76	5.2	13.3	MAHZA
U153	4101207	76	77	4.8	12.3	MAHZA
U153	4101208	77	78	5	12.6	MAHZA
U153	4101209	78	79	11.5	29.5	MAHZA
U153	4101210	79	80	8.1	20.8	MAHZA
U153	4101211	80	81	15.8	41.2	MAHZA
U153	4101212	81	82	13.4	34.8	MAHZA
U153	4101213	82	83	7.2	18.8	MAHZA
U153	4101214	83	84	5.9	15.4	MAHZA
U153	4101215	84	85	3.7	9.5	MAHZA
U153	4101216	85	86	7.4	19.3	MAHZA
U153	4101217	86	87	5.7	14.7	MAHZA
U153	4101218	87	88	4	10.4	MAHZA
U153	4101219	88	89	4.4	11.4	MAHZA
U153	4101220	89	90	4.3	11	MAHZA
U153	4101221	90	91	3.5	9	MAHZA
U153	4101222	91	92	2.6	6.7	MAHZA
U153	4101223	92	93	5.6	14.4	MAHZA
U153	4101224	93	94	14	36.2	MAHZA
U153	4101225	94	95	7.2	18.5	MAHZA
U153	4101226	95	96	6.5	16.9	MAHZA
U153	4101227	96	97	7.8	20	MAHZA
U153	4101228	97	98	11.6	30.1	MAHZA
U153	4101229	98	99	22.1	57.3	MAHBED
U153	4101230	99	100	17.1	44.3	MAHBED
U153	4101231	100	101	29.3	76.1	MAHBED
U153	4101232	101	102	21.5	56	MAHBED

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U153	4101233	102	103	13.8	36.5	MAHZB
U153	4101234	103	104	17.8	46.3	MAHZB
U153	4101235	104	105	7.2	18.5	MAHZB
U153	4101236	105	106	6.8	17.4	MAHZB
U153	4101237	106	107	15.4	39.4	MAHZB
U153	4101238	107	108	6.2	16	MAHZB
U153	4101239	108	109	5.8	14.9	MAHZB
U153	4101240	109	110	16.9	43.4	MAHZB
U153	4101241	110	111	17.1	44.5	MAHZB
U153	4101242	111	112	7.6	19.7	MAHZB
U153	4101243	112	113	13.3	34.6	MAHZB
U153	4101244	113	114	5.9	15.2	MAHZB
U153	4101245	114	115	4.9	12.8	MAHZB
U153	4101246	115	116	16.1	41.9	MAHZB
U153	4101247	116	117	7.9	20.5	MAHZB
U153	4101248	117	118	2.4	6.4	MAHZB
U153	4101249	118	119	3.7	9.6	MAHZB
U153	4101250	119	120	5.4	14	MAHZB
U153	4101251	120	121	8.1	21.2	MAHZB
U153	4101252	121	122	9.7	25.3	MAHZB
U153	4101253	122	123	10.5	27.4	MAHZB
U153	4101254	123	124	5.3	13.7	MAHZB
U153	4101255	124	125	3.8	9.9	MAHZB
U153	4101256	125	126	4.5	11.7	MAHZB
U153	4101257	126	127	7.5	19.4	MAHZB
U153	4101258	127	128	3.1	8	MAHZB
U153	4101259	128	129	1.7	4.3	MAHZB
U153	4101260	129	130	1.7	4.4	MAHZB
U153	4101261	130	131	4.3	11.1	MAHZB
U153	4101262	131	132	1.3	3.5	MAHZB
U153	4101263	132	133	9.5	24.5	MAHZB
U153	4101264	133	134	2.7	7	MAHZB
U153	4101265	134	135	8	20.6	MAHZB
U153	4101266	135	136	1.5	3.8	
U153	4101267	136	137	2.6	6.7	
U153	4101268	137	138	2.1	5.4	
U153	4101269	138	139	1.5	3.9	
U153	4101270	139	140	0.9	2.4	
U153	4101271	140	141	1.2	3.2	
U153	4101272	141	142	1.6	4.1	
U153	4101273	142	143	1.3	3.3	
U153	4101274	143	144	0.4	1	
U177	4101756	10	11	1.4	3.5	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U177	4101757	11	12	2	5.1	
U177	4101758	12	13	1.1	2.8	
U177	4101759	13	14	0.7	1.7	
U177	4101760	14	15	0.5	1.3	
U177	4101761	15	16	0.6	1.5	
U177	4101762	16	17	3.3	8.7	
U177	4101763	17	18	4.6	12.3	MAHZA
U177	4101764	18	19	11.2	29.8	MAHZA
U177	4101765	19	20	7	18.2	MAHZA
U177	4101766	20	21	4.4	11.5	MAHZA
U177	4101767	21	22	4	10.6	MAHZA
U177	4101768	22	23	5.9	15.4	MAHZA
U177	4101769	23	24	9.7	25.2	MAHZA
U177	4101770	24	25	6.9	17.8	MAHZA
U177	4101771	25	26	10.3	27.2	MAHZA
U177	4101772	26	27	17.3	46	MAHZA
U177	4101773	27	28	14.2	37.9	MAHZA
U177	4101774	28	29	6.9	18.2	MAHZA
U177	4101775	29	30	5.8	15.1	MAHZA
U177	4101776	30	31	3.8	10	MAHZA
U177	4101777	31	32	7.1	18.7	MAHZA
U177	4101778	32	33	6.2	16.4	MAHZA
U177	4101779	33	34	3.6	9.5	MAHZA
U177	4101780	34	35	4.3	11.2	MAHZA
U177	4101781	35	36	2.7	7.2	MAHZA
U177	4101782	36	37	3.6	9.6	MAHZA
U177	4101783	37	38	2.9	7.8	MAHZA
U177	4101784	38	39	4.3	11.4	MAHZA
U177	4101785	39	40	4.2	11.2	MAHZA
U177	4101786	40	41	10.4	27.2	MAHZA
U177	4101787	41	42	12.6	33	MAHZA
U177	4101788	42	43	7.7	20.6	MAHZA
U177	4101789	43	44	9	23.9	MAHZA
U177	4101790	44	45	14.5	38.1	MAHZA
U177	4101791	45	46	12.7	33.6	MAHZA
U177	4101792	46	47	18.4	49	MAHZA
U177	4101793	47	48	17.8	47.1	MAHZA
U177	4101794	48	49	23.1	61.3	MAHBED
U177	4101795	49	50	27.3	72.9	MAHBED
U177	4101796	50	51	19.4	51.3	MAHBED
U177	4101797	51	52	7.7	20.2	MAHZB
U177	4101798	52	53	6.8	17.8	MAHZB
U177	4101799	53	54	14.3	37.1	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U177	4101800	54	55	5.5	14.4	MAHZB
U177	4101801	55	56	12.3	32.4	MAHZB
U177	4101802	56	57	18.5	49	MAHZB
U177	4101803	57	58	10.8	28.7	MAHZB
U177	4101804	58	59	13.6	35.9	MAHZB
U177	4101805	59	60	7.2	19	MAHZB
U177	4101806	60	61	4.6	12	MAHZB
U177	4101807	61	62	6	15.9	MAHZB
U177	4101808	62	63	16.1	42	MAHZB
U177	4101809	63	64	4.9	12.8	MAHZB
U177	4101810	64	65	3.4	8.9	MAHZB
U177	4101811	65	66	6.2	16.3	MAHZB
U177	4101812	66	67	14	36.8	MAHZB
U177	4101813	67	68	11.1	29.6	MAHZB
U177	4101814	68	69	8	21.2	MAHZB
U177	4101815	69	70	10.5	28.1	MAHZB
U177	4101816	70	71	5.9	15.5	MAHZB
U177	4101817	71	72	3.6	9.5	MAHZB
U177	4101818	72	73	3.7	9.8	MAHZB
U177	4101819	73	74	5.7	14.9	MAHZB
U177	4101820	74	75	6.7	17.4	MAHZB
U177	4101821	75	76	2.9	7.5	MAHZB
U177	4101822	76	77	1.4	3.6	MAHZB
U177	4101823	77	78	2.9	7.6	MAHZB
U177	4101824	78	79	4.2	11.1	MAHZB
U177	4101825	79	80	3.6	9.4	MAHZB
U177	4101826	80	81	10	26.2	MAHZB
U177	4101827	81	82	2.5	6.7	MAHZB
U177	4101828	82	83	5.1	13.5	MAHZB
U177	4101829	83	84	6.4	16.8	MAHZB
U177	4101830	84	85	1.8	4.6	
U177	4101831	85	86	4.2	10.9	
U177	4101832	86	87	2	5.3	
U177	4101833	87	88	3	7.9	
U177	4101834	88	89	1.6	4.3	
U177	4101835	89	90	2.1	5.5	
U177	4101836	90	91	6.1	16	
U177	4101837	91	92	1.2	3.2	
U177	4101838	92	93	1.3	3.4	
U177	4101839	93	94	3.8	9.9	
U177	4101840	94	95	2.5	6.7	
U177	4101841	95	96	6.1	16.3	
U177	4101842	96	97	2.5	6.6	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U177	4101843	97	98	3.3	8.6	
U177	4101844	98	99	0.9	2.4	
U177	4101845	99	100	1.8	4.8	
U178	4101846	30	31	1.8	4.7	
U178	4101847	31	32	5.3	14	MAHZA
U178	4101848	32	33	4.9	13	MAHZA
U178	4101849	33	34	12.9	34.2	MAHZA
U178	4101850	34	35	5.4	14.3	MAHZA
U178	4101851	35	36	4.8	12.7	MAHZA
U178	4101852	36	37	3.7	9.8	MAHZA
U178	4101853	37	38	6.2	16.3	MAHZA
U178	4101854	38	39	10	26	MAHZA
U178	4101855	39	40	10.7	28.3	MAHZA
U178	4101856	40	41	9.2	24.2	MAHZA
U178	4101857	41	42	17.3	46.5	MAHZA
U178	4101858	42	43	16	42.7	MAHZA
U178	4101859	43	44	8.1	21.5	MAHZA
U178	4101860	44	45	6.6	17.3	MAHZA
U178	4101861	45	46	4.3	11.3	MAHZA
U178	4101862	46	47	5.2	13.5	MAHZA
U178	4101863	47	48	8.3	22	MAHZA
U178	4101864	48	49	4.7	12.4	MAHZA
U178	4101865	49	50	4.6	12.2	MAHZA
U178	4101866	50	51	2.9	7.6	MAHZA
U178	4101867	51	52	3	7.8	MAHZA
U178	4101868	52	53	3	8	MAHZA
U178	4101869	53	54	6.7	17.7	MAHZA
U178	4101870	54	55	15.3	40.3	MAHZA
U178	4101871	55	56	7.9	21	MAHZA
U178	4101872	56	57	8.9	23.6	MAHZA
U178	4101873	57	58	12.5	32.8	MAHZA
U178	4101874	58	59	15.7	41.7	MAHZA
U178	4101875	59	60	22.4	59.7	MAHBED
U178	4101876	60	61	25.6	67.9	MAHBED
U178	4101877	61	62	25.4	67.7	MAHBED
U178	4101878	62	63	17.6	47	MAHZB
U178	4101879	63	64	17.6	46.2	MAHZB
U178	4101880	64	65	6.6	17.2	MAHZB
U178	4101881	65	66	11.2	29.4	MAHZB
U178	4101882	66	67	8.5	22.4	MAHZB
U178	4101883	67	68	10.1	26.7	MAHZB
U178	4101884	68	69	19.1	50.6	MAHZB
U178	4101885	69	70	9.1	24.3	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U178	4101886	70	71	12	32.1	MAHZB
U178	4101887	71	72	5.5	14.5	MAHZB
U178	4101888	72	73	5.9	15.5	MAHZB
U178	4101889	73	74	13.9	36.5	MAHZB
U178	4101890	74	75	5.5	14.4	MAHZB
U178	4101891	75	76	3.4	8.9	MAHZB
U178	4101892	76	77	4	10.5	MAHZB
U178	4101893	77	78	5.4	14.2	MAHZB
U178	4101894	78	79	8	21.4	MAHZB
U178	4101895	79	80	6.4	16.9	MAHZB
U178	4101896	80	81	8.3	22.1	MAHZB
U178	4101897	81	82	10	26.6	MAHZB
U178	4101898	82	83	5.4	14.1	MAHZB
U178	4101899	83	84	3.5	9.2	MAHZB
U178	4101900	84	85	4.1	10.6	MAHZB
U178	4101901	85	86	8.7	22.6	MAHZB
U178	4101902	86	87	3.5	9.3	MAHZB
U178	4101903	87	88	2.4	6.2	MAHZB
U178	4101904	88	89	1.6	4.2	MAHZB
U178	4101905	89	90	3.2	8.5	MAHZB
U178	4101906	90	91	2.8	7.4	MAHZB
U178	4101907	91	92	8.1	21.2	MAHZB
U178	4101908	92	93	6.6	17.3	MAHZB
U178	4101909	93	94	2.4	6.4	MAHZB
U178	4101910	94	95	9.1	23.7	MAHZB
U178	4101911	95	96	1.3	3.4	
U178	4101912	96	97	3.8	9.9	
U178	4101913	97	98	0.6	1.5	
U178	4101914	98	99	2.1	5.6	
U178	4101915	99	100	1.5	4	
U178	4101916	100	101	2.4	6.2	
U178	4101917	101	102	0.8	2	
U178	4101918	102	103	4.6	12.1	
U178	4101919	103	104	2.6	6.9	
U178	4101920	104	105	6.8	18.2	
U178	4101921	105	106	3	7.9	
U178	4101922	106	107	2.1	5.5	
U178	4101923	107	108	1.4	3.6	
U178	4101924	108	109	2.2	5.7	
U178	4101925	109	110	1.5	3.9	
U178	4101926	110	111	1.2	3.2	
U178	4101927	111	112	2.2	5.8	
U178	4101928	112	113	4.8	12.6	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U178	4101929	113	114	3.2	8.6	
U178	4101930	114	115	0.4	0.9	
U178	4101931	115	116	0.9	2.2	
U178	4101932	116	117	0.7	1.9	
U178	4101933	117	118	0.8	2.2	
U178	4101934	118	119	8	21	
U178	4101935	119	120	8.3	21.6	
U178	4101936	120	121	2.3	6	
U178	4101937	121	122	1.5	3.8	
U178	4101938	122	123	0	0	
U178	4101939	123	124	0	0	
U178	4101940	124	125	3.3	8.7	
U178	4101941	125	126	0.8	2.2	
U178	4101942	126	127	4	10.4	
U178	4101943	127	128	1.1	2.8	
U179	4101944	20	21	3.4	9	MAHZA
U179	4101945	21	22	4	10.7	MAHZA
U179	4101946	22	23	7.6	20.2	MAHZA
U179	4101947	23	24	16.1	42.3	MAHZA
U179	4101948	24	25	7.4	19.8	MAHZA
U179	4101949	25	26	7.8	20.8	MAHZA
U179	4101950	26	27	11.8	31.3	MAHZA
U179	4101951	27	28	13.9	36.7	MAHZA
U179	4101952	28	29	27.9	73.6	MAHBED
U179	4101953	29	30	23.3	61.7	MAHBED
U179	4101954	30	31	16.1	42.4	MAHZB
U179	4101955	31	32	12.7	33.6	MAHZB
U179	4101956	32	33	9.4	24.6	MAHZB
U179	4101957	33	34	7.5	19.6	MAHZB
U179	4101958	34	35	6.7	17.4	MAHZB
U179	4101959	35	36	12	31.5	MAHZB
U179	4101960	36	37	15.5	41.2	MAHZB
U179	4101961	37	38	17.9	47.2	MAHZB
U179	4101962	38	39	18.2	48.3	MAHZB
U179	4101963	39	40	22.2	58.9	MAHZB
U179	4101964	40	41	10.4	27.7	MAHZB
U179	4101965	41	42	8.2	21.7	MAHZB
U179	4101966	42	43	5.2	13.8	MAHZB
U179	4101967	43	44	14.5	37.8	MAHZB
U179	4101968	44	45	7.5	19.6	MAHZB
U179	4101969	45	46	3.2	8.3	MAHZB
U179	4101970	46	47	3.8	10	MAHZB
U179	4101971	47	48	8.8	23.2	MAHZB

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U179	4101972	48	49	7.8	20.6	MAHZB
U179	4101973	49	50	8.2	21.8	MAHZB
U179	4101974	50	51	8.1	21.5	MAHZB
U179	4101975	51	52	9.6	25.4	MAHZB
U179	4101976	52	53	5	13.1	MAHZB
U179	4101977	53	54	3.7	9.6	MAHZB
U179	4101978	54	55	4.1	10.7	MAHZB
U179	4101979	55	56	8.9	23	MAHZB
U179	4101980	56	57	3.3	8.5	MAHZB
U179	4101981	57	58	1.9	4.9	MAHZB
U179	4101982	58	59	2	5.1	MAHZB
U179	4101983	59	60	4.3	11.4	MAHZB
U179	4101984	60	61	2.1	5.4	MAHZB
U179	4101985	61	62	11.3	29.4	MAHZB
U179	4101986	62	63	2.9	7.6	MAHZB
U179	4101987	63	64	4	10.5	MAHZB
U179	4101988	64	65	6.4	16.8	MAHZB
U179	4101989	65	66	1.4	3.7	
U179	4101990	66	67	4.3	11.2	
U179	4101991	67	68	3.8	9.9	
U179	4101992	68	69	0.9	2.4	
U179	4101993	69	70	1.8	4.6	
U179	4101994	70	71	1.1	3	
U179	4101995	71	72	0.6	1.6	
U179	4101996	72	73	0.8	2	
U179	4101997	73	74	4.3	11.3	
U179	4101998	74	75	2.6	6.9	
U179	4101999	75	76	5.2	14	
U179	4102000	76	77	3.8	10.1	
U179	4102001	77	78	3.6	9.5	
U179	4102002	78	79	1.1	2.8	
U179	4102003	79	80	1.7	4.3	
U179	4102004	80	81	2.2	5.9	
U179	4102005	81	82	1.4	3.8	
U179	4102006	82	83	1.9	4.9	
U179	4102007	83	84	0.6	1.4	
U179	4102008	84	85	1.9	4.8	
U179	4102009	85	86	5.9	15.8	
U179	4102010	86	87	3.8	9.9	
U179	4102011	87	88	1.4	3.6	
U179	4102012	88	89	1.1	2.7	
U179	4102013	89	90	1	2.5	
U179	4102014	90	91	7.3	18.8	

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U179	4102015	91	92	8.4	21.9	
U179	4102016	92	93	5.9	15.3	
U179	4102017	93	94	3.2	8.4	
U179	4102018	94	95	5.1	13.4	
U179	4102019	95	96	4.7	12.2	
U179	4102020	96	97	4.1	10.6	
U179	4102021	97	98	3.9	10.2	
U179	4102022	98	99	0	0	
U179	4102023	99	99.8	0	0	
U457	7312884	0	10	4.4	11.4	
U457	7312885	10	15	2.8	7.2	
U457	7312886	15	20	2.2	5.7	
U457	7312887	20	25	3.9	9.8	
U457	7312888	25	30	3.9	10.1	
U457	7312889	30	35	4.4	11.5	
U457	7312890	35	40	3.2	8.3	
U457	7312891	40	45	2.9	7.4	
U457	7312892	45	50	4.5	11.6	
U457	7312893	50	55	3.5	9.1	
U457	7312894	55	60	3.2	8.3	
U457	7312895	60	65	4.3	11.1	
U457	7312896	65	70	3.6	9.4	
U457	7312897	70	75	4	10.4	
U457	7312898	75	80	2.9	7.4	
U457	7312899	80	85	2	5.3	
U457	7312900	85	90	4.7	12.2	
U457	7312901	90	95	1.6	4.3	
U457	7312902	95	100	4.9	12.7	
U457	7312903	100	105	8.6	22.4	4SEN
U457	7312904	105	110	2.2	5.7	AGR
U457	7312905	110	115	2.3	6.1	AGR
U457	7312906	115	120	5.8	15.2	MAHZA
U457	7312907	120	125	10.4	27.6	MAHZA
U457	7312908	125	130	5.3	13.8	MAHZA
U457	7312909	130	135	7.4	19.3	MAHZA
U457	7312910	135	140	11.9	31.3	MAHZA
U457	7312911	140	145	22.2	58.8	MAHBED
U457	7312912	145	150	15.5	40.9	MAHZB
U457	7312913	187.5	188.9	0.8	2	MAHZB
U457	7312914	188.9	190.1	4.3	11.1	MAHZB
U457	7312915	190.1	191.8	3.2	8.5	MAHZB
U457	7312916	191.8	193	5.9	15.6	MAHZB
U457	7312917	193	194	2.6	6.8	BGR

Corehole Assay

BHID	SAMPID	FROM	TO	%shoil	shoilgt	zone
U457	7312918	194	195	2.4	6.3	BGR
U457	7312919	195	196	5	13.2	BGR
U457	7312920	196	197	1.1	2.8	BGR
U457	7312921	197	198	2.8	7.5	BGR
U457	7312922	198	199.3	2.2	5.7	BGR
U457	7312923	199.3	200.6	2.6	6.7	BGR
U457	7312924	200.6	201.8	2.8	7.4	BGR
U457	7312925	201.8	203	2.3	6.1	BGR
U457	7312926	203	204.2	0.8	2.1	BGR
U457	7312927	212	213.3	3.5	9	BGR
U457	7312928	213.3	214.7	3.1	8	BGR
U457	7312929	214.7	215.9	6.6	17.4	
U457	7312930	272	273	3.7	9.6	
U457	7312931	273	274.2	1.8	4.6	
U457	7312932	274.2	275.4	6.1	15.8	
U457	7312933	275.4	276.4	12	30.9	
U457	7312934	277.2	278	0.5	1.3	
U457	7312935	278	279	5.2	13.5	
U457	7312936	279	279.9	4.7	12.4	

APPENDIX D

GEOPHYSICAL LOG

APPENDIX D
GEOPHYSICAL LOG

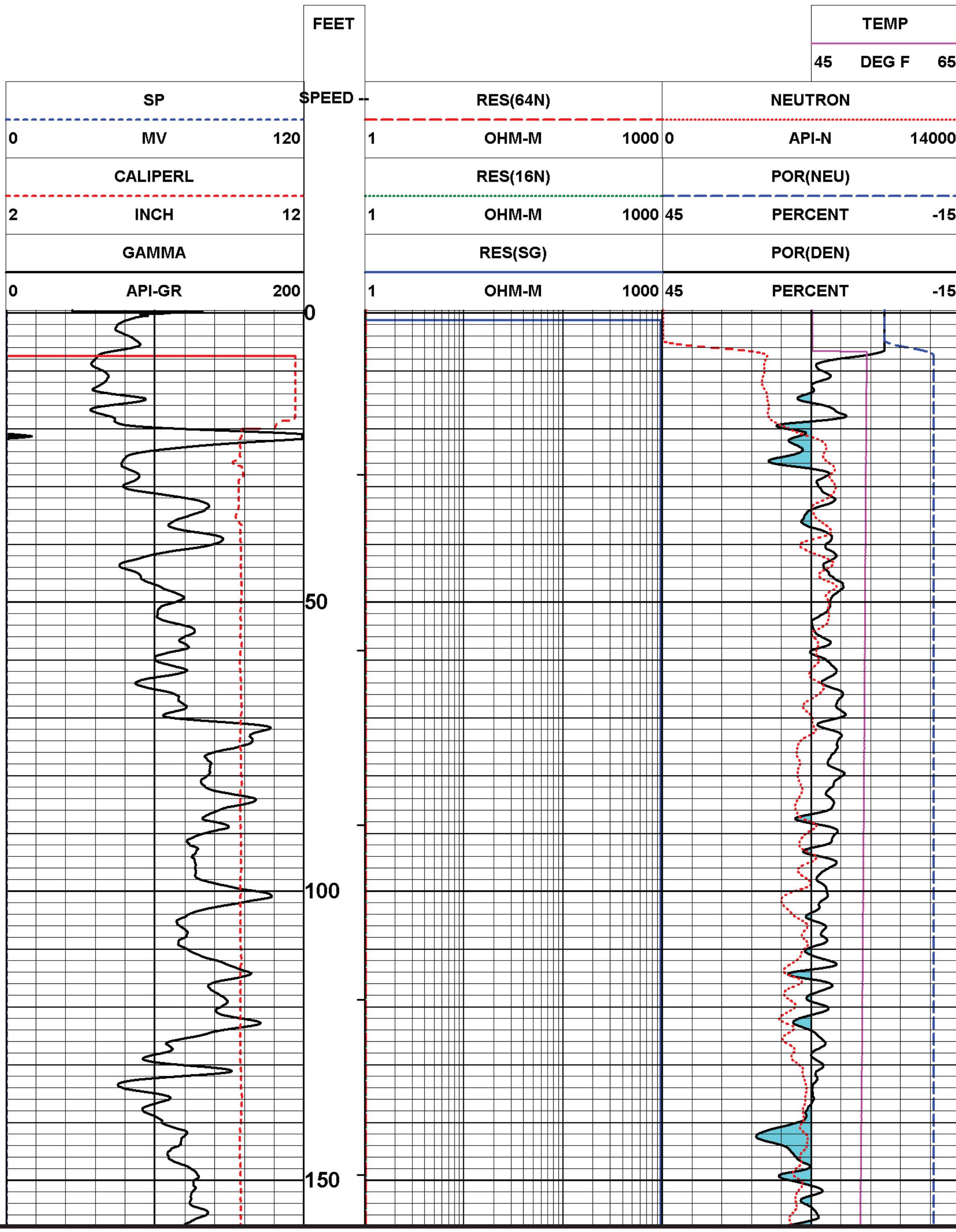
MW-04
Surveyed on September 25th, 2013

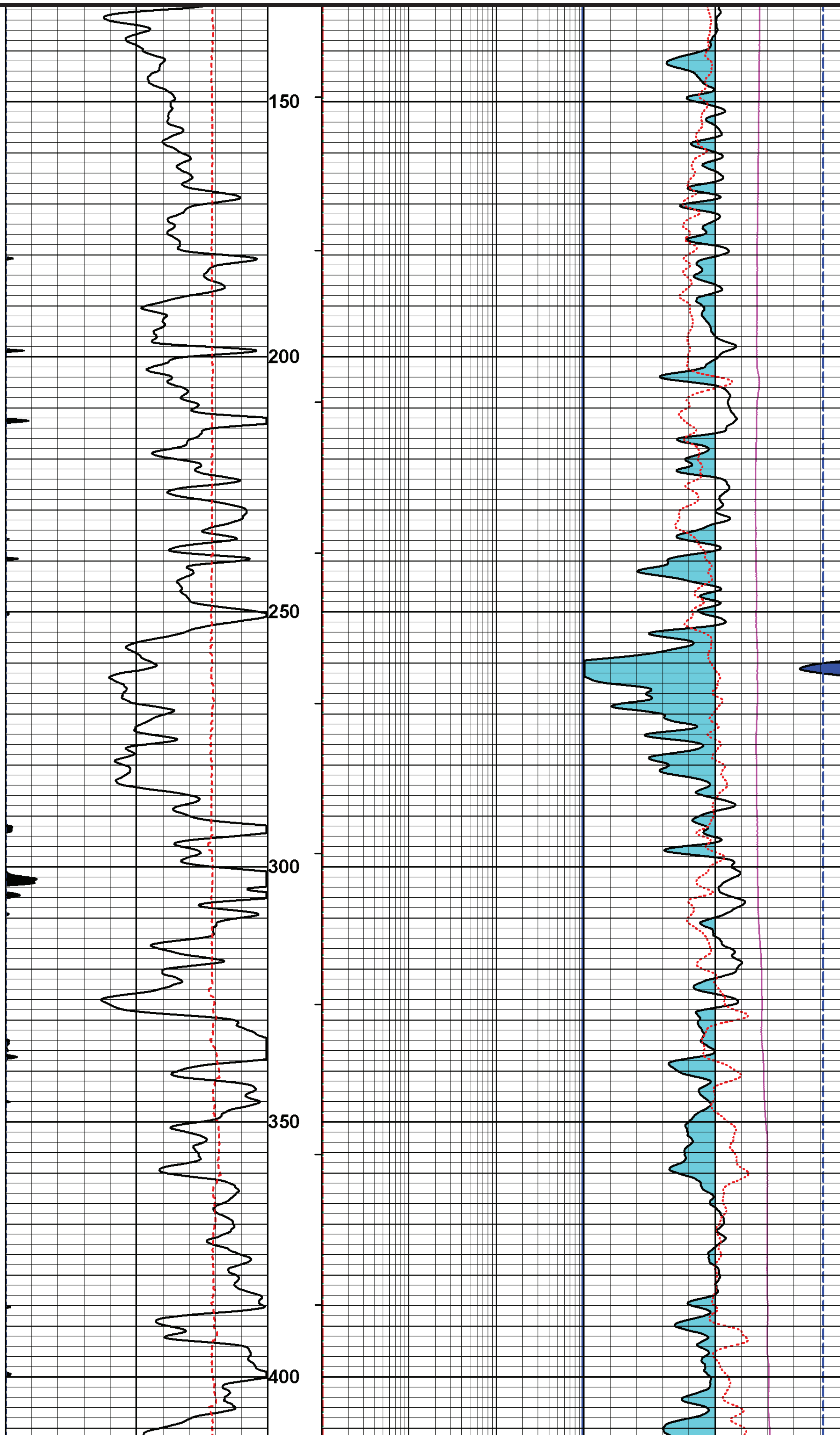
The Oil Mining Company, Inc.
Uintah County, Utah

5 INCH LOG, MERGED MW-04 09/25/13

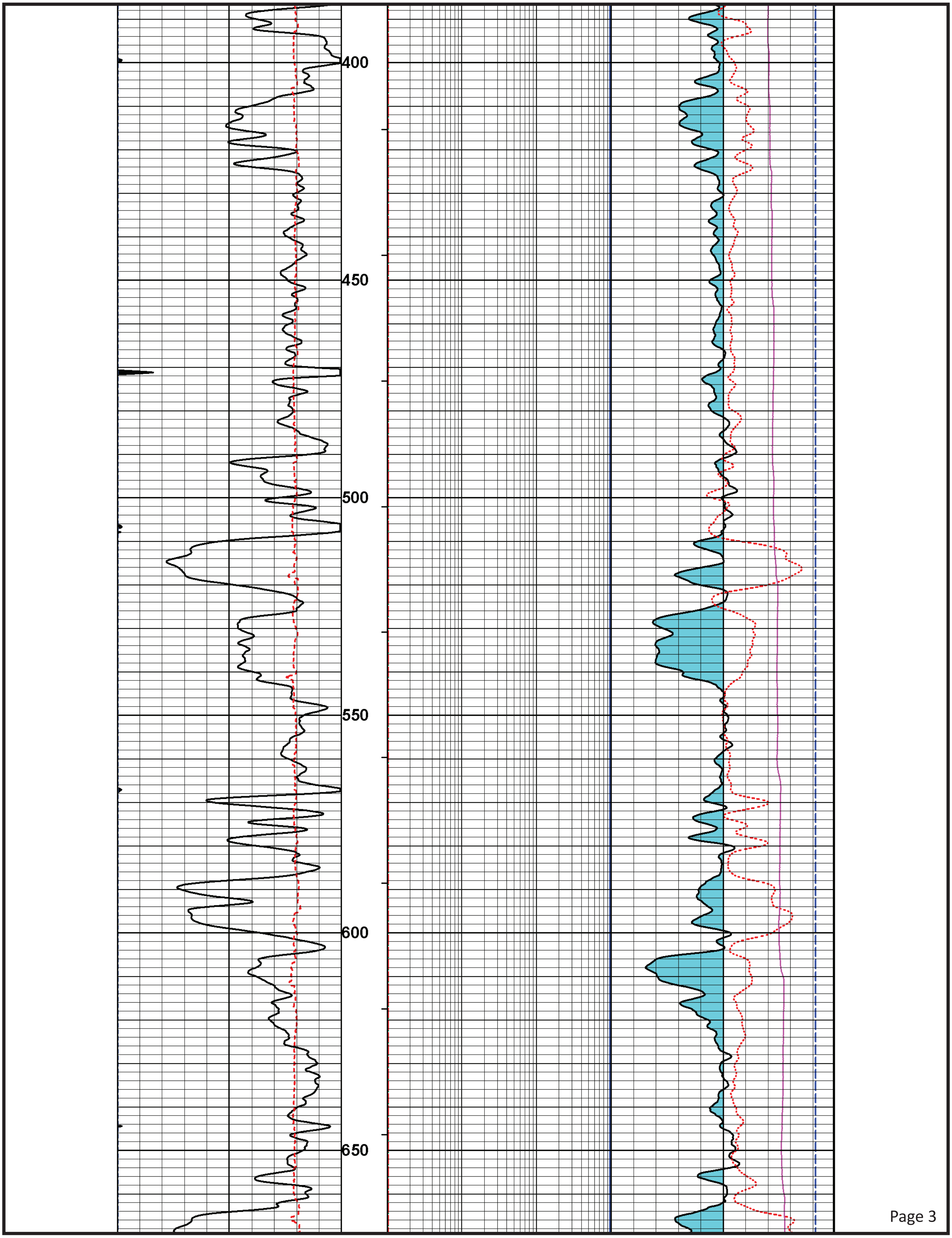
LOG PARAMETERS

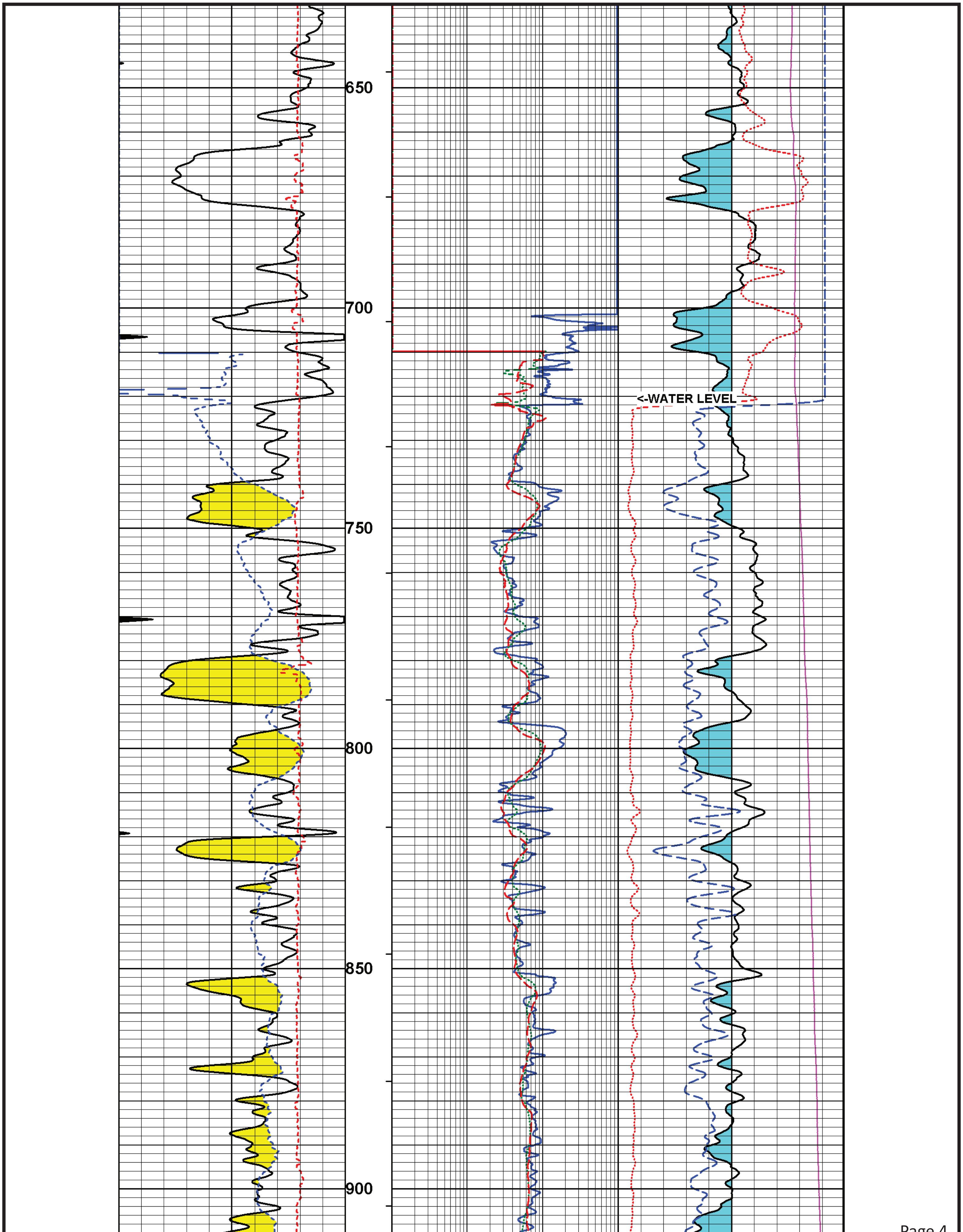
MATRIX DENSITY : 2.65
NEUTRON MATRIX : SANDSTONE
MATRIX DELTA T : 54
MAGNETIC DECL : 11
ELECT. CUTOFF : 99999.
BIT SIZE : 8.75
PRESENTATION NAME/DATE = TRIPLECOMBO WATER.0 09/26/2013
Version 3.65 JD

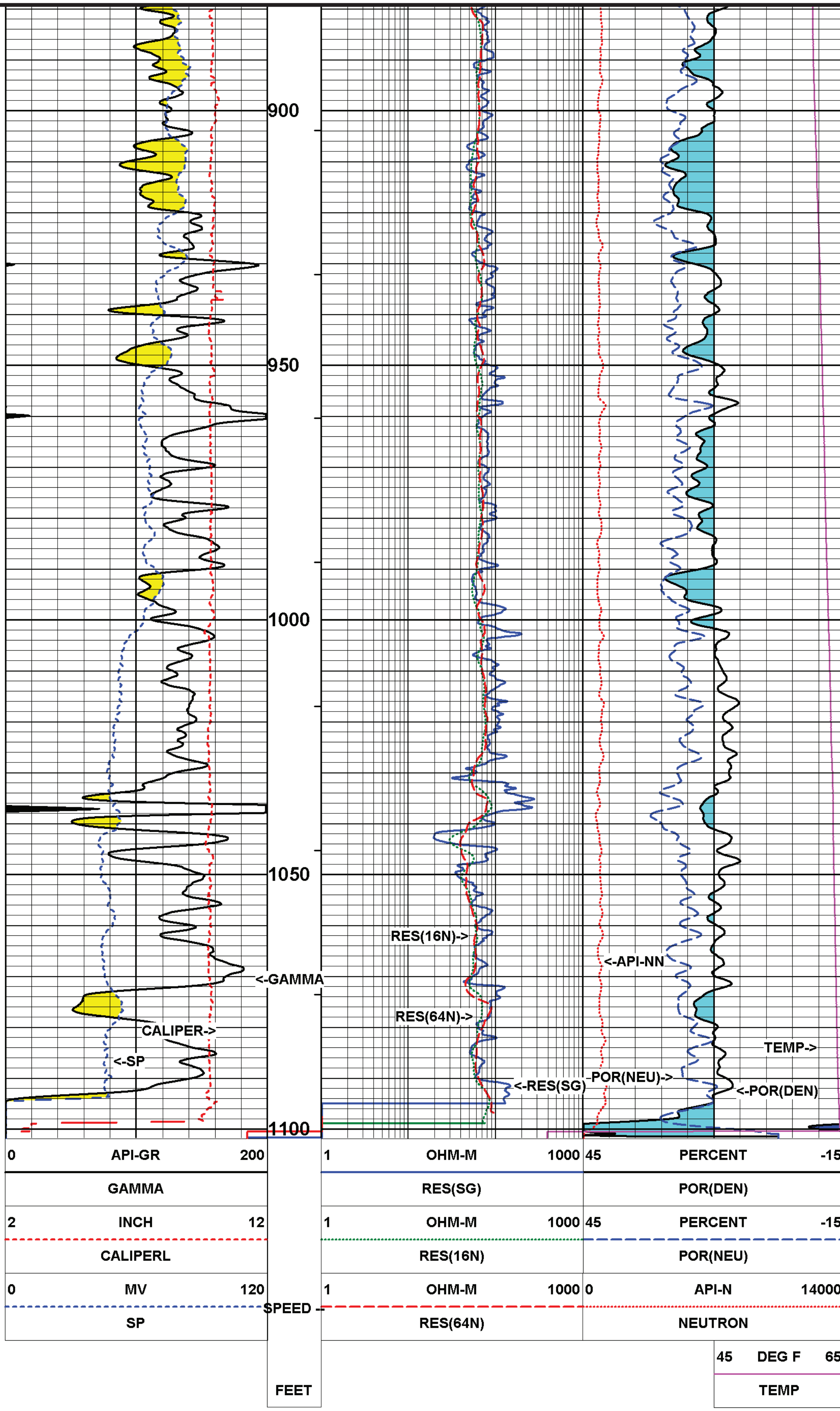




150
200
250
300
350
400


400
450
500
550
600
650


650
700
750
800
850
900
<-WATER LEVEL



900
950
1000
1050
1100
RES(16N)->
RES(64N)->
<-RES(SG)
<-GAMMA
CALIPER->
<-SP
<-API-NN
POR(NEU)->
<-POR(DEN)
TEMP->
0 API-GR 200
GAMMA
2 INCH 12
CALIPERL
0 MV 120
SP
SPEED --
FEET
1 OHM-M 1000
RES(SG)
1 OHM-M 1000
RES(16N)
1 OHM-M 1000
RES(64N)
45 PERCENT -15
POR(DEN)
45 PERCENT -15
POR(NEU)
0 API-N 14000
NEUTRON
45 DEG F 65
TEMP

APPENDIX E

MONITOR WELL LABORATORY ANALYTICAL RESULTS

Appendix E
Analytical Data

The Oil Mining Company, Inc.
Uintah County, Utah

Monitoring Well Groundwater Samples

ANALYTICAL REPORT

Job Number: 280-48451-1

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Senior Project Manager
11/26/2013 1:05 PM

Patrick J McEntee, Senior Project Manager
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
11/26/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-48451-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 10/26/2013 11:30 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 4.3º C.

Except:

Two HCl preserved Trip Blank vials were received, but were not listed on the COC. As no other volume was submitted for VOA analysis, the Trip Blank vials were not logged.

The COC lists 2 bottles for sample MW-03-2013, however 3 bottles were received for this sample.

ALKALINITY

Samples MW-01-2013 (280-48451-1), MW-03-2013 (280-48451-2), MW-04-2013 (280-48451-3) and MW-05-2013 (280-48451-4) were analyzed for Alkalinity in accordance with SM20 2320B. The samples were analyzed on 11/01/2013 and 11/06/2013.

Bicarbonate Alkalinity as CaCO3 and Total Alkalinity as CaCO3 were detected in method blank MB 280-199016/6 at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Bicarbonate Alkalinity as CaCO3 and Total Alkalinity as CaCO3 were detected in method blank MB 280-199619/6 and in the Instrument Blank at levels exceeding the reporting limit. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details. The concentrations of these analytes in the associated samples were greater than 10 times the concentration detected in the MB; therefore reanalysis was not required.

No other difficulties were encountered during the alkalinity analysis.

All other quality control parameters were within the acceptance limits.

ANIONS (28 DAYS)

Samples MW-01-2013 (280-48451-1), MW-03-2013 (280-48451-2), MW-04-2013 (280-48451-3) and MW-05-2013 (280-48451-4) were analyzed for anions (28 days) in accordance with EPA Method 300.0. The samples were analyzed on 10/26/2013, 11/17/2013 and 11/18/2013.

Sulfate was detected in method blank MB 280-198220/6 at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Samples MW-01-2013 (280-48451-1)[20X], MW-01-2013 (280-48451-1)[5X], MW-03-2013 (280-48451-2)[10X], MW-03-2013 (280-48451-2)[5X], MW-04-2013 (280-48451-3)[10X], MW-04-2013 (280-48451-3)[2X], MW-05-2013 (280-48451-4)[10X] and MW-05-2013 (280-48451-4)[2X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the anions analysis.

All other quality control parameters were within the acceptance limits.

ANIONS (48 HOURS)

Samples MW-01-2013 (280-48451-1), MW-03-2013 (280-48451-2), MW-04-2013 (280-48451-3) and MW-05-2013 (280-48451-4) were analyzed for anions (48 hours) in accordance with EPA Method 300.0. The samples were analyzed on 10/26/2013.

Samples MW-01-2013 (280-48451-1)[5X] and MW-03-2013 (280-48451-2)[5X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

Analysis of the MS and MSD was performed outside of the analytical holding time for sample MW-04-2013 (280-48451-3). The client requested MS/MSD was not analyzed with the original analysis of the parent sample. The sample and MS/MSD were re-analyzed outside of HT. The in-hold data was reported for the parent sample.

No other difficulties were encountered during the anions analysis.

All other quality control parameters were within the acceptance limits.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc.

Job Number: 280-48451-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-48451-1	MW-01-2013	Water	10/25/2013 1730	10/26/2013 1130
280-48451-2	MW-03-2013	Water	10/25/2013 1300	10/26/2013 1130
280-48451-3	MW-04-2013	Water	10/25/2013 1430	10/26/2013 1130
280-48451-3MSMS	MW-04-2013	Water	10/25/2013 1430	10/26/2013 1130
280-48451-3MSDMSD	MW-04-2013	Water	10/25/2013 1430	10/26/2013 1130
280-48451-4	MW-05-2013	Water	10/25/2013 1445	10/26/2013 1130

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Lab Sample ID / Client Sample ID / Analyte	Result	Qualifier	Reporting Limit	Units	Method
280-48451-1 MW-01-2013					
Chloride	530		60	mg/L	300.0
Fluoride	28		2.5	mg/L	300.0
Sulfate	110		25	mg/L	300.0
Total Alkalinity as CaCO3	3500	B ^	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3	2800	B ^	5.0	mg/L	SM 2320B
Carbonate Alkalinity as CaCO3	620		5.0	mg/L	SM 2320B
280-48451-2 MW-03-2013					
Chloride	180		15	mg/L	300.0
Fluoride	40		2.5	mg/L	300.0
Sulfate	340		50	mg/L	300.0
Total Alkalinity as CaCO3	2100	B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3	2100	B	5.0	mg/L	SM 2320B
280-48451-3 MW-04-2013					
Chloride	66		6.0	mg/L	300.0
Fluoride	3.2		0.50	mg/L	300.0
Sulfate	250		50	mg/L	300.0
Total Alkalinity as CaCO3	790	B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3	400	B	5.0	mg/L	SM 2320B
Carbonate Alkalinity as CaCO3	390		5.0	mg/L	SM 2320B
280-48451-4 MW-05-2013					
Chloride	65		6.0	mg/L	300.0
Fluoride	3.2		0.50	mg/L	300.0
Sulfate	240		50	mg/L	300.0
Total Alkalinity as CaCO3	790	B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3	390	B	5.0	mg/L	SM 2320B
Carbonate Alkalinity as CaCO3	400		5.0	mg/L	SM 2320B

METHOD SUMMARY

Client: Ecology and Environment, Inc.

Job Number: 280-48451-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Anions, Ion Chromatography	TAL DEN	MCAWW 300.0	
Alkalinity	TAL DEN	SM SM 2320B	

Lab References:

TAL DEN = TestAmerica Denver

Method References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater"

METHOD / ANALYST SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method	Analyst	Analyst ID
MCAWW 300.0	Elkin, David M	DME
MCAWW 300.0	Phan, Thu L	TLP
SM SM 2320B	Hoefler, Alexandra F	AFH

General Chemistry

Client Sample ID: **MW-01-2013**

Lab Sample ID: 280-48451-1 Date Sampled: 10/25/2013 1730
Client Matrix: Water Date Received: 10/26/2013 1130

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Chloride	530		mg/L	5.1	60	20	300.0
Analysis Batch: 280-201618	Analysis Date: 11/18/2013 0036						
Nitrate as N	ND		mg/L	0.21	2.5	5.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1606						
Fluoride	28		mg/L	0.30	2.5	5.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1606						
Nitrite as N	ND		mg/L	0.25	2.5	5.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1606						
Sulfate	110		mg/L	1.2	25	5.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1606						
Total Alkalinity as CaCO3	3500	B ^	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199619	Analysis Date: 11/06/2013 1612						
Bicarbonate Alkalinity as CaCO3	2800	B ^	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199619	Analysis Date: 11/06/2013 1612						
Carbonate Alkalinity as CaCO3	620		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199619	Analysis Date: 11/06/2013 1612						

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

General Chemistry

Client Sample ID: **MW-03-2013**

Lab Sample ID: 280-48451-2 Date Sampled: 10/25/2013 1300
Client Matrix: Water Date Received: 10/26/2013 1130

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Chloride	180		mg/L	1.3	15	5.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1747						
Nitrate as N	ND		mg/L	0.21	2.5	5.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1747						
Fluoride	40		mg/L	0.30	2.5	5.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1747						
Nitrite as N	ND		mg/L	0.25	2.5	5.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1747						
Sulfate	340		mg/L	2.3	50	10	300.0
Analysis Batch: 280-201618	Analysis Date: 11/17/2013 1404						
Total Alkalinity as CaCO3	2100	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1436						
Bicarbonate Alkalinity as CaCO3	2100	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1436						
Carbonate Alkalinity as CaCO3	ND		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1436						

General Chemistry

Client Sample ID: **MW-04-2013**

Lab Sample ID: 280-48451-3 Date Sampled: 10/25/2013 1430
Client Matrix: Water Date Received: 10/26/2013 1130

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Chloride	66		mg/L	0.51	6.0	2.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1803						
Nitrate as N	ND		mg/L	0.042	0.50	1.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1713						
Fluoride	3.2		mg/L	0.060	0.50	1.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1713						
Nitrite as N	ND		mg/L	0.049	0.50	1.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1713						
Sulfate	250		mg/L	2.3	50	10	300.0
Analysis Batch: 280-201618	Analysis Date: 11/17/2013 1420						
Total Alkalinity as CaCO3	790	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1600						
Bicarbonate Alkalinity as CaCO3	400	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1600						
Carbonate Alkalinity as CaCO3	390		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1600						

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

General Chemistry

Client Sample ID: **MW-05-2013**

Lab Sample ID: 280-48451-4 Date Sampled: 10/25/2013 1445
Client Matrix: Water Date Received: 10/26/2013 1130

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Chloride	65		mg/L	0.51	6.0	2.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1820						
Nitrate as N	ND		mg/L	0.042	0.50	1.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1730						
Fluoride	3.2		mg/L	0.060	0.50	1.0	300.0
Analysis Batch: 280-198184	Analysis Date: 10/26/2013 1730						
Nitrite as N	ND		mg/L	0.049	0.50	1.0	300.0
Analysis Batch: 280-198182	Analysis Date: 10/26/2013 1730						
Sulfate	240		mg/L	2.3	50	10	300.0
Analysis Batch: 280-201618	Analysis Date: 11/18/2013 1037						
Total Alkalinity as CaCO3	790	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1555						
Bicarbonate Alkalinity as CaCO3	390	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1555						
Carbonate Alkalinity as CaCO3	400		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1555						

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-198182

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198182/6	Analysis Batch:	280-198182	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1318	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Nitrate as N	ND		0.042	0.50
Nitrite as N	ND		0.049	0.50

Method Reporting Limit Check - Batch: 280-198182

Method: 300.0
Preparation: N/A

Lab Sample ID:	MRL 280-198182/3	Analysis Batch:	280-198182	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1227	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Nitrate as N	0.200	0.224	112	50 - 150	J
Nitrite as N	0.200	0.207	104	50 - 150	J

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198182

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198182/4	Analysis Batch:	280-198182	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1244	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198182/5	Analysis Batch:	280-198182	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1301	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Nitrate as N	105	105	90 - 110	0	10		
Nitrite as N	101	101	90 - 110	0	10		

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198182

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198182/4	Units: mg/L	LCSD Lab Sample ID:	LCSD 280-198182/5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/26/2013 1244		Analysis Date:	10/26/2013 1301
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Nitrate as N	5.00	5.00	5.27	5.27
Nitrite as N	5.00	5.00	5.05	5.06

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-198184

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198184/6	Analysis Batch:	280-198184	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1318	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Chloride	ND		0.25	3.0
Fluoride	ND		0.060	0.50
Sulfate	ND		0.23	5.0

Method Reporting Limit Check - Batch: 280-198184

Method: 300.0
Preparation: N/A

Lab Sample ID:	MRL 280-198184/3	Analysis Batch:	280-198184	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1227	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	1.00	1.06	106	50 - 150	J
Fluoride	0.200	0.199	100	50 - 150	J
Sulfate	1.00	1.06	106	50 - 150	J

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198184

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198184/4	Analysis Batch:	280-198184	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1244	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198184/5	Analysis Batch:	280-198184	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/26/2013 1301	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Chloride	103	103	90 - 110	0	10		
Fluoride	105	105	90 - 110	0	10		
Sulfate	105	105	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198184

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198184/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-198184/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/26/2013 1244			Analysis Date:	10/26/2013 1301
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Chloride	25.0	25.0	25.9	25.9
Fluoride	5.00	5.00	5.25	5.27
Sulfate	25.0	25.0	26.2	26.2

Client: Ecology and Environment, Inc. | Job Number: 280-48451-1

Method Blank - Batch: 280-198220

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198220/6	Analysis Batch:	280-198220	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1215	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Chloride	ND		0.25	3.0
Fluoride	ND		0.060	0.50
Sulfate	0.298	J	0.23	5.0

Method Reporting Limit Check - Batch: 280-198220

Method: 300.0
Preparation: N/A

Lab Sample ID:	MRL 280-198220/3	Analysis Batch:	280-198220	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1125	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	1.00	1.08	108	50 - 150	J
Fluoride	0.200	0.213	107	50 - 150	J
Sulfate	1.00	1.30	130	50 - 150	J

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198220

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198220/4	Analysis Batch:	280-198220	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1141	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198220/5	Analysis Batch:	280-198220	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1158	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Chloride	103	103	90 - 110	0	10		
Fluoride	105	105	90 - 110	0	10		
Sulfate	105	104	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198220

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198220/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-198220/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/28/2013 1141			Analysis Date:	10/28/2013 1158
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Chloride	25.0	25.0	25.7	25.7
Fluoride	5.00	5.00	5.27	5.27
Sulfate	25.0	25.0	26.2	26.0

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-198221

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198221/6	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1215	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Nitrate as N	ND		0.042	0.50
Nitrite as N	ND		0.049	0.50

Method Reporting Limit Check - Batch: 280-198221

Method: 300.0
Preparation: N/A

Lab Sample ID:	MRL 280-198221/3	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1125	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Nitrate as N	0.200	0.228	114	50 - 150	J
Nitrite as N	0.200	0.207	104	50 - 150	J

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198221

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198221/4	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1141	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198221/5	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1158	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Nitrate as N	105	105	90 - 110	0	10		
Nitrite as N	101	101	90 - 110	0	10		

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198221

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198221/4	Units: mg/L	LCSD Lab Sample ID:	LCSD 280-198221/5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/28/2013 1141		Analysis Date:	10/28/2013 1158
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Nitrate as N	5.00	5.00	5.24	5.23
Nitrite as N	5.00	5.00	5.03	5.03

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198221

Method: 300.0
Preparation: N/A

MS Lab Sample ID:	280-48451-3MS	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	118.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1424			Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48451-3MSD	Analysis Batch:	280-198221	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	119.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/28/2013 1440			Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Nitrate as N	106	108	80 - 120	2	20	H	H
Nitrite as N	101	103	80 - 120	2	20	H	H

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198221

Method: 300.0
Preparation: N/A

MS Lab Sample ID:	280-48451-3MS	Units: mg/L	MSD Lab Sample ID:	280-48451-3MSD
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/28/2013 1424		Analysis Date:	10/28/2013 1440
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Nitrate as N	ND	5.00	5.00	5.31	H	5.41	H
Nitrite as N	ND	5.00	5.00	5.05	H	5.15	H

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-201618 **Method: 300.0**
Preparation: N/A

Lab Sample ID:	MB 280-201618/6	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/17/2013 1155	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Chloride	ND		0.25	3.0
Fluoride	ND		0.060	0.50
Sulfate	ND		0.23	5.0

Method Reporting Limit Check - Batch: 280-201618 **Method: 300.0**
Preparation: N/A

Lab Sample ID:	MRL 280-201618/3	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/17/2013 1108	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	1.00	0.931	93	50 - 150	J
Fluoride	0.200	0.179	90	50 - 150	J
Sulfate	1.00	0.869	87	50 - 150	J

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-201618

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-201618/4	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	11/17/2013 1123	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-201618/5	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	11/17/2013 1139	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Chloride	101	102	90 - 110	0	10		
Fluoride	102	102	90 - 110	0	10		
Sulfate	101	100	90 - 110	1	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-201618

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-201618/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-201618/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/17/2013 1123			Analysis Date:	11/17/2013 1139
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Chloride	25.0	25.0	25.3	25.4
Fluoride	5.00	5.00	5.11	5.11
Sulfate	25.0	25.0	25.2	25.0

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-201618

Method: 300.0
Preparation: N/A

MS Lab Sample ID:	280-48451-3	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	124.TXT
Dilution:	10	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/17/2013 1451			Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48451-3	Analysis Batch:	280-201618	Instrument ID:	WC_IC7
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	125.TXT
Dilution:	10	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/17/2013 1507			Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Chloride	104	105	80 - 120	1	20		
Fluoride	90	91	80 - 120	1	20		
Sulfate	96	97	80 - 120	1	20		

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-201618

Method: 300.0
Preparation: N/A

MS Lab Sample ID:	280-48451-3	Units: mg/L	MSD Lab Sample ID:	280-48451-3
Client Matrix:	Water		Client Matrix:	Water
Dilution:	10		Dilution:	10
Analysis Date:	11/17/2013 1451		Analysis Date:	11/17/2013 1507
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Chloride	64		250	250	323	327
Fluoride	2.1	J	50.0	50.0	47.1	47.5
Sulfate	250		250	250	487	489

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

Lab Sample ID:	MB 280-199016/6	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1428	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Alkalinity as CaCO3	1.13	J	1.1	5.0
Bicarbonate Alkalinity as CaCO3	1.13	J	1.1	5.0
Carbonate Alkalinity as CaCO3	ND		1.1	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199016/4	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1419	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-199016/5	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1424	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Alkalinity as CaCO3	101	101	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199016/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-199016/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/01/2013 1419			Analysis Date:	11/01/2013 1424
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Alkalinity as CaCO3	200	200	203	202

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Method Blank - Batch: 280-199619

Method: SM 2320B
Preparation: N/A

Lab Sample ID:	MB 280-199619/6	Analysis Batch:	280-199619	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110613a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/06/2013 1600	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Alkalinity as CaCO3	6.01		1.1	5.0
Bicarbonate Alkalinity as CaCO3	5.40		1.1	5.0
Carbonate Alkalinity as CaCO3	ND		1.1	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-199619

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199619/4	Analysis Batch:	280-199619	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110613a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/06/2013 1553	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-199619/5	Analysis Batch:	280-199619	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110613a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/06/2013 1556	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Alkalinity as CaCO3	98	93	90 - 110	5	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-199619

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199619/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-199619/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/06/2013 1553			Analysis Date:	11/06/2013 1556
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Alkalinity as CaCO3	1000	1000	976	927

DATA REPORTING QUALIFIERS

Client: Ecology and Environment, Inc. Job Number: 280-48451-1

Lab Section	Qualifier	Description
General Chemistry		
	B	Compound was found in the blank and sample.
	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	H	Sample was prepped or analyzed beyond the specified holding time

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 280-48516-1

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Senior Project Manager
11/26/2013 2:48 PM

Patrick J McEntee, Senior Project Manager
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
11/26/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

TestAmerica Laboratories, Inc.
TestAmerica Denver 4955 Yarrow Street, Arvada, CO 80002
Tel (303) 736-0100 Fax (303) 431-7171 www.testamericainc.com

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-48516-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 10/29/2013; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was C.

The samples were received on 10/29/2013 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 6 coolers at receipt time were 0.3º C, 1.2º C, 2.7º C, 3.2º C, 3.8º C and 4.2º C.

Except:

Sample MW-05 was received outside of the 48 hour holding time for 300_48HR Nitrate/Nitrite analysis.

Sample MW-09 was received rapidly expiring for 300_48HR Nitrate/Nitrite analysis

Two Trip Blank vials were received which were not listed on the COC. The Trip Blank was logged for 8260B.

One unpreserved liter amber bottle for sample MW-01 was received with a broken cap. The cap was replaced.

Sample MW-01 lists two H2SO4 preserved bottles, however only one H2SO4 bottle was received.

One of six VOA vials for sample MW-09 was received broken. Sufficient volume remains for analysis.

One of eighteen VOA vials for sample MW-04 was received broken. Sufficient volume remains for analysis.

Two of eighteen VOA vials for sample MW-04 have bubbles greater than 6mm in diameter.

One of six VOA vials for sample MW-01 has a bubble greater than 6mm in diameter.

Per a phone conversation with Jonathan Reeve on 10/30/13, sample MW-02 was activated for Anions and Alkalinity analysis. This analysis was not originally requested on the chain-of-custody (COC). The client is aware that the sample is outside of holding time for Nitrate/Nitrite analysis, and asked the laboratory to complete the analysis within 2x holding time.

The sample IDs on the container labels have a "-2013" suffix, i.e. MW-04-2013. The IDs on the COC do not, i.e. MW-04. The sample IDs were logged per the COC.

Some MS/MSD bottles for sample MW-04 list collection time 1500 or 1515. The MS/MSD volume was logged with collection time 1430, to match the parent sample.
Per client instruction on 11/1/2013, samples MW04 and MW05 were logged for Stable Water Isotopes and Oxygen, Stable Water Isotopes and Carbon and Radiocarbon Analysis of Water. This analysis was performed by IsoTech Laboratories, located at 1308 Parkland Court, Champaign IL, 61821-1826, TEL (217) 398-3490. The results for these analyses are reported under separate cover (280-48516-2).

VOLATILE ORGANIC COMPOUNDS (GC-MS)

Samples TRIP BLANK (280-48516-1), MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for volatile organic compounds (GC-MS) in accordance with EPA SW-846 Method 8260B. The samples were analyzed on 11/05/2013 and 11/08/2013.

The following sample was received with insufficient preservation (pH >2): MW-01 (280-48516-2). The pH taken at time of analysis was approximately 7 and all vials were of similar result.

Toluene was detected in method blank MB 280-199243/5 at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

1,2-Dichloroethane-d4 (Surr) failed the surrogate recovery criteria high for MW-04MSD (280-48516-5MSD). Refer to the QC report for details. The parent sample's surrogate recovery was within limits and all spike recoveries were within control limits, therefore, the data have been reported.

No other difficulties were encountered during the volatiles analysis.

All other quality control parameters were within the acceptance limits.

GASOLINE RANGE ORGANICS

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for gasoline range organics in accordance with EPA SW-846 Method 8015C - GRO. The samples were analyzed on 10/31/2013 and 11/01/2013.

The following sample was received with insufficient preservation (pH >2): MW-01 (280-48516-2). The pH taken at time of analysis was approximately 5 and all vials were of similar result.

No other difficulties were encountered during the GRO analysis.

All other quality control parameters were within the acceptance limits.

DIESEL RANGE ORGANICS

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for Diesel Range Organics in accordance with EPA SW-846 Method 8015C - DRO. The samples were prepared on 10/29/2013 and analyzed on 10/31/2013.

o-Terphenyl (Surr) failed the surrogate recovery criteria high for MW-02 (280-48516-3). Refer to the QC report for details. Evidence of matrix interference is present; therefore, re-extraction and/or re-analysis was not performed.

The following samples formed emulsions during the extraction procedure: MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4).

A portion of sample MW-01 (280-48516-2) was used for analysis, rather than testing the entire sample amount in the original container, due to a large amount of sediment being present in the sample container. As such, the required solvent rinse of the original container could not be performed.

It is the laboratory's standard procedure to aliquot aqueous samples gravimetrically assuming a density of 1g/mL. The density of the following sample was greater than 1g/mL: MW-01 (280-48516-2). The weight of the sample aliquot was divided by the density of the sample to calculate the volume of the sample extracted.

No other difficulties were encountered during the DRO analysis.

All other quality control parameters were within the acceptance limits.

TOTAL METALS (ICP)

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for Total Metals (ICP) in accordance with EPA SW-846 Method 6010C. The samples were prepared on 10/30/2013 and analyzed on 11/01/2013.

No difficulties were encountered during the metals analysis.

All quality control parameters were within the acceptance limits.

DISSOLVED METALS (ICPMS)

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for dissolved metals (ICPMS) in accordance with EPA SW-846 Methods 6020A. The samples were prepared and analyzed on 11/06/2013.

Copper was detected in method blank MB 280-198697/1-A at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Selenium failed the recovery criteria low for the MS of sample MW-04MS (280-48516-5) in batch 280-199679. Selenium and Silver failed the recovery criteria low for the MSD of sample MW-04MSD (280-48516-5) in batch 280-199679. Refer to the QC report for details.

No other difficulties were encountered during the metals analysis.

All other quality control parameters were within the acceptance limits.

TOTAL METALS (ICPMS)
Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for metals (ICPMS) in accordance with SW846 6020A. The samples were prepared on 10/30/2013 and analyzed on 10/31/2013 and 11/04/2013.

Copper and Thallium were detected in method blank MB 280-198463/1-A at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Selenium failed the recovery criteria low for the MS of sample MW-04MS (280-48516-5) in batch 280-199090. Selenium failed the recovery criteria low for the MSD of sample MW-04MSD (280-48516-5) in batch 280-199090. Refer to the QC report for details.

No other difficulties were encountered during the metals analysis.

All other quality control parameters were within the acceptance limits.

DISSOLVED MERCURY
Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for dissolved mercury in accordance with EPA SW-846 Methods 7470A. The samples were prepared and analyzed on 11/12/2013.

No difficulties were encountered during the dissolved mercury analysis.

All quality control parameters were within the acceptance limits.

TOTAL MERCURY
Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for total mercury in accordance with EPA SW-846 Methods 7470A. The samples were prepared and analyzed on 10/31/2013.

No difficulties were encountered during the mercury analysis.

All quality control parameters were within the acceptance limits.

HEM (Oil & Grease)
Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for HEM (Oil & Grease)) in accordance with EPA Method 1664A. The samples were prepared and analyzed on 11/12/2013.

The following sample(s) was diluted due to the nature of the sample matrix: MW-02 (280-48516-3). Elevated reporting limits (RLs) are provided.

HEM failed the recovery criteria low for the MS of sample MW-04MS (280-48516-5) in batch 490-121238. Refer to the QC report for details.

No other difficulties were encountered during the HEM (Oil & Grease) analysis.

All other quality control parameters were within the acceptance limits.

ALKALINITY
Samples MW-02 (280-48516-3), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for Alkalinity in accordance with SM20 2320B. The samples were analyzed on 11/01/2013 and 11/07/2013.

Bicarbonate Alkalinity as CaCO3 and Total Alkalinity as CaCO3 were detected in method blank MB 280-199016/6 at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Bicarbonate Alkalinity as CaCO3 and Total Alkalinity as CaCO3 were detected in method blank MB 280-199930/6 at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Total Alkalinity as CaCO3 exceeded the RPD limit for the duplicate of sample MW-09DU (280-48516-7). Refer to the QC report for details.

No other difficulties were encountered during the alkalinity analysis.

All other quality control parameters were within the acceptance limits.

TOTAL DISSOLVED SOLIDS

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 11/01/2013.

No difficulties were encountered during the TDS analysis.

All quality control parameters were within the acceptance limits.

ANIONS (28 DAYS)

Samples MW-02 (280-48516-3), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for anions (28 days) in accordance with EPA Method 300.0. The samples were analyzed on 10/29/2013, 10/30/2013 and 10/31/2013.

Samples MW-02 (280-48516-3)[5X] and MW-05 (280-48516-6)[5X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the anions analysis.

All other quality control parameters were within the acceptance limits.

ANIONS (48 HOURS)

Samples MW-02 (280-48516-3), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for anions (48 hours) in accordance with EPA Method 300.0. The samples were analyzed on 10/29/2013 and 10/30/2013.

The request for Nitrate and Nitrite analysis on sample MW-05 (280-48516-6) was made after the holding time had expired. Samples MW-02 (280-48516-3) and MW-09 (280-48516-7) were received with the holding time rapidly expiring for Nitrate and Nitrite. Every effort was made to analyze the samples prior to the expiration of the holding time. Associated results are qualified "H".

No other difficulties were encountered during the anions analysis.

All other quality control parameters were within the acceptance limits.

TOTAL ORGANIC CARBON

Samples MW-01 (280-48516-2), MW-02 (280-48516-3), MW-03 (280-48516-4), MW-04 (280-48516-5), MW-05 (280-48516-6) and MW-09 (280-48516-7) were analyzed for total organic carbon in accordance with EPA SW-846 Method 9060A. The samples were analyzed on 11/14/2013.

Total Organic Carbon - Average was detected in method blank MB 280-201021/5 at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

Samples MW-01 (280-48516-2)[3.3X] and MW-03 (280-48516-4)[9X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the TOC analysis.

All other quality control parameters were within the acceptance limits.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-48516-1TB	TRIP BLANK	Water	10/25/2013 0000	10/29/2013 0900
280-48516-2	MW-01	Water	10/25/2013 1730	10/29/2013 0900
280-48516-3	MW-02	Water	10/27/2013 1500	10/29/2013 0900
280-48516-4	MW-03	Water	10/25/2013 1300	10/29/2013 0900
280-48516-5	MW-04	Water	10/25/2013 1430	10/29/2013 0900
280-48516-5MS	MW-04	Water	10/25/2013 1430	10/29/2013 0900
280-48516-5MSD	MW-04	Water	10/25/2013 1430	10/29/2013 0900
280-48516-6	MW-05	Water	10/25/2013 1445	10/29/2013 0900
280-48516-7	MW-09	Water	10/27/2013 1200	10/29/2013 0900

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-48516-1TB	**TRIP BLANK**					
Toluene		0.36	J B	1.0	ug/L	8260B
280-48516-2	**MW-01**					
Toluene		0.91	J B	1.0	ug/L	8260B
Gasoline Range Organics (GRO)-C6-C10		21	J	25	ug/L	8015C
Diesel Range Organics [C10-C28]		5.1		0.25	mg/L	8015C
Calcium		100000		200	ug/L	6010C
Magnesium		49000		200	ug/L	6010C
Potassium		17000		3000	ug/L	6010C
Sodium		1800000		1000	ug/L	6010C
SiO2		100000		500	ug/L	6010C
Antimony		14		2.0	ug/L	6020A
Arsenic		93		5.0	ug/L	6020A
Barium		790		1.0	ug/L	6020A
Beryllium		2.7		1.0	ug/L	6020A
Cadmium		1.4		1.0	ug/L	6020A
Chromium		230		2.0	ug/L	6020A
Cobalt		23		1.0	ug/L	6020A
Copper		65	B	2.0	ug/L	6020A
Lead		47		1.0	ug/L	6020A
Manganese		1300		1.0	ug/L	6020A
Nickel		180		2.0	ug/L	6020A
Selenium		1.9	J	5.0	ug/L	6020A
Silver		0.69	J	5.0	ug/L	6020A
Thallium		0.68	J B	1.0	ug/L	6020A
Vanadium		88		5.0	ug/L	6020A
Zinc		290		10	ug/L	6020A
Mercury		0.082	J	0.20	ug/L	7470A
HEM (Oil & Grease)		8.0		3.8	mg/L	1664A
Total Organic Carbon - Average		130	B	3.3	mg/L	9060A
Total Dissolved Solids		5700		83	mg/L	SM 2540C
Dissolved						
Antimony		14		2.0	ug/L	6020A
Arsenic		87		5.0	ug/L	6020A
Barium		150		1.0	ug/L	6020A
Beryllium		0.10	J	1.0	ug/L	6020A
Cadmium		0.21	J	1.0	ug/L	6020A
Chromium		0.59	J	2.0	ug/L	6020A
Cobalt		0.91	J	1.0	ug/L	6020A
Manganese		200		1.0	ug/L	6020A
Nickel		11		2.0	ug/L	6020A
Selenium		0.81	J	5.0	ug/L	6020A
Silver		0.092	J	5.0	ug/L	6020A
Thallium		0.14	J	1.0	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
Vanadium		5.0		5.0	ug/L	6020A
Zinc		6.9	J	10	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc.

Job Number: 280-48516-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-48516-3	**MW-02**					
Toluene		0.99	J B	1.0	ug/L	8260B
Diesel Range Organics [C10-C28]		19		0.24	mg/L	8015C
Calcium		140000		200	ug/L	6010C
Magnesium		58000		200	ug/L	6010C
Potassium		6100		3000	ug/L	6010C
Sodium		350000		1000	ug/L	6010C
SiO2		74000		500	ug/L	6010C
Antimony		5.1		2.0	ug/L	6020A
Arsenic		73		5.0	ug/L	6020A
Barium		740		1.0	ug/L	6020A
Beryllium		3.8		1.0	ug/L	6020A
Cadmium		0.77	J	1.0	ug/L	6020A
Chromium		38		2.0	ug/L	6020A
Cobalt		32		1.0	ug/L	6020A
Copper		93	B	2.0	ug/L	6020A
Lead		38		1.0	ug/L	6020A
Manganese		1600		1.0	ug/L	6020A
Nickel		100		2.0	ug/L	6020A
Selenium		6.5		5.0	ug/L	6020A
Silver		0.18	J	5.0	ug/L	6020A
Thallium		0.49	J B	1.0	ug/L	6020A
Vanadium		110		5.0	ug/L	6020A
Zinc		350		10	ug/L	6020A
Mercury		0.20		0.20	ug/L	7470A
HEM (Oil & Grease)		19		7.7	mg/L	1664A
Nitrate as N		0.53	H	0.50	mg/L	300.0
Chloride		21		3.0	mg/L	300.0
Nitrite as N		0.59	H	0.50	mg/L	300.0
Fluoride		8.2		0.50	mg/L	300.0
Sulfate		180		25	mg/L	300.0
Total Organic Carbon - Average		37	B	1.0	mg/L	9060A
Total Alkalinity as CaCO3		710	B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3		710	B	5.0	mg/L	SM 2320B
Total Dissolved Solids		1100		67	mg/L	SM 2540C
Dissolved						
Antimony		8.1		2.0	ug/L	6020A
Arsenic		19		5.0	ug/L	6020A
Barium		120		1.0	ug/L	6020A
Cobalt		3.1		1.0	ug/L	6020A
Copper		14	B	2.0	ug/L	6020A
Manganese		36		1.0	ug/L	6020A
Nickel		59		2.0	ug/L	6020A
Selenium		5.8		5.0	ug/L	6020A
Thallium		0.057	J	1.0	ug/L	6020A
Vanadium		5.9		5.0	ug/L	6020A
Zinc		17		10	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-48516-4	**MW-03**					
Benzene		0.23	J	1.0	ug/L	8260B
Toluene		3.9	B	1.0	ug/L	8260B
Ethylbenzene		0.28	J	1.0	ug/L	8260B
Gasoline Range Organics (GRO)-C6-C10		59		25	ug/L	8015C
Diesel Range Organics [C10-C28]		4.1		0.24	mg/L	8015C
Calcium		65000		200	ug/L	6010C
Magnesium		54000		200	ug/L	6010C
Potassium		9200		3000	ug/L	6010C
Sodium		1200000		1000	ug/L	6010C
SiO2		64000		500	ug/L	6010C
Antimony		4.5		2.0	ug/L	6020A
Arsenic		37		5.0	ug/L	6020A
Barium		480		1.0	ug/L	6020A
Beryllium		0.91	J	1.0	ug/L	6020A
Cadmium		0.34	J	1.0	ug/L	6020A
Chromium		140		2.0	ug/L	6020A
Cobalt		14		1.0	ug/L	6020A
Copper		22	B	2.0	ug/L	6020A
Lead		15		1.0	ug/L	6020A
Manganese		740		1.0	ug/L	6020A
Nickel		100		2.0	ug/L	6020A
Selenium		4.2	J	5.0	ug/L	6020A
Silver		0.23	J	5.0	ug/L	6020A
Thallium		0.27	J B	1.0	ug/L	6020A
Vanadium		54		5.0	ug/L	6020A
Zinc		110		10	ug/L	6020A
HEM (Oil & Grease)		5.0		3.7	mg/L	1664A
Total Organic Carbon - Average		410	B	9.0	mg/L	9060A
Total Dissolved Solids		3900		40	mg/L	SM 2540C
Dissolved						
Antimony		4.6		2.0	ug/L	6020A
Arsenic		26		5.0	ug/L	6020A
Barium		220		1.0	ug/L	6020A
Chromium		9.7		2.0	ug/L	6020A
Cobalt		1.0		1.0	ug/L	6020A
Manganese		290		1.0	ug/L	6020A
Nickel		16		2.0	ug/L	6020A
Selenium		3.3	J	5.0	ug/L	6020A
Vanadium		4.1	J	5.0	ug/L	6020A
Zinc		2.5	J	10	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID Client Sample ID Analyte	Result	Qualifier	Reporting Limit	Units	Method
280-48516-5 MW-04					
Benzene	3.0		1.0	ug/L	8260B
Toluene	5.1	B	1.0	ug/L	8260B
Ethylbenzene	1.1		1.0	ug/L	8260B
Xylenes, Total	0.22	J	2.0	ug/L	8260B
Gasoline Range Organics (GRO)-C6-C10	38		25	ug/L	8015C
Diesel Range Organics [C10-C28]	0.41		0.24	mg/L	8015C
Calcium	2000		200	ug/L	6010C
Magnesium	1600		200	ug/L	6010C
Potassium	1400	J	3000	ug/L	6010C
Sodium	500000		1000	ug/L	6010C
SiO2	16000		500	ug/L	6010C
Antimony	5.7		2.0	ug/L	6020A
Arsenic	15		5.0	ug/L	6020A
Barium	14		1.0	ug/L	6020A
Chromium	0.66	J	2.0	ug/L	6020A
Cobalt	0.23	J	1.0	ug/L	6020A
Copper	2.4	B	2.0	ug/L	6020A
Lead	0.89	J	1.0	ug/L	6020A
Manganese	17		1.0	ug/L	6020A
Nickel	2.2		2.0	ug/L	6020A
Thallium	0.090	J B	1.0	ug/L	6020A
Vanadium	0.89	J	5.0	ug/L	6020A
Zinc	12		10	ug/L	6020A
Total Organic Carbon - Average	25	B	1.0	mg/L	9060A
Total Dissolved Solids	1400		20	mg/L	SM 2540C
Dissolved					
Antimony	5.0		2.0	ug/L	6020A
Arsenic	11		5.0	ug/L	6020A
Barium	12		1.0	ug/L	6020A
Manganese	7.9		1.0	ug/L	6020A
Nickel	0.51	J	2.0	ug/L	6020A
Zinc	4.5	J	10	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID Client Sample ID Analyte	Result	Qualifier	Reporting Limit	Units	Method
280-48516-6 MW-05					
Benzene	2.8		1.0	ug/L	8260B
Toluene	5.1	B	1.0	ug/L	8260B
Ethylbenzene	0.96	J	1.0	ug/L	8260B
Xylenes, Total	0.30	J	2.0	ug/L	8260B
Gasoline Range Organics (GRO)-C6-C10	37		25	ug/L	8015C
Diesel Range Organics [C10-C28]	0.42		0.24	mg/L	8015C
Calcium	2200		200	ug/L	6010C
Magnesium	1700		200	ug/L	6010C
Potassium	1700	J	3000	ug/L	6010C
Sodium	520000		1000	ug/L	6010C
SiO2	17000		500	ug/L	6010C
Antimony	5.4		2.0	ug/L	6020A
Arsenic	14		5.0	ug/L	6020A
Barium	15		1.0	ug/L	6020A
Beryllium	0.10	J	1.0	ug/L	6020A
Chromium	0.84	J	2.0	ug/L	6020A
Cobalt	0.24	J	1.0	ug/L	6020A
Copper	1.6	J B	2.0	ug/L	6020A
Lead	0.88	J	1.0	ug/L	6020A
Manganese	18		1.0	ug/L	6020A
Nickel	1.4	J	2.0	ug/L	6020A
Thallium	0.15	J B	1.0	ug/L	6020A
Vanadium	1.3	J	5.0	ug/L	6020A
Zinc	11		10	ug/L	6020A
HEM (Oil & Grease)	1.3	J	3.8	mg/L	1664A
Chloride	63		15	mg/L	300.0
Fluoride	2.3		0.50	mg/L	300.0
Sulfate	250		25	mg/L	300.0
Total Organic Carbon - Average	25	B	1.0	mg/L	9060A
Total Alkalinity as CaCO3	770	B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3	430	B	5.0	mg/L	SM 2320B
Carbonate Alkalinity as CaCO3	340		5.0	mg/L	SM 2320B
Total Dissolved Solids	1400		20	mg/L	SM 2540C
Dissolved					
Antimony	4.2		2.0	ug/L	6020A
Arsenic	9.7		5.0	ug/L	6020A
Barium	13		1.0	ug/L	6020A
Manganese	7.8		1.0	ug/L	6020A
Nickel	0.47	J	2.0	ug/L	6020A
Thallium	0.080	J	1.0	ug/L	6020A
Zinc	4.4	J	10	ug/L	6020A

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-48516-7	**MW-09**					
Toluene		0.75	J	1.0	ug/L	8260B
Calcium		180	J	200	ug/L	6010C
Magnesium		44	J	200	ug/L	6010C
Sodium		620	J	1000	ug/L	6010C
SiO2		110	J	500	ug/L	6010C
Antimony		0.76	J	2.0	ug/L	6020A
Barium		1.4		1.0	ug/L	6020A
Chromium		0.66	J	2.0	ug/L	6020A
Copper		0.67	J B	2.0	ug/L	6020A
Lead		0.29	J	1.0	ug/L	6020A
Manganese		0.89	J	1.0	ug/L	6020A
Nickel		0.48	J	2.0	ug/L	6020A
Zinc		4.0	J	10	ug/L	6020A
Chloride		0.42	J	3.0	mg/L	300.0
Sulfate		0.58	J	5.0	mg/L	300.0
Total Organic Carbon - Average		0.65	J B	1.0	mg/L	9060A
Total Alkalinity as CaCO3		3.6	J B	5.0	mg/L	SM 2320B
Bicarbonate Alkalinity as CaCO3		3.6	J B	5.0	mg/L	SM 2320B

METHOD SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Volatile Organic Compounds (GC/MS)	TAL DEN	SW846 8260B	
Purge and Trap	TAL DEN		SW846 5030B
Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)	TAL DEN	SW846 8015C	
Purge and Trap	TAL DEN		SW846 5030C
Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)	TAL DEN	SW846 8015C	
Liquid-Liquid Extraction (Separatory Funnel)	TAL DEN		SW846 3510C
Metals (ICP)	TAL DEN	SW846 6010C	
Preparation, Total Metals	TAL DEN		SW846 3010A
Metals (ICP/MS)	TAL DEN	SW846 6020A	
Preparation, Total Recoverable or Dissolved Metals	TAL DEN		SW846 3005A
Sample Filtration, Field			FIELD_FLTRD
Metals (ICP/MS)	TAL DEN	SW846 6020A	
Preparation, Total Metals	TAL DEN		SW846 3020A
Mercury (CVAA)	TAL DEN	SW846 7470A	
Preparation, Mercury	TAL DEN		SW846 7470A
Mercury (CVAA)	TAL DEN	SW846 7470A	
Preparation, Mercury	TAL DEN		SW846 7470A
Sample Filtration, Field			FIELD_FLTRD
Anions, Ion Chromatography	TAL DEN	MCAWW 300.0	
Organic Carbon, Total (TOC)	TAL DEN	SW846 9060A	
Alkalinity	TAL DEN	SM SM 2320B	
Solids, Total Dissolved (TDS)	TAL DEN	SM SM 2540C	
HEM and SGT-HEM	TAL NSH	1664A 1664A	
HEM and SGT-HEM (SPE)	TAL NSH		1664A 1664A

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

Method References:

1664A = EPA-821-98-002

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method	Analyst	Analyst ID
SW846 8260B	Berger, Brent B	BBB
SW846 8260B	Tinkham, Sarah A	SAT
SW846 8015C	Byl, Amelia M	AMB1
SW846 8015C	Birdsell, Matthew R	MRB
SW846 6010C	Scott, Samantha J	SJS
SW846 6020A	Trudell, Lynn-Anne M	LMT
SW846 7470A	Mooney, Joseph C	JM
SW846 7470A	Rhoades, Chris R	CRR
1664A 1664A	Dunn, Bradley	BAD
MCAWW 300.0	Allen, Andrew J	AJA
MCAWW 300.0	Phan, Thu L	TLP
SW846 9060A	Bandy, Darlene F	DFB
SM SM 2320B	Hoefler, Alexandra F	AFH
SM SM 2540C	Benson, Alex F	AFB

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **TRIP BLANK**

Lab Sample ID:	280-48516-1TB	Date Sampled:	10/25/2013 0000
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7489.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0006			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0006				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	ND		0.16	1.0
Toluene	0.36	J B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	113		70 - 127
Toluene-d8 (Surr)	92		80 - 125
4-Bromofluorobenzene (Surr)	94		78 - 120
Dibromofluoromethane (Surr)	98		77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-01**

Lab Sample ID:	280-48516-2	Date Sampled:	10/25/2013 1730
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7490.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0028			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0028				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	ND		0.16	1.0
Toluene	0.91	J B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	119		70 - 127
Toluene-d8 (Surr)	98		80 - 125
4-Bromofluorobenzene (Surr)	94		78 - 120
Dibromofluoromethane (Surr)	101		77 - 120

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-02**

Lab Sample ID:	280-48516-3	Date Sampled:	10/27/2013 1500
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7491.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0050			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0050				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	ND		0.16	1.0
Toluene	0.99	J B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	125		70 - 127
Toluene-d8 (Surr)	92		80 - 125
4-Bromofluorobenzene (Surr)	88		78 - 120
Dibromofluoromethane (Surr)	104		77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-03**

Lab Sample ID: 280-48516-4 Date Sampled: 10/25/2013 1300
Client Matrix: Water Date Received: 10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7492.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0111			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0111				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	0.23	J	0.16	1.0
Toluene	3.9	B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	0.28	J	0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	125		70 - 127
Toluene-d8 (Surr)	95		80 - 125
4-Bromofluorobenzene (Surr)	89		78 - 120
Dibromofluoromethane (Surr)	101		77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-04**

Lab Sample ID:	280-48516-5	Date Sampled:	10/25/2013 1430
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7499.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0341			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0341				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	3.0		0.16	1.0
Toluene	5.1	B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	1.1		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	0.22	J	0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	112		70 - 127
Toluene-d8 (Surr)	95		80 - 125
4-Bromofluorobenzene (Surr)	82		78 - 120
Dibromofluoromethane (Surr)	97		77 - 120

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-05**

Lab Sample ID:	280-48516-6	Date Sampled:	10/25/2013 1445
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	H7496.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0237			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0237				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	2.8		0.16	1.0
Toluene	5.1	B	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	0.96	J	0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	0.30	J	0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	118		70 - 127
Toluene-d8 (Surr)	89		80 - 125
4-Bromofluorobenzene (Surr)	95		78 - 120
Dibromofluoromethane (Surr)	100		77 - 120

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-09**

Lab Sample ID:	280-48516-7	Date Sampled:	10/27/2013 1200
Client Matrix:	Water	Date Received:	10/29/2013 0900

8260B Volatile Organic Compounds (GC/MS)

Analysis Method:	8260B	Analysis Batch:	280-199896	Instrument ID:	VMS_P
Prep Method:	5030B	Prep Batch:	N/A	Lab File ID:	P4558.D
Dilution:	1.0			Initial Weight/Volume:	20 mL
Analysis Date:	11/08/2013 0406			Final Weight/Volume:	20 mL
Prep Date:	11/08/2013 0406				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Benzene	ND		0.16	1.0
Toluene	0.75	J	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	100		70 - 127
Toluene-d8 (Surr)	101		80 - 125
4-Bromofluorobenzene (Surr)	105		78 - 120
Dibromofluoromethane (Surr)	102		77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-01**

Lab Sample ID: 280-48516-2 Date Sampled: 10/25/2013 1730
Client Matrix: Water Date Received: 10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	10/31/2013 1929			Injection Volume:	
Prep Date:	10/31/2013 1929			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	21	J	10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	92		82 - 110

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-02**

Lab Sample ID:	280-48516-3	Date Sampled:	10/27/2013 1500
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	10/31/2013 1954			Injection Volume:	
Prep Date:	10/31/2013 1954			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	ND		10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	95		82 - 110

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-03**

Lab Sample ID: 280-48516-4 Date Sampled: 10/25/2013 1300
Client Matrix: Water Date Received: 10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	10/31/2013 2018			Injection Volume:	
Prep Date:	10/31/2013 2018			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	59		10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	101		82 - 110

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-04**

Lab Sample ID:	280-48516-5	Date Sampled:	10/25/2013 1430
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	11/01/2013 1018			Injection Volume:	
Prep Date:	11/01/2013 1018			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	38		10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	90		82 - 110

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-05**

Lab Sample ID:	280-48516-6	Date Sampled:	10/25/2013 1445
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	11/01/2013 1132			Injection Volume:	
Prep Date:	11/01/2013 1132			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	37		10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	97		82 - 110

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID:	**MW-09**		
Lab Sample ID:	280-48516-7	Date Sampled:	10/27/2013 1200
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Prep Method:	5030C		N/A	Initial Weight/Volume:	5 mL
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	10/31/2013 2248			Injection Volume:	
Prep Date:	10/31/2013 2248			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	ND		10	25

Surrogate	%Rec	Qualifier	Acceptance Limits
a,a,a-Trifluorotoluene	98		82 - 110

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID:	**MW-01**
Lab Sample ID:	280-48516-2
Client Matrix:	Water

Date Sampled: 10/25/2013 1730
Date Received: 10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1016.4 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 1944			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	5.1		0.032	0.25

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	83		50 - 115

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-02**

Lab Sample ID:	280-48516-3	Date Sampled:	10/27/2013 1500
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1045.2 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 2013			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	19		0.031	0.24

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	171	X	50 - 115

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID:	**MW-03**		
Lab Sample ID:	280-48516-4	Date Sampled:	10/25/2013 1300
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1046.5 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 2042			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	4.1		0.031	0.24

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	89		50 - 115

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-04**

Lab Sample ID:	280-48516-5	Date Sampled:	10/25/2013 1430
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1039.5 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 2110			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	0.41		0.031	0.24

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	80		50 - 115

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-05**

Lab Sample ID:	280-48516-6	Date Sampled:	10/25/2013 1445
Client Matrix:	Water	Date Received:	10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1045.4 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 2236			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	0.42		0.031	0.24

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	83		50 - 115

Analytical Data

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Client Sample ID: **MW-09**

Lab Sample ID: 280-48516-7 | Date Sampled: 10/27/2013 1200
Client Matrix: Water | Date Received: 10/29/2013 0900

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analysis Method:	8015C	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Prep Method:	3510C	Prep Batch:	280-198384	Initial Weight/Volume:	1029.9 mL
Dilution:	1.0			Final Weight/Volume:	1000 uL
Analysis Date:	10/31/2013 2305			Injection Volume:	1 uL
Prep Date:	10/29/2013 2041			Result Type:	PRIMARY

Analyte	Result (mg/L)	Qualifier	MDL	RL
Diesel Range Organics [C10-C28]	ND		0.032	0.24

Surrogate	%Rec	Qualifier	Acceptance Limits
o-Terphenyl (Surr)	79		50 - 115

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Client Sample ID: **MW-01**

Lab Sample ID:	280-48516-2	Date Sampled:	10/25/2013 1730
Client Matrix:	Water	Date Received:	10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0204			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	100000		35	200
Magnesium	49000		11	200
Potassium	17000		240	3000
Sodium	1800000		92	1000
SiO2	100000		35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	069SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1637			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	14		0.40	2.0
Arsenic	93		0.33	5.0
Barium	790		0.29	1.0
Beryllium	2.7		0.080	1.0
Cadmium	1.4		0.10	1.0
Chromium	230		0.50	2.0
Cobalt	23		0.054	1.0
Copper	65	B	0.56	2.0
Lead	47		0.18	1.0
Manganese	1300		0.31	1.0
Nickel	180		0.30	2.0
Selenium	1.9	J	0.70	5.0
Silver	0.69	J	0.033	5.0
Thallium	0.68	J B	0.050	1.0
Vanadium	88		0.50	5.0
Zinc	290		2.0	10

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	029SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1257			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	14		0.40	2.0
Arsenic	87		0.33	5.0

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-01**

Lab Sample ID: 280-48516-2 Date Sampled: 10/25/2013 1730
Client Matrix: Water Date Received: 10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	150		0.29	1.0
Beryllium	0.10	J	0.080	1.0
Cadmium	0.21	J	0.10	1.0
Chromium	0.59	J	0.50	2.0
Cobalt	0.91	J	0.054	1.0
Copper	ND		0.56	2.0
Lead	ND		0.18	1.0
Manganese	200		0.31	1.0
Nickel	11		0.30	2.0
Selenium	0.81	J	0.70	5.0
Silver	0.092	J	0.033	5.0
Thallium	0.14	J	0.050	1.0
Vanadium	5.0		0.50	5.0
Zinc	6.9	J	2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1428			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	0.082	J	0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2157			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-02**

Lab Sample ID:	280-48516-3	Date Sampled:	10/27/2013 1500
Client Matrix:	Water	Date Received:	10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0207			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	140000		35	200
Magnesium	58000		11	200
Potassium	6100		240	3000
Sodium	350000		92	1000
SiO2	74000		35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	070SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1640			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	5.1		0.40	2.0
Arsenic	73		0.33	5.0
Barium	740		0.29	1.0
Beryllium	3.8		0.080	1.0
Cadmium	0.77	J	0.10	1.0
Chromium	38		0.50	2.0
Cobalt	32		0.054	1.0
Copper	93	B	0.56	2.0
Lead	38		0.18	1.0
Manganese	1600		0.31	1.0
Nickel	100		0.30	2.0
Selenium	6.5		0.70	5.0
Silver	0.18	J	0.033	5.0
Thallium	0.49	J B	0.050	1.0
Vanadium	110		0.50	5.0
Zinc	350		2.0	10

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	030SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1300			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	8.1		0.40	2.0
Arsenic	19		0.33	5.0

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-02**

Lab Sample ID: 280-48516-3 Date Sampled: 10/27/2013 1500
Client Matrix: Water Date Received: 10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	120		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	3.1		0.054	1.0
Copper	14	B	0.56	2.0
Lead	ND		0.18	1.0
Manganese	36		0.31	1.0
Nickel	59		0.30	2.0
Selenium	5.8		0.70	5.0
Silver	ND		0.033	5.0
Thallium	0.057	J	0.050	1.0
Vanadium	5.9		0.50	5.0
Zinc	17		2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1431			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	0.20		0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2159			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-03**

Lab Sample ID:	280-48516-4	Date Sampled:	10/25/2013 1300
Client Matrix:	Water	Date Received:	10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0210			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	65000		35	200
Magnesium	54000		11	200
Potassium	9200		240	3000
Sodium	1200000		92	1000
SiO2	64000		35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	071SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1644			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	4.5		0.40	2.0
Arsenic	37		0.33	5.0
Barium	480		0.29	1.0
Beryllium	0.91	J	0.080	1.0
Cadmium	0.34	J	0.10	1.0
Chromium	140		0.50	2.0
Cobalt	14		0.054	1.0
Copper	22	B	0.56	2.0
Lead	15		0.18	1.0
Manganese	740		0.31	1.0
Nickel	100		0.30	2.0
Selenium	4.2	J	0.70	5.0
Silver	0.23	J	0.033	5.0
Thallium	0.27	J B	0.050	1.0
Vanadium	54		0.50	5.0
Zinc	110		2.0	10

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	031SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1304			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	4.6		0.40	2.0
Arsenic	26		0.33	5.0

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-03**

Lab Sample ID: 280-48516-4
Client Matrix: Water

Date Sampled: 10/25/2013 1300
Date Received: 10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	220		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	9.7		0.50	2.0
Cobalt	1.0		0.054	1.0
Copper	ND		0.56	2.0
Lead	ND		0.18	1.0
Manganese	290		0.31	1.0
Nickel	16		0.30	2.0
Selenium	3.3	J	0.70	5.0
Silver	ND		0.033	5.0
Thallium	ND		0.050	1.0
Vanadium	4.1	J	0.50	5.0
Zinc	2.5	J	2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1433			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2202			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-04**

Lab Sample ID: 280-48516-5 Date Sampled: 10/25/2013 1430
Client Matrix: Water Date Received: 10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0222			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	2000		35	200
Magnesium	1600		11	200
Potassium	1400	J	240	3000
Sodium	500000		92	1000
SiO2	16000		35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	075SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1658			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	5.7		0.40	2.0
Arsenic	15		0.33	5.0
Barium	14		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	0.66	J	0.50	2.0
Cobalt	0.23	J	0.054	1.0
Copper	2.4	B	0.56	2.0
Lead	0.89	J	0.18	1.0
Manganese	17		0.31	1.0
Nickel	2.2		0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	0.090	J B	0.050	1.0
Vanadium	0.89	J	0.50	5.0
Zinc	12		2.0	10

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	032SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1308			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	5.0		0.40	2.0
Arsenic	11		0.33	5.0

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-04**

Lab Sample ID: 280-48516-5 Date Sampled: 10/25/2013 1430
Client Matrix: Water Date Received: 10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	12		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	ND		0.054	1.0
Copper	ND		0.56	2.0
Lead	ND		0.18	1.0
Manganese	7.9		0.31	1.0
Nickel	0.51	J	0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	ND		0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	4.5	J	2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1435			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2209			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Analytical Data

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-05**

Lab Sample ID:	280-48516-6	Date Sampled:	10/25/2013 1445
Client Matrix:	Water	Date Received:	10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0235			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	2200		35	200
Magnesium	1700		11	200
Potassium	1700	J	240	3000
Sodium	520000		92	1000
SiO2	17000		35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	080SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1716			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Arsenic	14		0.33	5.0
Barium	15		0.29	1.0
Beryllium	0.10	J	0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	0.84	J	0.50	2.0
Cobalt	0.24	J	0.054	1.0
Copper	1.6	J B	0.56	2.0
Lead	0.88	J	0.18	1.0
Manganese	18		0.31	1.0
Nickel	1.4	J	0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	0.15	J B	0.050	1.0
Vanadium	1.3	J	0.50	5.0
Zinc	11		2.0	10

Analysis Method:	6020A	Analysis Batch:	280-199221	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	052SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/04/2013 1431			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	5.4		0.40	2.0

6020A Metals (ICP/MS)-Dissolved

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-05**

Lab Sample ID:	280-48516-6	Date Sampled:	10/25/2013 1445
Client Matrix:	Water	Date Received:	10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	040SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1338			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	4.2		0.40	2.0
Arsenic	9.7		0.33	5.0
Barium	13		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	ND		0.054	1.0
Copper	ND		0.56	2.0
Lead	ND		0.18	1.0
Manganese	7.8		0.31	1.0
Nickel	0.47	J	0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	0.080	J	0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	4.4	J	2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1447			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2216			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Client Sample ID: **MW-09**

Lab Sample ID:	280-48516-7	Date Sampled:	10/27/2013 1200
Client Matrix:	Water	Date Received:	10/29/2013 0900

6010C Metals (ICP)

Analysis Method:	6010C	Analysis Batch:	280-198837	Instrument ID:	MT_025
Prep Method:	3010A	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0238			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Calcium	180	J	35	200
Magnesium	44	J	11	200
Potassium	ND		240	3000
Sodium	620	J	92	1000
SiO2	110	J	35	500

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Prep Method:	3020A	Prep Batch:	280-198463	Lab File ID:	081SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1720			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	0.76	J	0.40	2.0
Arsenic	ND		0.33	5.0
Barium	1.4		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	0.66	J	0.50	2.0
Cobalt	ND		0.054	1.0
Copper	0.67	J B	0.56	2.0
Lead	0.29	J	0.18	1.0
Manganese	0.89	J	0.31	1.0
Nickel	0.48	J	0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	ND		0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	4.0	J	2.0	10

6020A Metals (ICP/MS)-Dissolved

Analysis Method:	6020A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Prep Method:	3005A	Prep Batch:	280-198697	Lab File ID:	041SMPL.d
Dilution:	1.0			Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1341			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	ND		0.40	2.0
Arsenic	ND		0.33	5.0

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Client Sample ID: **MW-09**

Lab Sample ID: 280-48516-7 Date Sampled: 10/27/2013 1200
Client Matrix: Water Date Received: 10/29/2013 0900

6020A Metals (ICP/MS)-Dissolved

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	ND		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	ND		0.054	1.0
Copper	ND		0.56	2.0
Lead	ND		0.18	1.0
Manganese	ND		0.31	1.0
Nickel	ND		0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	ND		0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	ND		2.0	10

7470A Mercury (CVAA)

Analysis Method:	7470A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1449			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

7470A Mercury (CVAA)-Dissolved

Analysis Method:	7470A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Prep Method:	7470A	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0			Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2218			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Mercury	ND		0.027	0.20

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

General Chemistry

Client Sample ID: **MW-01**

Lab Sample ID: 280-48516-2 Date Sampled: 10/25/2013 1730
Client Matrix: Water Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	8.0		mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Total Organic Carbon - Average	130	B	mg/L	0.51	3.3	3.3	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0056						
Total Dissolved Solids	5700		mg/L	39	83	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

General Chemistry

Client Sample ID: **MW-02**

Lab Sample ID: 280-48516-3 Date Sampled: 10/27/2013 1500
Client Matrix: Water Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	19		mg/L	2.7	7.7	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Chloride	21		mg/L	0.25	3.0	1.0	300.0
Analysis Batch: 280-198951	Analysis Date: 10/30/2013 1904						
Nitrate as N	0.53	H	mg/L	0.042	0.50	1.0	300.0
Analysis Batch: 280-198950	Analysis Date: 10/30/2013 1904						
Fluoride	8.2		mg/L	0.060	0.50	1.0	300.0
Analysis Batch: 280-198951	Analysis Date: 10/30/2013 1904						
Nitrite as N	0.59	H	mg/L	0.049	0.50	1.0	300.0
Analysis Batch: 280-198950	Analysis Date: 10/30/2013 1904						
Sulfate	180		mg/L	1.2	25	5.0	300.0
Analysis Batch: 280-198951	Analysis Date: 10/31/2013 0210						
Total Organic Carbon - Average	37	B	mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0126						
Total Alkalinity as CaCO3	710	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2104						
Bicarbonate Alkalinity as CaCO3	710	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2104						
Carbonate Alkalinity as CaCO3	ND		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2104						
Total Dissolved Solids	1100		mg/L	31	67	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

General Chemistry

Client Sample ID: **MW-03**

Lab Sample ID: 280-48516-4 Date Sampled: 10/25/2013 1300
Client Matrix: Water Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	5.0		mg/L	1.3	3.7	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Total Organic Carbon - Average	410	B	mg/L	1.4	9.0	9.0	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0156						
Total Dissolved Solids	3900		mg/L	19	40	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

Client: Ecology and Environment, Inc.   Job Number: 280-48516-1

General Chemistry

Client Sample ID: **MW-04**

Lab Sample ID: 280-48516-5   Date Sampled: 10/25/2013 1430
Client Matrix: Water   Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	ND		mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Total Organic Carbon - Average	25	B	mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0216						
Total Dissolved Solids	1400		mg/L	9.4	20	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

General Chemistry

Client Sample ID: **MW-05**

Lab Sample ID: 280-48516-6 Date Sampled: 10/25/2013 1445
Client Matrix: Water Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	1.3	J	mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Chloride	63		mg/L	1.3	15	5.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/30/2013 0252						
Nitrate as N	ND	H	mg/L	0.042	0.50	1.0	300.0
Analysis Batch: 280-198510	Analysis Date: 10/29/2013 2057						
Fluoride	2.3		mg/L	0.060	0.50	1.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/29/2013 2057						
Nitrite as N	ND	H	mg/L	0.049	0.50	1.0	300.0
Analysis Batch: 280-198510	Analysis Date: 10/29/2013 2057						
Sulfate	250		mg/L	1.2	25	5.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/30/2013 0252						
Total Organic Carbon - Average	25	B	mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0312						
Total Alkalinity as CaCO3	770	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1538						
Bicarbonate Alkalinity as CaCO3	430	B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1538						
Carbonate Alkalinity as CaCO3	340		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199016	Analysis Date: 11/01/2013 1538						
Total Dissolved Solids	1400		mg/L	9.4	20	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

General Chemistry

Client Sample ID: **MW-09**

Lab Sample ID: 280-48516-7 Date Sampled: 10/27/2013 1200
Client Matrix: Water Date Received: 10/29/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	ND		mg/L	1.3	3.6	1.0	1664A
Analysis Batch: 490-121238	Analysis Date: 11/12/2013 1055						
Prep Batch: 490-121230	Prep Date: 11/12/2013 1055						
Chloride	0.42	J	mg/L	0.25	3.0	1.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/29/2013 2113						
Nitrate as N	ND	H	mg/L	0.042	0.50	1.0	300.0
Analysis Batch: 280-198510	Analysis Date: 10/29/2013 2113						
Fluoride	ND		mg/L	0.060	0.50	1.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/29/2013 2113						
Nitrite as N	ND	H	mg/L	0.049	0.50	1.0	300.0
Analysis Batch: 280-198510	Analysis Date: 10/29/2013 2113						
Sulfate	0.58	J	mg/L	0.23	5.0	1.0	300.0
Analysis Batch: 280-198509	Analysis Date: 10/29/2013 2113						
Total Organic Carbon - Average	0.65	J B	mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-201021	Analysis Date: 11/14/2013 0331						
Total Alkalinity as CaCO3	3.6	J B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2056						
Bicarbonate Alkalinity as CaCO3	3.6	J B	mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2056						
Carbonate Alkalinity as CaCO3	ND		mg/L	1.1	5.0	1.0	SM 2320B
Analysis Batch: 280-199930	Analysis Date: 11/07/2013 2056						
Total Dissolved Solids	ND		mg/L	19	40	1.0	SM 2540C
Analysis Batch: 280-198932	Analysis Date: 11/01/2013 1338						

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Surrogate Recovery Report

8260B Volatile Organic Compounds (GC/MS)

Client Matrix: Water

Lab Sample ID	Client Sample ID	DBFM %Rec	DCA %Rec	TOL %Rec	BFB %Rec
280-48516-1	TRIP BLANK	98	113	92	94
280-48516-2	MW-01	101	119	98	94
280-48516-3	MW-02	104	125	92	88
280-48516-4	MW-03	101	125	95	89
280-48516-5	MW-04	97	112	95	82
280-48516-6	MW-05	100	118	89	95
280-48516-7	MW-09	102	100	101	105
MB 280-199243/5		100	116	95	93
MB 280-199896/6		103	100	100	103
LCS 280-199243/4		95	114	100	82
LCS 280-199896/4		100	94	99	98
280-48516-5 MS	MW-04 MS	97	123	101	94
280-48516-5 MSD	MW-04 MSD	103	129X	105	86

Surrogate	Acceptance Limits
DBFM = Dibromofluoromethane (Surr)	77-120
DCA = 1,2-Dichloroethane-d4 (Surr)	70-127
TOL = Toluene-d8 (Surr)	80-125
BFB = 4-Bromofluorobenzene (Surr)	78-120

Surrogate Recovery Report

8015C Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Client Matrix: Water

Lab Sample ID	Client Sample ID	TFT1 %Rec
280-48516-2	MW-01	92
280-48516-3	MW-02	95
280-48516-4	MW-03	101
280-48516-5	MW-04	90
280-48516-6	MW-05	97
280-48516-7	MW-09	98
MB 280-198686/5		100
LCS 280-198686/6		93
LCSD 280-198686/7		94
280-48516-5 MS	MW-04 MS	89
280-48516-5 MSD	MW-04 MSD	97

Surrogate	Acceptance Limits
TFT = a,a,a-Trifluorotoluene	82-110

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Surrogate Recovery Report

8015C Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Client Matrix: Water

Lab Sample ID	Client Sample ID	OTPH1 %Rec
280-48516-2	MW-01	83
280-48516-3	MW-02	171X
280-48516-4	MW-03	89
280-48516-5	MW-04	80
280-48516-6	MW-05	83
280-48516-7	MW-09	79
MB 280-198384/1-A		79
LCS 280-198384/2-A		83
280-48516-5 MS	MW-04 MS	82
280-48516-5 MSD	MW-04 MSD	65

Surrogate	Acceptance Limits
OTPH = o-Terphenyl (Surr)	50-115

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-199243 **Method: 8260B**
Preparation: 5030B

Lab Sample ID:	MB 280-199243/5	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	H7478.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/04/2013 2009	Units:	ug/L	Final Weight/Volume:	20 mL
Prep Date:	11/04/2013 2009				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Benzene	ND		0.16	1.0
Toluene	0.337	J	0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	116	70 - 127
Toluene-d8 (Surr)	95	80 - 125
4-Bromofluorobenzene (Surr)	93	78 - 120
Dibromofluoromethane (Surr)	100	77 - 120

Lab Control Sample - Batch: 280-199243 **Method: 8260B**
Preparation: 5030B

Lab Sample ID:	LCS 280-199243/4	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	H7477.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/04/2013 1947	Units:	ug/L	Final Weight/Volume:	20 mL
Prep Date:	11/04/2013 1947				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Benzene	5.00	4.90	98	74 - 135	
Toluene	5.00	5.00	100	73 - 120	
m-Xylene & p-Xylene	5.00	4.86	97	74 - 135	
o-Xylene	5.00	4.78	96	73 - 135	
Ethylbenzene	5.00	4.72	94	72 - 120	
Naphthalene	5.00	5.04	101	48 - 135	
Xylenes, Total	10.0	9.64	96	75 - 135	

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	114	70 - 127
Toluene-d8 (Surr)	100	80 - 125
4-Bromofluorobenzene (Surr)	82	78 - 120
Dibromofluoromethane (Surr)	95	77 - 120

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-199243

Method: 8260B
Preparation: 5030B

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	H7494.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0154			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0154				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-199243	Instrument ID:	VMS_H
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	H7495.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/05/2013 0215			Final Weight/Volume:	20 mL
Prep Date:	11/05/2013 0215				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Benzene	94	99	74 - 135	3	20		
Toluene	88	91	73 - 120	2	20		
m-Xylene & p-Xylene	98	98	74 - 135	0	20		
o-Xylene	90	93	73 - 135	3	20		
Ethylbenzene	90	94	72 - 120	4	26		
Naphthalene	108	109	48 - 135	1	32		
Xylenes, Total	92	93	75 - 135	1	20		

Surrogate	MS % Rec	MSD % Rec		Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	123	129	X	70 - 127
Toluene-d8 (Surr)	101	105		80 - 125
4-Bromofluorobenzene (Surr)	94	86		78 - 120
Dibromofluoromethane (Surr)	97	103		77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-199243

Method: 8260B
Preparation: 5030B

MS Lab Sample ID:	280-48516-5	Units:	ug/L
Client Matrix:	Water		
Dilution:	1.0		
Analysis Date:	11/05/2013 0154		
Prep Date:	11/05/2013 0154		
Leach Date:	N/A		

MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water
Dilution:	1.0
Analysis Date:	11/05/2013 0215
Prep Date:	11/05/2013 0215
Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Benzene	3.0		5.00	5.00	7.69	7.94
Toluene	5.1		5.00	5.00	9.49	9.65
m-Xylene & p-Xylene	ND		5.00	5.00	4.90	4.90
o-Xylene	ND		5.00	5.00	4.52	4.64
Ethylbenzene	1.1		5.00	5.00	5.63	5.84
Naphthalene	ND		5.00	5.00	5.40	5.45
Xylenes, Total	0.22	J	10.0	10.0	9.42	9.54

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-199896

Method: 8260B
Preparation: 5030B

Lab Sample ID:	MB 280-199896/6	Analysis Batch:	280-199896	Instrument ID:	VMS_P
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	P4547.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/08/2013 0014	Units:	ug/L	Final Weight/Volume:	20 mL
Prep Date:	11/08/2013 0014				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Benzene	ND		0.16	1.0
Toluene	ND		0.17	1.0
m-Xylene & p-Xylene	ND		0.34	2.0
o-Xylene	ND		0.19	1.0
Ethylbenzene	ND		0.16	1.0
Naphthalene	ND		0.22	1.0
Xylenes, Total	ND		0.19	2.0

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	100	70 - 127
Toluene-d8 (Surr)	100	80 - 125
4-Bromofluorobenzene (Surr)	103	78 - 120
Dibromofluoromethane (Surr)	103	77 - 120

Lab Control Sample - Batch: 280-199896

Method: 8260B
Preparation: 5030B

Lab Sample ID:	LCS 280-199896/4	Analysis Batch:	280-199896	Instrument ID:	VMS_P
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	P4546.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	20 mL
Analysis Date:	11/07/2013 2353	Units:	ug/L	Final Weight/Volume:	20 mL
Prep Date:	11/07/2013 2353				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Benzene	5.00	5.06	101	74 - 135	
Toluene	5.00	5.27	105	73 - 120	
m-Xylene & p-Xylene	5.00	4.78	96	74 - 135	
o-Xylene	5.00	4.69	94	73 - 135	
Ethylbenzene	5.00	4.79	96	72 - 120	
Naphthalene	5.00	3.96	79	48 - 135	
Xylenes, Total	10.0	9.48	95	75 - 135	

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	94	70 - 127
Toluene-d8 (Surr)	99	80 - 125
4-Bromofluorobenzene (Surr)	98	78 - 120
Dibromofluoromethane (Surr)	100	77 - 120

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198686

Method: 8015C
Preparation: 5030C

Lab Sample ID:	MB 280-198686/5	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	005F0501.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	10/31/2013 1225	Units:	ug/L	Final Weight/Volume:	5 mL
Prep Date:	10/31/2013 1225			Injection Volume:	
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Gasoline Range Organics (GRO)-C6-C10	ND		10	25

Surrogate	% Rec	Acceptance Limits
a,a,a-Trifluorotoluene	100	82 - 110

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198686

Method: 8015C
Preparation: 5030C

LCS Lab Sample ID:	LCS 280-198686/6	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	006F0601.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	10/31/2013 1250	Units:	ug/L	Final Weight/Volume:	5 mL
Prep Date:	10/31/2013 1250			Injection Volume:	
Leach Date:	N/A			Column ID:	PRIMARY

LCSD Lab Sample ID:	LCSD 280-198686/7	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	007F0701.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	10/31/2013 1315	Units:	ug/L	Final Weight/Volume:	5 mL
Prep Date:	10/31/2013 1315			Injection Volume:	
Leach Date:	N/A			Column ID:	PRIMARY

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Gasoline Range Organics (GRO)-C6-C10	104	107	79 - 149	3	27		

Surrogate	LCS % Rec	LCSD % Rec	Acceptance Limits
a,a,a-Trifluorotoluene	93	94	82 - 110

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198686

Method: 8015C
Preparation: 5030C

LCS Lab Sample ID:	LCS 280-198686/6	Units: ug/L		LCSD Lab Sample ID:	LCSD 280-198686/7
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/31/2013 1250			Analysis Date:	10/31/2013 1315
Prep Date:	10/31/2013 1250			Prep Date:	10/31/2013 1315
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Gasoline Range Organics (GRO)-C6-C10	101	101	105	108

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198686

Method: 8015C
Preparation: 5030C

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	035F3501.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/01/2013 1042			Final Weight/Volume:	5 mL
Prep Date:	11/01/2013 1042			Injection Volume:	
Leach Date:	N/A			Column ID:	PRIMARY

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-198686	Instrument ID:	VGC_Q
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	036F3601.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	5 mL
Analysis Date:	11/01/2013 1107			Final Weight/Volume:	5 mL
Prep Date:	11/01/2013 1107			Injection Volume:	
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	% Rec. MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Gasoline Range Organics (GRO)-C6-C10	111	107	79 - 149	3	27		

Surrogate	MS % Rec	MSD % Rec	Acceptance Limits
a,a,a-Trifluorotoluene	89	97	82 - 110

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198686

Method: 8015C
Preparation: 5030C

MS Lab Sample ID:	280-48516-5	Units: ug/L	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	11/01/2013 1042		Analysis Date:	11/01/2013 1107
Prep Date:	11/01/2013 1042		Prep Date:	11/01/2013 1107
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Gasoline Range Organics (GRO)-C6-C10	38	101	101	150	145

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198384

Method: 8015C
Preparation: 3510C

Lab Sample ID:	MB 280-198384/1-A	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Client Matrix:	Water	Prep Batch:	280-198384	Lab File ID:	10310006.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	10/31/2013 1430	Units:	mg/L	Final Weight/Volume:	1000 uL
Prep Date:	10/29/2013 2041			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel Range Organics [C10-C28]	ND		0.033	0.25

Surrogate	% Rec	Acceptance Limits
o-Terphenyl (Surr)	79	50 - 115

Lab Control Sample - Batch: 280-198384

Method: 8015C
Preparation: 3510C

Lab Sample ID:	LCS 280-198384/2-A	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Client Matrix:	Water	Prep Batch:	280-198384	Lab File ID:	10310007.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	10/31/2013 1459	Units:	mg/L	Final Weight/Volume:	1000 uL
Prep Date:	10/29/2013 2041			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel Range Organics [C10-C28]	2.00	1.75	87	54 - 115	

Surrogate	% Rec	Acceptance Limits
o-Terphenyl (Surr)	83	50 - 115

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198384

Method: 8015C
Preparation: 3510C

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Client Matrix:	Water	Prep Batch:	280-198384	Lab File ID:	10310021.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	986.2 mL
Analysis Date:	10/31/2013 2139			Final Weight/Volume:	1000 uL
Prep Date:	10/29/2013 2041			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-198700	Instrument ID:	SGC_U
Client Matrix:	Water	Prep Batch:	280-198384	Lab File ID:	10310022.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1053.4 mL
Analysis Date:	10/31/2013 2208			Final Weight/Volume:	1000 uL
Prep Date:	10/29/2013 2041			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Diesel Range Organics [C10-C28]	70	55	50 - 115	23	31		

Surrogate	MS % Rec	MSD % Rec	Acceptance Limits
o-Terphenyl (Surr)	82	65	50 - 115

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198384

Method: 8015C
Preparation: 3510C

MS Lab Sample ID:	280-48516-5	Units: mg/L		MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/31/2013 2139			Analysis Date:	10/31/2013 2208
Prep Date:	10/29/2013 2041			Prep Date:	10/29/2013 2041
Leach Date:	N/A			Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Diesel Range Organics [C10-C28]	0.41	2.03	1.90	1.84	1.46

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198459 **Method: 6010C**
Preparation: 3010A

Lab Sample ID:	MB 280-198459/1-A	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0155	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Calcium	ND		35	200
Magnesium	ND		11	200
Potassium	ND		240	3000
Sodium	ND		92	1000
SiO2	ND		35	500

Lab Control Sample - Batch: 280-198459 **Method: 6010C**
Preparation: 3010A

Lab Sample ID:	LCS 280-198459/2-A	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0157	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Calcium	50000	48300	97	90 - 111	
Magnesium	50000	46900	94	90 - 113	
Potassium	50000	49700	99	89 - 114	
Sodium	50000	50400	101	90 - 115	
SiO2	21400	21100	99	80 - 110	

Post Digestion Spike - Batch: 280-198459 **Method: 6010C**
Preparation: 3010A

Lab Sample ID:	280-48516-5	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0233	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Spike Amount	Result	% Rec.	Limit	Qual
Calcium	2000		20000	21000	95	75 - 125	
Magnesium	1600		20000	19300	89	75 - 125	
Potassium	1400	J	20000	21700	101	75 - 125	
Sodium	500000		20000	508000	NC	75 - 125	
SiO2	16000		10700	26400	97	75 - 125	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198459

Method: 6010C
Preparation: 3010A

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0227			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0230			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Calcium	95	99	48 - 153	4	20		
Magnesium	91	93	62 - 146	2	20		
Potassium	101	106	76 - 132	4	20		
Sodium	111	153	70 - 203	4	20	4	4
SiO2	100	110	75 - 141	6	20		

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198459

Method: 6010C
Preparation: 3010A

MS Lab Sample ID:	280-48516-5	Units:	ug/L	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/01/2013 0227			Analysis Date:	11/01/2013 0230
Prep Date:	10/30/2013 1000			Prep Date:	10/30/2013 1000
Leach Date:	N/A			Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Calcium	2000		50000	50000	49500		51600	
Magnesium	1600		50000	50000	47000		47900	
Potassium	1400	J	50000	50000	51900		54300	
Sodium	500000		50000	50000	553000	4	574000	4
SiO2	16000		21400	21400	37400		39600	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Serial Dilution - Batch: 280-198459

Method: 6010C
Preparation: 3010A

Lab Sample ID:	280-48516-5	Analysis Batch:	280-198837	Instrument ID:	MT_025
Client Matrix:	Water	Prep Batch:	280-198459	Lab File ID:	25B2103113.asc
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/01/2013 0225	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1000				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Result	%Diff	Limit	Qual
Calcium	2000		2110	3.3	10	
Magnesium	1600		1640	2.5	10	
Potassium	1400	J	1630	NC	10	J
Sodium	500000		502000	0.86	10	
SiO2	16000		15600	2.0	10	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198463

Method: 6020A
Preparation: 3020A

Lab Sample ID:	MB 280-198463/1-A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	063_BLK.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1615	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Antimony	ND		0.40	2.0
Arsenic	ND		0.33	5.0
Barium	ND		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	ND		0.054	1.0
Copper	0.733	J	0.56	2.0
Lead	ND		0.18	1.0
Manganese	ND		0.31	1.0
Nickel	ND		0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	0.0790	J	0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	ND		2.0	10

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Control Sample - Batch: 280-198463

Method: 6020A
Preparation: 3020A

Lab Sample ID:	LCS 280-198463/2-A	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	064_LCS.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1619	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	40.0	37.9	95	85 - 115	
Arsenic	40.0	39.9	100	85 - 117	
Barium	40.0	38.8	97	85 - 118	
Beryllium	40.0	41.4	103	80 - 125	
Cadmium	40.0	40.1	100	85 - 115	
Chromium	40.0	40.6	102	84 - 121	
Cobalt	40.0	41.3	103	85 - 120	
Copper	40.0	41.0	103	85 - 119	
Lead	40.0	41.6	104	85 - 118	
Manganese	40.0	41.5	104	85 - 117	
Nickel	40.0	40.9	102	85 - 119	
Selenium	40.0	42.5	106	77 - 122	
Silver	40.0	41.1	103	85 - 115	
Thallium	40.0	41.2	103	85 - 118	
Vanadium	40.0	39.8	99	85 - 120	
Zinc	40.0	40.9	102	83 - 122	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Post Digestion Spike - Batch: 280-198463

Method: 6020A
Preparation: 3020A

Lab Sample ID:	280-48516-5	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	079SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1712	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Spike Amount	Result	% Rec.	Limit	Qual
Antimony	5.7		200	201	98	75 - 125	
Arsenic	15		200	218	102	75 - 125	
Barium	14		200	218	102	75 - 125	
Beryllium	ND		200	202	101	75 - 125	
Cadmium	ND		200	195	98	75 - 125	
Chromium	0.66	J	200	204	102	75 - 125	
Cobalt	0.23	J	200	206	103	75 - 125	
Copper	2.4		200	201	99	75 - 125	
Lead	0.89	J	200	202	100	75 - 125	
Manganese	17		200	221	102	75 - 125	
Nickel	2.2		200	202	100	75 - 125	
Selenium	ND		200	207	103	75 - 125	
Silver	ND		50.0	47.6	95	75 - 125	
Thallium	0.090	J	200	201	100	75 - 125	
Vanadium	0.89	J	200	209	104	75 - 125	
Zinc	12		200	226	107	75 - 125	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198463

Method: 6020A
Preparation: 3020A

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	077SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1705			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	078SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1709			Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Antimony	95	93	85 - 115	2	20		
Arsenic	101	92	85 - 117	7	20		
Barium	103	96	85 - 118	5	20		
Beryllium	100	99	80 - 125	1	20		
Cadmium	99	94	85 - 115	4	20		
Chromium	102	100	84 - 121	2	20		
Cobalt	102	98	85 - 120	4	20		
Copper	98	96	85 - 119	1	20		
Lead	97	97	85 - 118	0	20		
Manganese	101	96	85 - 117	3	20		
Nickel	100	96	85 - 119	3	20		
Selenium	19	16	77 - 122	20	20	F	F
Silver	90	89	85 - 115	0	20		
Thallium	97	97	85 - 118	0	20		
Vanadium	105	100	85 - 120	5	20		
Zinc	100	97	83 - 122	3	20		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198463

Method: 6020A
Preparation: 3020A

MS Lab Sample ID:	280-48516-5	Units: ug/L	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/31/2013 1705		Analysis Date:	10/31/2013 1709
Prep Date:	10/30/2013 1004		Prep Date:	10/30/2013 1004
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Antimony	5.7		40.0	40.0	43.5		42.7	
Arsenic	15		40.0	40.0	55.4		51.9	
Barium	14		40.0	40.0	55.5		52.9	
Beryllium	ND		40.0	40.0	39.9		39.5	
Cadmium	ND		40.0	40.0	39.5		37.8	
Chromium	0.66	J	40.0	40.0	41.5		40.7	
Cobalt	0.23	J	40.0	40.0	41.2		39.4	
Copper	2.4		40.0	40.0	41.5		40.9	
Lead	0.89	J	40.0	40.0	39.7		39.8	
Manganese	17		40.0	40.0	57.7		55.8	
Nickel	2.2		40.0	40.0	42.1		40.7	
Selenium	ND		40.0	40.0	7.69	F	6.30	F
Silver	ND		40.0	40.0	35.8		35.7	
Thallium	0.090	J	40.0	40.0	38.8		38.8	
Vanadium	0.89	J	40.0	40.0	43.0		40.9	
Zinc	12		40.0	40.0	52.6		51.1	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Serial Dilution - Batch: 280-198463

Method: 6020A
Preparation: 3020A

Lab Sample ID:	280-48516-5	Analysis Batch:	280-199090	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198463	Lab File ID:	076SMPL.d
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/31/2013 1702	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	10/30/2013 1004				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Result	%Diff	Limit	Qual
Antimony	5.7		5.93	NC	10	J
Arsenic	15		15.1	NC	10	J
Barium	14		15.0	NC	10	
Beryllium	ND		ND	NC	10	
Cadmium	ND		ND	NC	10	
Chromium	0.66	J	ND	NC	10	
Cobalt	0.23	J	ND	NC	10	
Copper	2.4		ND	NC	10	
Lead	0.89	J	0.995	NC	10	J
Manganese	17		16.2	6.4	10	
Nickel	2.2		2.19	NC	10	J
Selenium	ND		ND	NC	10	
Silver	ND		ND	NC	10	
Thallium	0.090	J	ND	NC	10	
Vanadium	0.89	J	ND	NC	10	
Zinc	12		16.8	NC	10	J

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Total Recoverable

Lab Sample ID:	MB 280-198697/1-A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	027_BLK.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1249	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Antimony	ND		0.40	2.0
Arsenic	ND		0.33	5.0
Barium	ND		0.29	1.0
Beryllium	ND		0.080	1.0
Cadmium	ND		0.10	1.0
Chromium	ND		0.50	2.0
Cobalt	ND		0.054	1.0
Copper	0.598	J	0.56	2.0
Lead	ND		0.18	1.0
Nickel	ND		0.30	2.0
Selenium	ND		0.70	5.0
Silver	ND		0.033	5.0
Thallium	ND		0.050	1.0
Vanadium	ND		0.50	5.0
Zinc	ND		2.0	10

Method Blank - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Total Recoverable

Lab Sample ID:	MB 280-198697/1-A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	047_BLK.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1406	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Manganese	ND		0.31	1.0

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Control Sample - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Total Recoverable

Lab Sample ID:	LCS 280-198697/2-A	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	028_LCS.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1253	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	40.0	37.6	94	85 - 115	
Arsenic	40.0	41.1	103	85 - 117	
Barium	40.0	40.5	101	85 - 118	
Beryllium	40.0	37.5	94	80 - 125	
Cadmium	40.0	41.1	103	85 - 115	
Chromium	40.0	40.8	102	84 - 121	
Cobalt	40.0	41.4	103	85 - 120	
Copper	40.0	41.1	103	85 - 119	
Lead	40.0	41.0	102	85 - 118	
Manganese	40.0	41.3	103	85 - 117	
Nickel	40.0	42.0	105	85 - 119	
Selenium	40.0	39.8	100	77 - 122	
Silver	40.0	40.3	101	85 - 115	
Thallium	40.0	40.4	101	85 - 118	
Vanadium	40.0	40.6	101	85 - 120	
Zinc	40.0	42.1	105	83 - 122	

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Post Digestion Spike - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Dissolved

Lab Sample ID:	280-48516-5	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	036SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1323	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Spike Amount	Result	% Rec.	Limit	Qual
Antimony	5.0		200	207	101	75 - 125	
Arsenic	11		200	209	99	75 - 125	
Barium	12		200	210	99	75 - 125	
Beryllium	ND		200	191	96	75 - 125	
Cadmium	ND		200	196	98	75 - 125	
Chromium	ND		200	196	98	75 - 125	
Cobalt	ND		200	195	98	75 - 125	
Copper	ND		200	191	96	75 - 125	
Lead	ND		200	192	96	75 - 125	
Manganese	7.9		200	211	102	75 - 125	
Nickel	0.51	J	200	194	97	75 - 125	
Selenium	ND		200	193	96	75 - 125	
Silver	ND		50.0	45.9	92	75 - 125	
Thallium	ND		200	197	98	75 - 125	
Vanadium	ND		200	199	100	75 - 125	
Zinc	4.5	J	200	210	103	75 - 125	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Dissolved

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	034SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1315			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	035SMPL.d
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1319			Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Antimony	91	93	85 - 115	1	20		
Arsenic	100	94	85 - 117	5	20		
Barium	100	94	85 - 118	5	20		
Beryllium	94	88	80 - 125	7	20		
Cadmium	100	96	85 - 115	5	20		
Chromium	97	91	84 - 121	6	20		
Cobalt	98	93	85 - 120	4	20		
Copper	94	88	85 - 119	6	20		
Lead	94	90	85 - 118	4	20		
Manganese	103	96	85 - 117	6	20		
Nickel	96	90	85 - 119	6	20		
Selenium	23	24	77 - 122	4	20	F	F
Silver	86	81	85 - 115	6	20		F
Thallium	94	89	85 - 118	5	20		
Vanadium	100	94	85 - 120	6	20		
Zinc	92	91	83 - 122	1	20		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Dissolved

MS Lab Sample ID:	280-48516-5	Units: ug/L	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	11/06/2013 1315		Analysis Date:	11/06/2013 1319
Prep Date:	11/06/2013 0730		Prep Date:	11/06/2013 0730
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Antimony	5.0		40.0	40.0	41.5		42.0	
Arsenic	11		40.0	40.0	51.6		49.2	
Barium	12		40.0	40.0	52.4		49.8	
Beryllium	ND		40.0	40.0	37.6		35.1	
Cadmium	ND		40.0	40.0	40.2		38.3	
Chromium	ND		40.0	40.0	38.9		36.5	
Cobalt	ND		40.0	40.0	39.1		37.4	
Copper	ND		40.0	40.0	37.5		35.2	
Lead	ND		40.0	40.0	37.6		36.1	
Manganese	7.9		40.0	40.0	49.2		46.2	
Nickel	0.51	J	40.0	40.0	39.1		36.7	
Selenium	ND		40.0	40.0	9.14	F	9.56	F
Silver	ND		40.0	40.0	34.3		32.4	F
Thallium	ND		40.0	40.0	37.6		35.6	
Vanadium	ND		40.0	40.0	39.9		37.4	
Zinc	4.5	J	40.0	40.0	41.2		40.9	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Serial Dilution - Batch: 280-198697

Method: 6020A
Preparation: 3005A
Dissolved

Lab Sample ID:	280-48516-5	Analysis Batch:	280-199679	Instrument ID:	MT_077
Client Matrix:	Water	Prep Batch:	280-198697	Lab File ID:	033SMPL.d
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	11/06/2013 1312	Units:	ug/L	Final Weight/Volume:	50 mL
Prep Date:	11/06/2013 0730				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Result	%Diff	Limit	Qual
Antimony	5.0		6.31	NC	10	J
Arsenic	11		12.1	NC	10	J
Barium	12		12.4	NC	10	
Beryllium	ND		ND	NC	10	
Cadmium	ND		ND	NC	10	
Chromium	ND		ND	NC	10	
Cobalt	ND		ND	NC	10	
Copper	ND		ND	NC	10	
Lead	ND		ND	NC	10	
Manganese	7.9		11.3	NC	10	
Nickel	0.51	J	ND	NC	10	
Selenium	ND		ND	NC	10	
Silver	ND		ND	NC	10	
Thallium	ND		ND	NC	10	
Vanadium	ND		ND	NC	10	
Zinc	4.5	J	ND	NC	10	

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198428

Method: 7470A
Preparation: 7470A

Lab Sample ID:	MB 280-198428/1-A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2152	Units:	ug/L	Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Mercury	ND		0.027	0.20

Lab Control Sample - Batch: 280-198428

Method: 7470A
Preparation: 7470A

Lab Sample ID:	LCS 280-198428/2-A	Analysis Batch:	280-200762	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2155	Units:	ug/L	Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	5.00	4.98	100	84 - 120	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198428

Method: 7470A
Preparation: 7470A
Dissolved

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-200762	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2211			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-200762	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198428	Lab File ID:	131112tad.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	11/12/2013 2213			Final Weight/Volume:	30 mL
Prep Date:	11/12/2013 1330				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Mercury	99	98	75 - 125	0	20		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198428

Method: 7470A
Preparation: 7470A
Dissolved

MS Lab Sample ID:	280-48516-5	Units: ug/L		MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/12/2013 2211			Analysis Date:	11/12/2013 2213
Prep Date:	11/12/2013 1330			Prep Date:	11/12/2013 1330
Leach Date:	N/A			Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Mercury	ND	5.00	5.00	4.93	4.91

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198430

Method: 7470A
Preparation: 7470A

Lab Sample ID:	MB 280-198430/1-A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1424	Units:	ug/L	Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Mercury	ND		0.027	0.20

Lab Control Sample - Batch: 280-198430

Method: 7470A
Preparation: 7470A

Lab Sample ID:	LCS 280-198430/2-A	Analysis Batch:	280-198910	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1426	Units:	ug/L	Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	5.00	4.75	95	84 - 120	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198430

Method: 7470A
Preparation: 7470A

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-198910	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1438			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-198910	Instrument ID:	MT_034
Client Matrix:	Water	Prep Batch:	280-198430	Lab File ID:	131031taa.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 mL
Analysis Date:	10/31/2013 1445			Final Weight/Volume:	30 mL
Prep Date:	10/31/2013 0945				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Mercury	94	94	75 - 125	1	20		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-198430

Method: 7470A
Preparation: 7470A

MS Lab Sample ID:	280-48516-5	Units:	ug/L
Client Matrix:	Water		
Dilution:	1.0		
Analysis Date:	10/31/2013 1438		
Prep Date:	10/31/2013 0945		
Leach Date:	N/A		

MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water
Dilution:	1.0
Analysis Date:	10/31/2013 1445
Prep Date:	10/31/2013 0945
Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Mercury	ND	5.00	5.00	4.72	4.68

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 490-121230

Method: 1664A
Preparation: 1664A

Lab Sample ID:	MB 490-121230/1-A	Analysis Batch:	490-121238	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-121230	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	11/12/2013 1055	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	11/12/2013 1055				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
HEM (Oil & Grease)	ND		1.4	4.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 490-121230

Method: 1664A
Preparation: 1664A

LCS Lab Sample ID:	LCS 490-121230/2-A	Analysis Batch:	490-121238	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-121230	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	11/12/2013 1055	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	11/12/2013 1055				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 490-121230/3-A	Analysis Batch:	490-121238	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-121230	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	11/12/2013 1055	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	11/12/2013 1055				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
HEM (Oil & Grease)	91	90	78 - 114	17	18		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 490-121230

Method: 1664A
Preparation: 1664A

LCS Lab Sample ID:	LCS 490-121230/2-A	Units: mg/L		LCSD Lab Sample ID:	LCSD 490-121230/3-A
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/12/2013 1055			Analysis Date:	11/12/2013 1055
Prep Date:	11/12/2013 1055			Prep Date:	11/12/2013 1055
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
HEM (Oil & Grease)	41.7	41.7	37.8	37.5

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 490-121230

Method: 1664A
Preparation: 1664A

MS Lab Sample ID:	280-48516-5	Analysis Batch:	490-121238	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-121230	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1040 mL
Analysis Date:	11/12/2013 1055			Final Weight/Volume:	960 mL
Prep Date:	11/12/2013 1055				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	490-121238	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-121230	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1040 mL
Analysis Date:	11/12/2013 1055			Final Weight/Volume:	960 mL
Prep Date:	11/12/2013 1055				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
HEM (Oil & Grease)	76	80	78 - 114	5	18	F	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 490-121230

Method: 1664A
Preparation: 1664A

MS Lab Sample ID:	280-48516-5	Units:	mg/L	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/12/2013 1055			Analysis Date:	11/12/2013 1055
Prep Date:	11/12/2013 1055			Prep Date:	11/12/2013 1055
Leach Date:	N/A			Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual
HEM (Oil & Grease)	ND	38.5	38.5	29.2	F	30.7

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198509

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198509/11	Analysis Batch:	280-198509	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1342	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Chloride	ND		0.25	3.0
Fluoride	ND		0.060	0.50
Sulfate	ND		0.23	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198509

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198509/9	Analysis Batch:	280-198509	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1309	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198509/10	Analysis Batch:	280-198509	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1326	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Chloride	99	99	90 - 110	0	10		
Fluoride	101	100	90 - 110	1	10		
Sulfate	96	97	90 - 110	0	10		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198509

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198509/9	LCSD Lab Sample ID:	LCSD 280-198509/10
Client Matrix:	Water	Client Matrix:	Water
Dilution:	1.0	Dilution:	1.0
Analysis Date:	10/29/2013 1309	Analysis Date:	10/29/2013 1326
Prep Date:	N/A	Prep Date:	N/A
Leach Date:	N/A	Leach Date:	N/A

Units: mg/L

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Chloride	25.0	25.0	24.7	24.8
Fluoride	5.00	5.00	5.06	4.99
Sulfate	25.0	25.0	24.1	24.2

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198510 **Method: 300.0**
Preparation: N/A

Lab Sample ID:	MB 280-198510/11	Analysis Batch:	280-198510	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1342	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Nitrate as N	ND		0.042	0.50
Nitrite as N	ND		0.049	0.50

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198510 **Method: 300.0**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198510/9	Analysis Batch:	280-198510	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1309	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198510/10	Analysis Batch:	280-198510	Instrument ID:	WC_IC10
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102913.csv
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/29/2013 1326	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Nitrate as N	93	93	90 - 110	0	10		
Nitrite as N	98	99	90 - 110	1	10		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198510

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198510/9	Units: mg/L	LCSD Lab Sample ID:	LCSD 280-198510/10
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/29/2013 1309		Analysis Date:	10/29/2013 1326
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Nitrate as N	5.00	5.00	4.63	4.65
Nitrite as N	5.00	5.00	4.91	4.95

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-198950

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 280-198950/6	Analysis Batch:	280-198950	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1150	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Nitrate as N	ND		0.042	0.50
Nitrite as N	ND		0.049	0.50

Method Reporting Limit Check - Batch: 280-198950

Method: 300.0
Preparation: N/A

Lab Sample ID:	MRL 280-198950/3	Analysis Batch:	280-198950	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1100	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Nitrate as N	0.200	0.205	103	50 - 150	J
Nitrite as N	0.200	0.191	96	50 - 150	J

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198950

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198950/4	Analysis Batch:	280-198950	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1117	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198950/5	Analysis Batch:	280-198950	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1134	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Nitrate as N	99	98	90 - 110	0	10		
Nitrite as N	100	100	90 - 110	0	10		

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198950

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198950/4	Units: mg/L	LCSD Lab Sample ID:	LCSD 280-198950/5
Client Matrix:	Water		Client Matrix:	Water
Dilution:	1.0		Dilution:	1.0
Analysis Date:	10/30/2013 1117		Analysis Date:	10/30/2013 1134
Prep Date:	N/A		Prep Date:	N/A
Leach Date:	N/A		Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Nitrate as N	5.00	5.00	4.93	4.92
Nitrite as N	5.00	5.00	5.00	5.00

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Method Blank - Batch: 280-198951 | **Method: 300.0** | **Preparation: N/A**

Lab Sample ID:	MB 280-198951/6	Analysis Batch:	280-198951	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	115.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1150	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Chloride	ND		0.25	3.0
Fluoride	ND		0.060	0.50
Sulfate	ND		0.23	5.0

Method Reporting Limit Check - Batch: 280-198951 | **Method: 300.0** | **Preparation: N/A**

Lab Sample ID:	MRL 280-198951/3	Analysis Batch:	280-198951	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	112.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1100	Units:	mg/L	Final Weight/Volume:	5 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	1.00	0.999	100	50 - 150	J
Fluoride	0.200	0.172	86	50 - 150	J
Sulfate	1.00	1.06	106	50 - 150	J

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198951

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198951/4	Analysis Batch:	280-198951	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	113.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1117	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198951/5	Analysis Batch:	280-198951	Instrument ID:	WC_IC8
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	114.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/30/2013 1134	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Chloride	102	102	90 - 110	0	10		
Fluoride	105	104	90 - 110	0	10		
Sulfate	102	102	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198951

Method: 300.0
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198951/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-198951/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/30/2013 1117			Analysis Date:	10/30/2013 1134
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Chloride	25.0	25.0	25.4	25.4
Fluoride	5.00	5.00	5.23	5.22
Sulfate	25.0	25.0	25.6	25.5

Client: Ecology and Environment, Inc.   Job Number: 280-48516-1

Method Blank - Batch: 280-201021   **Method: 9060A**
Preparation: N/A

Lab Sample ID:	MB 280-201021/5	Analysis Batch:	280-201021	Instrument ID:	WC_SHI2
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	111313.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/13/2013 2049	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Organic Carbon - Average	0.167	J	0.16	1.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-201021   **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-201021/3	Analysis Batch:	280-201021	Instrument ID:	WC_SHI2
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	111313.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/13/2013 2011	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-201021/4	Analysis Batch:	280-201021	Instrument ID:	WC_SHI2
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	111313.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/13/2013 2030	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Organic Carbon - Average	99	99	88 - 112	0	15		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-201021   **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-201021/3	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-201021/4
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/13/2013 2011			Analysis Date:	11/13/2013 2030
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Organic Carbon - Average	25.0	25.0	24.7	24.7

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-201021

Method: 9060A
Preparation: N/A

MS Lab Sample ID:	280-48516-5	Analysis Batch:	280-201021	Instrument ID:	WC_SHI2
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	111313.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/14/2013 0234			Final Weight/Volume:	50 mL
Prep Date:	N/A				
Leach Date:	N/A				

MSD Lab Sample ID:	280-48516-5	Analysis Batch:	280-201021	Instrument ID:	WC_SHI2
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	111313.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/14/2013 0253			Final Weight/Volume:	50 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	% Rec. MS	% Rec. MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Total Organic Carbon - Average	101	101	88 - 112	0	15		

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-201021

Method: 9060A
Preparation: N/A

Units: mg/L

MS Lab Sample ID:	280-48516-5	MSD Lab Sample ID:	280-48516-5
Client Matrix:	Water	Client Matrix:	Water
Dilution:	1.0	Dilution:	1.0
Analysis Date:	11/14/2013 0234	Analysis Date:	11/14/2013 0253
Prep Date:	N/A	Prep Date:	N/A
Leach Date:	N/A	Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Total Organic Carbon - Average	25	25.0	25.0	49.9	49.7

Client: Ecology and Environment, Inc. | Job Number: 280-48516-1

Method Blank - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

Lab Sample ID:	MB 280-199016/6	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1428	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Alkalinity as CaCO3	1.13	J	1.1	5.0
Bicarbonate Alkalinity as CaCO3	1.13	J	1.1	5.0
Carbonate Alkalinity as CaCO3	ND		1.1	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199016/4	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1419	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-199016/5	Analysis Batch:	280-199016	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110113a.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/01/2013 1424	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Alkalinity as CaCO3	101	101	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-199016

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199016/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-199016/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/01/2013 1419			Analysis Date:	11/01/2013 1424
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Alkalinity as CaCO3	200	200	203	202

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Method Blank - Batch: 280-199930

Method: SM 2320B
Preparation: N/A

Lab Sample ID:	MB 280-199930/6	Analysis Batch:	280-199930	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110713b.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/07/2013 2029	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Alkalinity as CaCO3	1.50	J	1.1	5.0
Bicarbonate Alkalinity as CaCO3	1.50	J	1.1	5.0
Carbonate Alkalinity as CaCO3	ND		1.1	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-199930

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199930/4	Analysis Batch:	280-199930	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110713b.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/07/2013 2020	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-199930/5	Analysis Batch:	280-199930	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110713b.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/07/2013 2025	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Alkalinity as CaCO3	100	100	90 - 110	0	10		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-199930

Method: SM 2320B
Preparation: N/A

LCS Lab Sample ID:	LCS 280-199930/4	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-199930/5
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/07/2013 2020			Analysis Date:	11/07/2013 2025
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Alkalinity as CaCO3	200	200	200	199

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Duplicate - Batch: 280-199930

Method: SM 2320B
Preparation: N/A

Lab Sample ID:	280-48516-7	Analysis Batch:	280-199930	Instrument ID:	WC-AT3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	110713b.TXT
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/07/2013 2059	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Result	RPD	Limit	Qual
Total Alkalinity as CaCO3	3.6	J	1.67	72	10	J

Client:	Ecology and Environment, Inc.	Job Number:	280-48516-1

Method Blank - Batch: 280-198932

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	MB 280-198932/1	Analysis Batch:	280-198932	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	11/01/2013 1338	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Dissolved Solids	ND		4.7	10

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-198932

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198932/2	Analysis Batch:	280-198932	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	11/01/2013 1338	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-198932/3	Analysis Batch:	280-198932	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	11/01/2013 1338	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	96	95	86 - 110	0	20		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-198932

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-198932/2	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-198932/3
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/01/2013 1338			Analysis Date:	11/01/2013 1338
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Dissolved Solids	500	500	478	476

DATA REPORTING QUALIFIERS

Client: Ecology and Environment, Inc. Job Number: 280-48516-1

Lab Section	Qualifier	Description
GC/MS VOA		
	B	Compound was found in the blank and sample.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	X	Surrogate is outside control limits
GC VOA		
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
GC Semi VOA		
	X	Surrogate is outside control limits
Metals		
	B	Compound was found in the blank and sample.
	4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
	F	MS/MSD Recovery and/or RPD exceeds the control limits
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
General Chemistry		
	B	Compound was found in the blank and sample.
	F	MS/MSD Recovery and/or RPD exceeds the control limits
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	H	Sample was prepped or analyzed beyond the specified holding time

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 280-48516-2

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Senior Project Manager
12/6/2013 5:34 PM

Patrick J McEntee, Senior Project Manager
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
12/06/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

Table of Contents

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-48516-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 10/29/2013 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 6 coolers at receipt time were 0.3º C, 1.2º C, 2.7º C, 3.2º C, 3.8º C and 4.2º C.

The sample IDs on the container labels have a "-2013" suffix, i.e. MW-04-2013. The IDs on the COC do not, i.e. MW-04. The sample IDs were logged per the COC.
This report represents the analysis of samples MW04 and MW05 for Stable Water Isotopes and Oxygen, Stable Water Isotopes and Carbon and Radiocarbon Analysis of Water. The other analyses requested on the COC are reported under separate cover (280-48516-1).
Per client instruction on 11/1/2013, samples MW04 and MW05 were logged for Stable Water Isotopes and Oxygen, Stable Water Isotopes and Carbon and Radiocarbon Analysis of Water. This analysis was performed by IsoTech Laboratories, Inc., located at 1308 Parkland Court, Champaign IL, 61821-1826, TEL (217) 398-3490. The analytical report is presented in it's entirety.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48516-2

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-48516-5	MW-04	Water	10/25/2013 1430	10/29/2013 0900
280-48516-6	MW-05	Water	10/25/2013 1445	10/29/2013 0900

METHOD SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-48516-2

Description	Lab Location	Method	Preparation Method
Matrix: Water			
General Sub Contract Method	Isotech	Subcontract	

Lab References:

Isotech = Isotech Laboratories Inc

Method References:

Subcontract Data

ISOTECH
ISOTECH LABORATORIES INC
ANALYSIS REPORT

Water Analysis

Lab Number:	392695	Job Number: 23440	IS-67948
Submitter Sample Name:	MW-04 (280-48516-5)		
Submitter Sample ID:			
Submitter Job #:			
Company:	TestAmerica		
Field or Site:	TomCo, Utah		
Location:			
Depth/Formation:			
Container Type:	1 Liter Plastic Bottle		
Sample Collected:	10/25/2013	Results Reported:	11/26/2013

δD of water	---------------	-129.0 ‰ relative to VSMOW
$\delta^{18}O$ of water	---------------	-16.31 ‰ relative to VSMOW
Tritium content of water	---------------	na
$\delta^{13}C$ of DIC	---------------	-6.8 ‰ relative to VPDB
^{14}C content of DIC	---------------	15.9 ± 0.1 percent modern carbon
$\delta^{15}N$ of nitrate	---------------	na
$\delta^{18}O$ of nitrate	---------------	na
$\delta^{34}S$ of sulfate	---------------	na
$\delta^{18}O$ of sulfate	---------------	na

Remarks:

ISOTECH
ISOTECH LABORATORIES INC
ANALYSIS REPORT

Water Analysis

Lab Number:	392696	Job Number:	23440	IS-67948
Submitter Sample Name:	MW-05 (280-48516-6)			
Submitter Sample ID:				
Submitter Job #:				
Company:	TestAmerica			
Field or Site:	TomCo, Utah			
Location:				
Depth/Formation:				
Container Type:	1 Liter Plastic Bottle			
Sample Collected:	10/25/2013	Results Reported:	11/26/2013	

δD of water	---------------	-129.0 ‰ relative to VSMOW
$\delta^{18}O$ of water	---------------	-16.33 ‰ relative to VSMOW
Tritium content of water	---------------	na
$\delta^{13}C$ of DIC	---------------	-6.8 ‰ relative to VPDB
^{14}C content of DIC	---------------	15.8 ± 0.1 percent modern carbon
$\delta^{15}N$ of nitrate	---------------	na
$\delta^{18}O$ of nitrate	---------------	na
$\delta^{34}S$ of sulfate	---------------	na
$\delta^{18}O$ of sulfate	---------------	na

Remarks:

Packer Test Groundwater Samples

ANALYTICAL REPORT

Job Number: 280-47192-1

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Project Manager II
10/17/2013 8:30 AM

Patrick J McEntee, Project Manager II
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
10/17/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

Table of Contents

Table of Contents

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-47192-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 9/27/2013 10:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 2.0º C.

HEM (Oil & Grease)

Samples PT-04 (280-47192-1) and PT-03 (280-47192-2) were analyzed for HEM (Oil & Grease) in accordance with EPA Method 1664A. The samples were prepared and analyzed on 10/07/2013.

No difficulties were encountered during the HEM (Oil & Grease) analysis.

All quality control parameters were within the acceptance limits.

TOTAL DISSOLVED SOLIDS

Samples PT-04 (280-47192-1) and PT-03 (280-47192-2) were analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 09/30/2013.

The following sample(s) was received with insufficient time remaining to perform the analysis within holding time: PT-03 (280-47192-2). The sample was collected on 9/22/2013 and received on 9/27/2013. Every effort was made to analyze the sample prior to the exipration of the 7 day holding time.

Constant weight was not achieved after 3 drying cycles for the following sample(s): PT-04 (280-47192-1)

No other difficulties were encountered during the TDS analysis.

All quality control parameters were within the acceptance limits.

TOTAL ORGANIC CARBON

Samples PT-04 (280-47192-1) and PT-03 (280-47192-2) were analyzed for total organic carbon in accordance with EPA SW-846 Method 9060A. The samples were analyzed on 10/07/2013.

Sample PT-03 (280-47192-2)[14X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No difficulties were encountered during the TOC analysis.

All quality control parameters were within the acceptance limits.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc.   Job Number: 280-47192-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-47192-1	PT-04	Water	09/23/2013 1300	09/27/2013 1000
280-47192-2	PT-03	Water	09/22/2013 0920	09/27/2013 1000

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-47192-1	**PT-04**					
HEM (Oil & Grease)		1.3	J	3.8	mg/L	1664A
Total Organic Carbon - Average		41		1.0	mg/L	9060A
Total Dissolved Solids		920		10	mg/L	SM 2540C
280-47192-2	**PT-03**					
Total Organic Carbon - Average		660		14	mg/L	9060A
Total Dissolved Solids		4900	H	40	mg/L	SM 2540C

METHOD SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Organic Carbon, Total (TOC)	TAL DEN	SW846 9060A	
Solids, Total Dissolved (TDS)	TAL DEN	SM SM 2540C	
HEM and SGT-HEM	TAL NSH	1664A 1664A	
HEM and SGT-HEM (SPE)	TAL NSH		1664A 1664A

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

Method References:

1664A = EPA-821-98-002

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Ecology and Environment, Inc.   Job Number: 280-47192-1

Method	Analyst	Analyst ID
1664A 1664A	Dunn, Bradley	BAD
SW846 9060A	Bandy, Darlene F	DFB
SM SM 2540C	Newcome, Robin D	RDN

General Chemistry

Client Sample ID: PT-04

Lab Sample ID: 280-47192-1 Date Sampled: 09/23/2013 1300
Client Matrix: Water Date Received: 09/27/2013 1000

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	1.3	J	mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-112433	Analysis Date: 10/07/2013 1043						
Prep Batch: 490-112429	Prep Date: 10/07/2013 1043						
Total Organic Carbon - Average	41		mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-194721	Analysis Date: 10/07/2013 0115						
Total Dissolved Solids	920		mg/L	4.7	10	1.0	SM 2540C
Analysis Batch: 280-193767	Analysis Date: 09/30/2013 1557						

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

General Chemistry

Client Sample ID: PT-03

Lab Sample ID: 280-47192-2 Date Sampled: 09/22/2013 0920
Client Matrix: Water Date Received: 09/27/2013 1000

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM (Oil & Grease)	ND		mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-112433	Analysis Date: 10/07/2013 1043						
Prep Batch: 490-112429	Prep Date: 10/07/2013 1043						
Total Organic Carbon - Average	660		mg/L	2.2	14	14	9060A
Analysis Batch: 280-194721	Analysis Date: 10/07/2013 0207						
Total Dissolved Solids	4900	H	mg/L	19	40	1.0	SM 2540C
Analysis Batch: 280-193767	Analysis Date: 09/30/2013 1557						

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Method Blank - Batch: 490-112429

Method: 1664A
Preparation: 1664A

Lab Sample ID:	MB 490-112429/1-A	Analysis Batch:	490-112433	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-112429	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/07/2013 1043	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/07/2013 1043				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
HEM (Oil & Grease)	ND		1.4	4.0

Lab Control Sample - Batch: 490-112429

Method: 1664A
Preparation: 1664A

Lab Sample ID:	LCS 490-112429/2-A	Analysis Batch:	490-112433	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-112429	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/07/2013 1043	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/07/2013 1043				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
HEM (Oil & Grease)	41.7	36.3	87	78 - 114	

Client: Ecology and Environment, Inc. | Job Number: 280-47192-1

Method Blank - Batch: 280-194721 | **Method: 9060A**
Preparation: N/A

Lab Sample ID:	MB 280-194721/5	Analysis Batch:	280-194721	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	100613.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/06/2013 1940	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Organic Carbon - Average	ND		0.16	1.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-194721 | **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-194721/3	Analysis Batch:	280-194721	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	100613.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/06/2013 1911	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-194721/4	Analysis Batch:	280-194721	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	100613.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/06/2013 1925	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Organic Carbon - Average	101	101	88 - 112	0	15		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-194721 | **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-194721/3	Units: mg/L		LCSD Lab Sample ID:	LCSD 280-194721/4
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/06/2013 1911			Analysis Date:	10/06/2013 1925
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Organic Carbon - Average	25.0	25.0	25.3	25.2

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Method Blank - Batch: 280-193767

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	MB 280-193767/1	Analysis Batch:	280-193767	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	09/30/2013 1557	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Dissolved Solids	ND		4.7	10

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-193767

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-193767/2	Analysis Batch:	280-193767	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	09/30/2013 1557	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-193767/3	Analysis Batch:	280-193767	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	09/30/2013 1557	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	95	96	86 - 110	1	20		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-193767

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-193767/2	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-193767/3
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	09/30/2013 1557			Analysis Date:	09/30/2013 1557
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Dissolved Solids	506	506	482	487

DATA REPORTING QUALIFIERS

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Lab Section	Qualifier	Description
General Chemistry		
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	H	Sample was prepped or analyzed beyond the specified holding time

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Prep Batch: 490-112429					
LCS 490-112429/2-A	Lab Control Sample	T	Water	1664A	
MB 490-112429/1-A	Method Blank	T	Water	1664A	
280-47192-1	PT-04	T	Water	1664A	
280-47192-2	PT-03	T	Water	1664A	
Analysis Batch:490-112433					
LCS 490-112429/2-A	Lab Control Sample	T	Water	1664A	490-112429
MB 490-112429/1-A	Method Blank	T	Water	1664A	490-112429
280-47192-1	PT-04	T	Water	1664A	490-112429
280-47192-2	PT-03	T	Water	1664A	490-112429
Analysis Batch:280-193767					
LCS 280-193767/2	Lab Control Sample	T	Water	SM 2540C	
LCSD 280-193767/3	Lab Control Sample Duplicate	T	Water	SM 2540C	
MB 280-193767/1	Method Blank	T	Water	SM 2540C	
280-47192-1	PT-04	T	Water	SM 2540C	
280-47192-2	PT-03	T	Water	SM 2540C	
Analysis Batch:280-194721					
LCS 280-194721/3	Lab Control Sample	T	Water	9060A	
LCSD 280-194721/4	Lab Control Sample Duplicate	T	Water	9060A	
MB 280-194721/5	Method Blank	T	Water	9060A	
280-47192-1	PT-04	T	Water	9060A	
280-47192-2	PT-03	T	Water	9060A	

Report Basis

T = Total

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Laboratory Chronicle

Lab ID: 280-47192-1 **Client ID: PT-04**

Sample Date/Time: 09/23/2013 13:00 Received Date/Time: 09/27/2013 10:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47192-A-1-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:1664A	280-47192-A-1-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:9060A	280-47192-C-1		280-194721		10/07/2013 01:15	1	TAL DEN	DFB
A:SM 2540C	280-47192-B-1		280-193767		09/30/2013 15:57	1	TAL DEN	RDN

Lab ID: 280-47192-2 **Client ID: PT-03**

Sample Date/Time: 09/22/2013 09:20 Received Date/Time: 09/27/2013 10:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47192-A-2-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:1664A	280-47192-A-2-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:9060A	280-47192-C-2		280-194721		10/07/2013 02:07	14	TAL DEN	DFB
A:SM 2540C	280-47192-B-2		280-193767		09/30/2013 15:57	1	TAL DEN	RDN

Lab ID: MB **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	MB 490-112429/1-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:1664A	MB 490-112429/1-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:9060A	MB 280-194721/5		280-194721		10/06/2013 19:40	1	TAL DEN	DFB
A:SM 2540C	MB 280-193767/1		280-193767		09/30/2013 15:57	1	TAL DEN	RDN

Lab ID: LCS **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	LCS 490-112429/2-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:1664A	LCS 490-112429/2-A		490-112433	490-112429	10/07/2013 10:43	1	TAL NSH	BAD
A:9060A	LCS 280-194721/3		280-194721		10/06/2013 19:11	1	TAL DEN	DFB
A:SM 2540C	LCS 280-193767/2		280-193767		09/30/2013 15:57	1	TAL DEN	RDN

TestAmerica Denver A = Analytical Method P = Prep Method

Client: Ecology and Environment, Inc. Job Number: 280-47192-1

Laboratory Chronicle

Lab ID: **LCSD** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:9060A	LCSD 280-194721/4		280-194721		10/06/2013 19:25	1	TAL DEN	DFB
A:SM 2540C	LCSD 280-193767/3		280-193767		09/30/2013 15:57	1	TAL DEN	RDN

Lab References:
TAL DEN = TestAmerica Denver
TAL NSH = TestAmerica Nashville

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 280-47554-1

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Project Manager II
10/29/2013 5:13 PM

Patrick J McEntee, Project Manager II
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
10/29/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

Table of Contents

Table of Contents

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-47554-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT
The samples were received on 10/8/2013 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 1.0º C.

Except:

Sample PT-05 was received on the 6th day of the 7 day holding time for TDS analysis.

HEM (Oil & Grease)
Samples PT-05 (280-47554-1), PT-10 (280-47554-2) and PT-20 (280-47554-3) were analyzed for HEM (Oil & Grease) in accordance with EPA Method 1664A. The samples were prepared and analyzed on 10/24/2013.

The following sample(s) was improperly preserved in the field: PT-05 (280-47554-1), PT-10 (280-47554-2), PT-20 (280-47554-3). Sample(s) was received with a PH of 7 and preserved in lab to <2.

No other difficulties were encountered during the HEM analysis.

All other quality control parameters were within the acceptance limits.

TOTAL DISSOLVED SOLIDS
Samples PT-05 (280-47554-1), PT-10 (280-47554-2) and PT-20 (280-47554-3) were analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 10/09/2013 and 10/11/2013.

No difficulties were encountered during the TDS analysis.

All quality control parameters were within the acceptance limits.

TOTAL ORGANIC CARBON
Samples PT-05 (280-47554-1), PT-10 (280-47554-2) and PT-20 (280-47554-3) were analyzed for total organic carbon in accordance with EPA SW-846 Method 9060A. The samples were analyzed on 10/22/2013.

The following sample(s) was improperly preserved in the field: PT-10 (280-47554-2), PT-20 (280-47554-3). The samples were acidified to pH <2 at the bench prior to analysis.

Samples PT-05 (280-47554-1)[1.8X], PT-10 (280-47554-2)[10X] and PT-20 (280-47554-3)[10X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the TOC analysis.

All other quality control parameters were within the acceptance limits.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-47554-1	PT-05	Water	10/02/2013 1605	10/08/2013 0900
280-47554-2	PT-10	Water	10/05/2013 1310	10/08/2013 0900
280-47554-3	PT-20	Water	10/05/2013 1450	10/08/2013 0900

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc.   Job Number: 280-47554-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-47554-1	**PT-05**					
HEM		1.9	J	3.8	mg/L	1664A
Total Organic Carbon - Average		71		1.8	mg/L	9060A
Total Dissolved Solids		2500		20	mg/L	SM 2540C
280-47554-2	**PT-10**					
HEM		9.3		4.0	mg/L	1664A
Total Organic Carbon - Average		440		10	mg/L	9060A
Total Dissolved Solids		15000		100	mg/L	SM 2540C
280-47554-3	**PT-20**					
HEM		8.3		3.7	mg/L	1664A
Total Organic Carbon - Average		420		10	mg/L	9060A
Total Dissolved Solids		15000		100	mg/L	SM 2540C

METHOD SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Organic Carbon, Total (TOC)	TAL DEN	SW846 9060A	
Solids, Total Dissolved (TDS)	TAL DEN	SM SM 2540C	
HEM and SGT-HEM	TAL NSH	1664A 1664A	
HEM and SGT-HEM (SPE)	TAL NSH		1664A 1664A

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

Method References:

1664A = EPA-821-98-002

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Method	Analyst	Analyst ID
1664A 1664A	Dunn, Bradley	BAD
SW846 9060A	Bandy, Darlene F	DFB
SM SM 2540C	Newcome, Robin D	RDN

Client: Ecology and Environment, Inc. | Job Number: 280-47554-1

General Chemistry

Client Sample ID: **PT-05**

Lab Sample ID: 280-47554-1 | Date Sampled: 10/02/2013 1605
Client Matrix: Water | Date Received: 10/08/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM	1.9	J	mg/L	1.3	3.8	1.0	1664A
Analysis Batch: 490-116693	Analysis Date: 10/24/2013 1034						
Prep Batch: 490-116691	Prep Date: 10/24/2013 1034						
Total Organic Carbon - Average	71		mg/L	0.28	1.8	1.8	9060A
Analysis Batch: 280-197160	Analysis Date: 10/22/2013 0712						
Total Dissolved Solids	2500		mg/L	9.4	20	1.0	SM 2540C
Analysis Batch: 280-195133	Analysis Date: 10/09/2013 1039						

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

General Chemistry

Client Sample ID: **PT-10**

Lab Sample ID: 280-47554-2 Date Sampled: 10/05/2013 1310
Client Matrix: Water Date Received: 10/08/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM	9.3		mg/L	1.4	4.0	1.0	1664A
Analysis Batch: 490-116693	Analysis Date: 10/24/2013 1034						
Prep Batch: 490-116691	Prep Date: 10/24/2013 1034						
Total Organic Carbon - Average	440		mg/L	1.6	10	10	9060A
Analysis Batch: 280-197160	Analysis Date: 10/22/2013 0727						
Total Dissolved Solids	15000		mg/L	47	100	1.0	SM 2540C
Analysis Batch: 280-195592	Analysis Date: 10/11/2013 1034						

General Chemistry

Client Sample ID: **PT-20**

Lab Sample ID: 280-47554-3 Date Sampled: 10/05/2013 1450
Client Matrix: Water Date Received: 10/08/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM	8.3		mg/L	1.3	3.7	1.0	1664A
Analysis Batch: 490-116693	Analysis Date: 10/24/2013 1034						
Prep Batch: 490-116691	Prep Date: 10/24/2013 1034						
Total Organic Carbon - Average	420		mg/L	1.6	10	10	9060A
Analysis Batch: 280-197160	Analysis Date: 10/22/2013 0741						
Total Dissolved Solids	15000		mg/L	47	100	1.0	SM 2540C
Analysis Batch: 280-195592	Analysis Date: 10/11/2013 1034						

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Method Blank - Batch: 490-116691

Method: 1664A
Preparation: 1664A

Lab Sample ID:	MB 490-116691/1-A	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/24/2013 1034	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
HEM	ND		1.4	4.0

Lab Control Sample - Batch: 490-116691

Method: 1664A
Preparation: 1664A

Lab Sample ID:	LCS 490-116691/2-A	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/24/2013 1034	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
HEM	41.7	39.6	95	78 - 114	

Method Blank - Batch: 280-197160

Method: 9060A
Preparation: N/A

Lab Sample ID:	MB 280-197160/37	Analysis Batch:	280-197160	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102113.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 0208	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Organic Carbon - Average	ND		0.16	1.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-197160

Method: 9060A
Preparation: N/A

LCS Lab Sample ID:	LCS 280-197160/35	Analysis Batch:	280-197160	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102113.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 0138	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-197160/36	Analysis Batch:	280-197160	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102113.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 0153	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Organic Carbon - Average	101	101	88 - 112	0	15		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-197160

Method: 9060A
Preparation: N/A

LCS Lab Sample ID:	LCS 280-197160/35	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-197160/36
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/22/2013 0138			Analysis Date:	10/22/2013 0153
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Organic Carbon - Average	25.0	25.0	25.3	25.4

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Method Blank - Batch: 280-195133

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	MB 280-195133/1	Analysis Batch:	280-195133	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/09/2013 1039	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Dissolved Solids	ND		4.7	10

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-195133

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195133/2	Analysis Batch:	280-195133	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/09/2013 1039	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-195133/3	Analysis Batch:	280-195133	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/09/2013 1039	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	96	98	86 - 110	1	20		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-195133

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195133/2	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-195133/3
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/09/2013 1039			Analysis Date:	10/09/2013 1039
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Dissolved Solids	500	500	482	488

Quality Control Results

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Duplicate - Batch: 280-195133

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	280-47554-1	Analysis Batch:	280-195133	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	50 mL
Analysis Date:	10/09/2013 1039	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Total Dissolved Solids	2500	2540	0.2	10	

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Method Blank - Batch: 280-195592

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	MB 280-195592/1	Analysis Batch:	280-195592	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/11/2013 1034	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Dissolved Solids	ND		4.7	10

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-195592

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195592/2	Analysis Batch:	280-195592	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/11/2013 1034	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-195592/3	Analysis Batch:	280-195592	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/11/2013 1034	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	95	98	86 - 110	3	20		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-195592

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195592/2	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-195592/3
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/11/2013 1034			Analysis Date:	10/11/2013 1034
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Dissolved Solids	500	500	474	488

DATA REPORTING QUALIFIERS

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Lab Section	Qualifier	Description
General Chemistry		
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Prep Batch: 490-116691					
LCS 490-116691/2-A	Lab Control Sample	T	Water	1664A	
MB 490-116691/1-A	Method Blank	T	Water	1664A	
280-47554-1	PT-05	T	Water	1664A	
280-47554-2	PT-10	T	Water	1664A	
280-47554-3	PT-20	T	Water	1664A	
Analysis Batch:490-116693					
LCS 490-116691/2-A	Lab Control Sample	T	Water	1664A	490-116691
MB 490-116691/1-A	Method Blank	T	Water	1664A	490-116691
280-47554-1	PT-05	T	Water	1664A	490-116691
280-47554-2	PT-10	T	Water	1664A	490-116691
280-47554-3	PT-20	T	Water	1664A	490-116691
Analysis Batch:280-195133					
LCS 280-195133/2	Lab Control Sample	T	Water	SM 2540C	
LCSD 280-195133/3	Lab Control Sample Duplicate	T	Water	SM 2540C	
MB 280-195133/1	Method Blank	T	Water	SM 2540C	
280-47554-1	PT-05	T	Water	SM 2540C	
280-47554-1DU	Duplicate	T	Water	SM 2540C	
Analysis Batch:280-195592					
LCS 280-195592/2	Lab Control Sample	T	Water	SM 2540C	
LCSD 280-195592/3	Lab Control Sample Duplicate	T	Water	SM 2540C	
MB 280-195592/1	Method Blank	T	Water	SM 2540C	
280-47554-2	PT-10	T	Water	SM 2540C	
280-47554-3	PT-20	T	Water	SM 2540C	
Analysis Batch:280-197160					
LCS 280-197160/35	Lab Control Sample	T	Water	9060A	
LCSD 280-197160/36	Lab Control Sample Duplicate	T	Water	9060A	
MB 280-197160/37	Method Blank	T	Water	9060A	
280-47554-1	PT-05	T	Water	9060A	
280-47554-2	PT-10	T	Water	9060A	
280-47554-3	PT-20	T	Water	9060A	

Report Basis

T = Total

Client: Ecology and Environment, Inc.　　Job Number: 280-47554-1

Laboratory Chronicle

Lab ID: 280-47554-1　　**Client ID: PT-05**

Sample Date/Time: 10/02/2013 16:05　　Received Date/Time: 10/08/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47554-A-1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47554-A-1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47554-C-1		280-197160		10/22/2013 07:12	1.8	TAL DEN	DFB
A:SM 2540C	280-47554-B-1		280-195133		10/09/2013 10:39	1	TAL DEN	RDN

Lab ID: 280-47554-1 DU　　**Client ID: PT-05**

Sample Date/Time: 10/02/2013 16:05　　Received Date/Time: 10/08/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:SM 2540C	280-47554-B-1 DU		280-195133		10/09/2013 10:39	1	TAL DEN	RDN

Lab ID: 280-47554-2　　**Client ID: PT-10**

Sample Date/Time: 10/05/2013 13:10　　Received Date/Time: 10/08/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47554-A-2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47554-A-2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47554-C-2		280-197160		10/22/2013 07:27	10	TAL DEN	DFB
A:SM 2540C	280-47554-B-2		280-195592		10/11/2013 10:34	1	TAL DEN	RDN

Lab ID: 280-47554-3　　**Client ID: PT-20**

Sample Date/Time: 10/05/2013 14:50　　Received Date/Time: 10/08/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47554-A-3-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47554-A-3-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47554-C-3		280-197160		10/22/2013 07:41	10	TAL DEN	DFB
A:SM 2540C	280-47554-B-3		280-195592		10/11/2013 10:34	1	TAL DEN	RDN

Lab ID: MB　　**Client ID: N/A**

Sample Date/Time: N/A　　Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	MB 490-116691/1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	MB 490-116691/1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	MB 280-197160/37		280-197160		10/22/2013 02:08	1	TAL DEN	DFB
A:SM 2540C	MB 280-195133/1		280-195133		10/09/2013 10:39	1	TAL DEN	RDN
A:SM 2540C	MB 280-195592/1		280-195592		10/11/2013 10:34	1	TAL DEN	RDN

Client: Ecology and Environment, Inc. Job Number: 280-47554-1

Laboratory Chronicle

Lab ID: **LCS** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	LCS 490-116691/2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	LCS 490-116691/2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	LCS 280-197160/35		280-197160		10/22/2013 01:38	1	TAL DEN	DFB
A:SM 2540C	LCS 280-195133/2		280-195133		10/09/2013 10:39	1	TAL DEN	RDN
A:SM 2540C	LCS 280-195592/2		280-195592		10/11/2013 10:34	1	TAL DEN	RDN

Lab ID: **LCSD** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:9060A	LCSD 280-197160/36		280-197160		10/22/2013 01:53	1	TAL DEN	DFB
A:SM 2540C	LCSD 280-195133/3		280-195133		10/09/2013 10:39	1	TAL DEN	RDN
A:SM 2540C	LCSD 280-195592/3		280-195592		10/11/2013 10:34	1	TAL DEN	RDN

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

ANALYTICAL REPORT

Job Number: 280-47715-1

Job Description: TomCo, Utah

For:
Ecology and Environment, Inc.
7440 S. Creek Road
Suite 400
Sandy, UT 84093

Attention: Mr. Tom Ferarro

Approved for release.
Patrick J McEntee
Project Manager II
10/29/2013 5:34 PM

Patrick J McEntee, Project Manager II
4955 Yarrow Street, Arvada, CO, 80002
(303)736-0107
patrick.mcentee@testamericainc.com
10/29/2013

The test results in this report relate only to the samples in this report and meet all requirements of NELAC, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is E87667.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

Table of Contents

Table of Contents

CASE NARRATIVE

Client: Ecology and Environment, Inc.

Project: TomCo, Utah

Report Number: 280-47715-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 10/9/2013 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 2.1º C.

Except:
1of 2 250ml AG bottles was received broken upon receipt. Sufficient volume remains to complete the requested analysis.

HEM (Oil & Grease)

Sample PT-11 (280-47715-1) was analyzed for HEM (Oil & Grease) in accordance with EPA Method 1664A. The samples were prepared and analyzed on 10/24/2013.

No difficulties were encountered during the HEM analysis.

All quality control parameters were within the acceptance limits.

TOTAL DISSOLVED SOLIDS

Sample PT-11 (280-47715-1) was analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 10/14/2013.

No difficulties were encountered during the TDS analysis.

All quality control parameters were within the acceptance limits.

TOTAL ORGANIC CARBON

Sample PT-11 (280-47715-1) was analyzed for total organic carbon in accordance with EPA SW-846 Method 9060A. The samples were analyzed on 10/22/2013.

No difficulties were encountered during the TOC analysis.

All quality control parameters were within the acceptance limits.

SAMPLE SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
280-47715-1	PT-11	Water	10/07/2013 0909	10/09/2013 0900
280-47715-1MS	PT-11	Water	10/07/2013 0909	10/09/2013 0900
280-47715-1MSD	PT-11	Water	10/07/2013 0909	10/09/2013 0900

EXECUTIVE SUMMARY - Detections

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
280-47715-1	**PT-11**					
Total Organic Carbon - Average		37		1.0	mg/L	9060A
Total Dissolved Solids		940		10	mg/L	SM 2540C

METHOD SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Organic Carbon, Total (TOC)	TAL DEN	SW846 9060A	
Solids, Total Dissolved (TDS)	TAL DEN	SM SM 2540C	
HEM and SGT-HEM	TAL NSH	1664A 1664A	
HEM and SGT-HEM (SPE)	TAL NSH		1664A 1664A

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

Method References:

1664A = EPA-821-98-002

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Method	Analyst	Analyst ID
1664A 1664A	Dunn, Bradley	BAD
SW846 9060A	Bandy, Darlene F	DFB
SM SM 2540C	Newcome, Robin D	RDN

General Chemistry

Client Sample ID: **PT-11**

Lab Sample ID: 280-47715-1 Date Sampled: 10/07/2013 0909
Client Matrix: Water Date Received: 10/09/2013 0900

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
HEM	ND		mg/L	1.3	3.7	1.0	1664A
Analysis Batch: 490-116693	Analysis Date: 10/24/2013 1034						
Prep Batch: 490-116691	Prep Date: 10/24/2013 1034						
Total Organic Carbon - Average	37		mg/L	0.16	1.0	1.0	9060A
Analysis Batch: 280-197370	Analysis Date: 10/22/2013 2304						
Total Dissolved Solids	940		mg/L	4.7	10	1.0	SM 2540C
Analysis Batch: 280-195872	Analysis Date: 10/14/2013 1141						

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Method Blank - Batch: 490-116691

Method: 1664A
Preparation: 1664A

Lab Sample ID:	MB 490-116691/1-A	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/24/2013 1034	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
HEM	ND		1.4	4.0

Lab Control Sample - Batch: 490-116691

Method: 1664A
Preparation: 1664A

Lab Sample ID:	LCS 490-116691/2-A	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	960 mL
Analysis Date:	10/24/2013 1034	Units:	mg/L	Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
HEM	41.7	39.6	95	78 - 114	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 490-116691

Method: 1664A
Preparation: 1664A

MS Lab Sample ID:	280-47715-1	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1020 mL
Analysis Date:	10/24/2013 1034			Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

MSD Lab Sample ID:	280-47715-1	Analysis Batch:	490-116693	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	490-116691	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	980 mL
Analysis Date:	10/24/2013 1034			Final Weight/Volume:	960 mL
Prep Date:	10/24/2013 1034				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
HEM	81	84	78 - 114	8	18		

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 490-116691

Method: 1664A
Preparation: 1664A

MS Lab Sample ID:	280-47715-1	Units:	mg/L
Client Matrix:	Water		
Dilution:	1.0		
Analysis Date:	10/24/2013 1034		
Prep Date:	10/24/2013 1034		
Leach Date:	N/A		

MSD Lab Sample ID:	280-47715-1
Client Matrix:	Water
Dilution:	1.0
Analysis Date:	10/24/2013 1034
Prep Date:	10/24/2013 1034
Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
HEM	ND	39.2	40.8	31.8	34.5

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Method Blank - Batch: 280-197370 **Method: 9060A**
Preparation: N/A

Lab Sample ID:	MB 280-197370/19	Analysis Batch:	280-197370	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102213.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 2232	Units:	mg/L	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Organic Carbon - Average	ND		0.16	1.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-197370 **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-197370/17	Analysis Batch:	280-197370	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102213.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 2203	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-197370/18	Analysis Batch:	280-197370	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102213.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 2218	Units:	mg/L	Final Weight/Volume:	200 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Organic Carbon - Average	100	100	88 - 112	0	15		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-197370 **Method: 9060A**
Preparation: N/A

LCS Lab Sample ID:	LCS 280-197370/17	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-197370/18
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/22/2013 2203			Analysis Date:	10/22/2013 2218
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Organic Carbon - Average	25.0	25.0	25.1	25.1

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-197370

Method: 9060A
Preparation: N/A

MS Lab Sample ID:	280-47715-1	Analysis Batch:	280-197370	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102213.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 2321			Final Weight/Volume:	50 mL
Prep Date:	N/A				
Leach Date:	N/A				

MSD Lab Sample ID:	280-47715-1	Analysis Batch:	280-197370	Instrument ID:	WC_SHI3
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	102213.txt
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	10/22/2013 2335			Final Weight/Volume:	50 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	% Rec. MS	% Rec. MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Total Organic Carbon - Average	96	98	88 - 112	1	15	E	E

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 280-197370

Method: 9060A
Preparation: N/A

Units: mg/L

MS Lab Sample ID:	280-47715-1	MSD Lab Sample ID:	280-47715-1
Client Matrix:	Water	Client Matrix:	Water
Dilution:	1.0	Dilution:	1.0
Analysis Date:	10/22/2013 2321	Analysis Date:	10/22/2013 2335
Prep Date:	N/A	Prep Date:	N/A
Leach Date:	N/A	Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Total Organic Carbon - Average	37	25.0	25.0	60.8 E	61.2 E

Method Blank - Batch: 280-195872

Method: SM 2540C
Preparation: N/A

Lab Sample ID:	MB 280-195872/1	Analysis Batch:	280-195872	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/14/2013 1141	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Total Dissolved Solids	ND		4.7	10

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 280-195872

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195872/2	Analysis Batch:	280-195872	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/14/2013 1141	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 280-195872/3	Analysis Batch:	280-195872	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	100 mL
Analysis Date:	10/14/2013 1141	Units:	mg/L	Final Weight/Volume:	100 mL
Prep Date:	N/A				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	93	93	86 - 110	0	20		

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 280-195872

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID:	LCS 280-195872/2	Units:	mg/L	LCSD Lab Sample ID:	LCSD 280-195872/3
Client Matrix:	Water			Client Matrix:	Water
Dilution:	1.0			Dilution:	1.0
Analysis Date:	10/14/2013 1141			Analysis Date:	10/14/2013 1141
Prep Date:	N/A			Prep Date:	N/A
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Total Dissolved Solids	500	500	465	465

DATA REPORTING QUALIFIERS

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Lab Section	Qualifier	Description
General Chemistry		
	E	Result exceeded calibration range.

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Prep Batch: 490-116691					
LCS 490-116691/2-A	Lab Control Sample	T	Water	1664A	
MB 490-116691/1-A	Method Blank	T	Water	1664A	
280-47715-1	PT-11	T	Water	1664A	
280-47715-1MS	Matrix Spike	T	Water	1664A	
280-47715-1MSD	Matrix Spike Duplicate	T	Water	1664A	
Analysis Batch:490-116693					
LCS 490-116691/2-A	Lab Control Sample	T	Water	1664A	490-116691
MB 490-116691/1-A	Method Blank	T	Water	1664A	490-116691
280-47715-1	PT-11	T	Water	1664A	490-116691
280-47715-1MS	Matrix Spike	T	Water	1664A	490-116691
280-47715-1MSD	Matrix Spike Duplicate	T	Water	1664A	490-116691
Analysis Batch:280-195872					
LCS 280-195872/2	Lab Control Sample	T	Water	SM 2540C	
LCSD 280-195872/3	Lab Control Sample Duplicate	T	Water	SM 2540C	
MB 280-195872/1	Method Blank	T	Water	SM 2540C	
280-47715-1	PT-11	T	Water	SM 2540C	
Analysis Batch:280-197370					
LCS 280-197370/17	Lab Control Sample	T	Water	9060A	
LCSD 280-197370/18	Lab Control Sample Duplicate	T	Water	9060A	
MB 280-197370/19	Method Blank	T	Water	9060A	
280-47715-1	PT-11	T	Water	9060A	
280-47715-1MS	Matrix Spike	T	Water	9060A	
280-47715-1MSD	Matrix Spike Duplicate	T	Water	9060A	

Report Basis
T = Total

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Laboratory Chronicle

Lab ID: **280-47715-1** **Client ID:** **PT-11**

Sample Date/Time: 10/07/2013 09:09 Received Date/Time: 10/09/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47715-A-1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47715-A-1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47715-G-1		280-197370		10/22/2013 23:04	1	TAL DEN	DFB
A:SM 2540C	280-47715-F-1		280-195872		10/14/2013 11:41	1	TAL DEN	RDN

Lab ID: **280-47715-1** **Client ID:** **PT-11**

Sample Date/Time: 10/07/2013 09:09 Received Date/Time: 10/09/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47715-A-1-B MS		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47715-A-1-B MS		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47715-G-1 MS		280-197370		10/22/2013 23:21	1	TAL DEN	DFB

Lab ID: **280-47715-1** **Client ID:** **PT-11**

Sample Date/Time: 10/07/2013 09:09 Received Date/Time: 10/09/2013 09:00

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	280-47715-A-1-C MSD		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	280-47715-A-1-C MSD		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	280-47715-G-1 MSD		280-197370		10/22/2013 23:35	1	TAL DEN	DFB

Lab ID: **MB** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	MB 490-116691/1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	MB 490-116691/1-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	MB 280-197370/19		280-197370		10/22/2013 22:32	1	TAL DEN	DFB
A:SM 2540C	MB 280-195872/1		280-195872		10/14/2013 11:41	1	TAL DEN	RDN

Lab ID: **LCS** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:1664A	LCS 490-116691/2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:1664A	LCS 490-116691/2-A		490-116693	490-116691	10/24/2013 10:34	1	TAL NSH	BAD
A:9060A	LCS 280-197370/17		280-197370		10/22/2013 22:03	1	TAL DEN	DFB
A:SM 2540C	LCS 280-195872/2		280-195872		10/14/2013 11:41	1	TAL DEN	RDN

Client: Ecology and Environment, Inc. Job Number: 280-47715-1

Laboratory Chronicle

Lab ID: **LCSD** **Client ID:** **N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:9060A	LCSD 280-197370/18		280-197370		10/22/2013 22:18	1	TAL DEN	DFB
A:SM 2540C	LCSD 280-195872/3		280-195872		10/14/2013 11:41	1	TAL DEN	RDN

Lab References:

TAL DEN = TestAmerica Denver

TAL NSH = TestAmerica Nashville

APPENDIX F

MONITOR WELL AGE DATING CALCULATIONS

ESTIMATED GROUNDWATER AGE CLACULATIONS (MW-04)

MW-04 measured parameters (see Appendix E for analytical results)
^{14}C DIC (pMC) = 15.9
$\delta^{13}C$ DIC (%) = -6.8

Groundwater age equation (Muennich 1957 and 1968)

$$t = \frac{\tau}{\ln 2}.\ln(\frac{N}{No})$$

where:
t = age of water based in equation
τ = half life of ^{14}C (5730 years)
N = measured ^{14}C of sample (reported in pMC (percent modern carbon))
N_o = initial ^{14}C of biogenic CO_2, assumed to have ^{14}C activity of 100 pMC

Calculations

1- No data correction

$$t = \frac{5730}{\ln 2}.\ln(\frac{15.9}{100})$$

t = -8267 x ln (0.159) = **15,201 years**

2- N_o Corrected estimation
Although N_o values of ^{14}C can be assumed to be 100 pMC, in reality, in closed (e.g. groundwater) systems, initial ^{14}C (N_o) values can range from 54 – 84 pMC (Geyh 2000).

If N_o = 54 pMC:
$$t = \frac{5730}{\ln 2}.\ln(\frac{15.9}{54})$$

t = -8267 x ln (0.294) = **10,120 years**

If N_o = 84 pMC:
$$t = \frac{5730}{\ln 2}.\ln(\frac{15.9}{84})$$

t = -8267 x ln (0.189) = **13,760 years**

3- Incorporation of stable carbon isotope values

Stable carbon isotope values ($\delta^{13}C$) can be applied in a mixing model that allows for the incorporation of ^{14}C-active DIC during carbonate dissolution when exposed to atmospheric conditions (i.e. open system) and subsequent ^{14}C dilution belowground (i.e. closed-system conditions). The revised equation is:

$$t = \frac{\tau}{\ln 2}.\ln(\frac{N}{q.No})$$

where q = correction factor based on carbon isotope mass-balance calculation and defined as:

$$q = \frac{\delta^{13}C_{DIC} - \delta^{13}C_{carb}}{\delta^{13}C_{soil} - \delta^{13}C_{carb}}$$

$\delta^{13}C_{DIC}$ = measured value (6.8‰)
$\delta^{13}C_{carb}$ = $\delta^{13}C$ of the calcite being dissolved, usually close to 0‰ for old carbonate formations
$\delta^{13}C_{soil}$ = $\delta^{13}C$ of the soil CO_2 (usually close to and assumed to be -23‰)

At higher (7 – 10) pH values however, the DIC in equilibrium with the CO_2 is enriched in ^{13}C. Deep groundwater from the area has been shown to be approximately pH = 7.4 (Kimball 1981). The correction ($\varepsilon^{13}C_{DIC\text{-}CO^2(soil)}$) factor, based on the pH is approximately +6‰ (based on Clark and Fritz 1997).

The revised, pH-corrected equation is:

$$q = \frac{\delta^{13}C_{DIC} - \delta^{13}C_{carb}}{\delta^{13}C_{rech} - \delta^{13}C_{carb}}$$

where $\delta^{13}C_{rech\,=\,\delta}{}^{13}C_{soil} + \varepsilon^{13}C_{DIC\text{-}CO^2(soil)}$

For $\delta^{13}C_{DIC}$ = -6.8‰, $\delta^{13}C_{carb}$ = 0‰, $\delta^{13}C_{soil}$ = -23‰, and $\varepsilon^{13}C_{DIC\text{-}CO^2(soil)}$ = +6‰:

$$q = \frac{-6.8 - 0}{(-23 + 6) - 0} = 0.4$$

Thus, given N = 15.9 pMC, the revised t is:

$$t = \frac{\tau}{\ln 2}.\ln(\frac{N}{q.No})$$

$$t = \frac{5730}{\ln 2}.\ln(\frac{15.9}{0.4\ (100\ pMC)})$$

$$t = \frac{5730}{\ln 2}.\ln(0.3975)$$

t = **7,626 years**

References

Clark I.D. and Fritz P. 1997. Environmental isotopes in hydrogeology. CRC Press, Boca Raton, FL. 328 p.

Geyh M.A. 2000. An overview of ^{14}C analysis in the study of groundwater. Radiocarbon. 42(1):99-114.

Kimball B.A. 1981. Geochemistry of Spring Water, southeastern Uinta Basin, Utah and Colorado. Geological Survey Water Supply Paper 2074. 28 p.

Muennich K.O. 1957. Messung des ^{14}C-Gehaltes von hartem grundwasser. Naturwissenschaften 34:32-3.

Muennich K.O. 1968. Isotopen-Datierun von grundwasser. Naturwissenchaften. 55:158-63.

APPENDIX G

SPLP LEACHATE ANALYSIS

American West
ANALYTICAL LABORATORIES

John Wallace
IGES
4153 South Commerce Drive
Salt Lake City, UT 84107
TEL: (801) 270-9400

RE: Red Leaf ECOSHALE / 01109-013

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Dear John Wallace: Lab Set ID: 1110545

American West Analytical Laboratories received 3 sample(s) on 10/27/2011 for the analyses presented in the following report.

All analyses were performed in accordance to The NELAC Institute protocols unless noted otherwise. American West Analytical Laboratories is certified by The NELAC Institute in Utah and Texas; and is state certified in Colorado, Idaho, and Missouri. Certification document is available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

11/7/2011: This is a revision to a report originally issued 11/2/2011. Pages 1, 8-34, 46, and 51-79 have been revised.

11/9/2011: Pages 1 and 7 have been revised for cosmetic corrections.

Thank You,

Kyle F. Gross

Digitally signed by Kyle F. Gross
DN: cn=Kyle F. Gross, o=AWAL, ou=AWAL, email=kyle@awal-labs.com, c=US
Date: 2011.11.09 10:15:32 -07'00'

Approved by:

Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client:	IGES	**Contact:**	John Wallace
Project:	Red Leaf ECOSHALE / 01109-013		
Lab Sample ID:	1110545-001		
Client Sample ID:	R11-122 #1		
Collection Date:	10/27/2011 0930h		
Received Date:	10/27/2011 1346h		

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00500	**0.00923**	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00300	**0.0367**	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	**0.0483**	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.500	**0.840**	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**3.44**	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1932h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**1.14**	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1010h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1640h	SW6010C	0.0200	**0.129**	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1640h	SW6010C	1.00	**4.23**	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	**0.00786**	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	1.00	**36.9**	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00400	**0.0686**	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1214h	SW6010C	0.0500	**0.0638**	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0029h	SW6020A	0.0250	< 0.0250	*

** - The reporting limits were raised due to sample matrix interferences.*

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-002
Client Sample ID: R11-122 #2
Collection Date: 10/27/2011 0935h
Received Date: 10/27/2011 1346h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00500	**0.00761**	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00300	**0.0371**	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	**0.0479**	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.500	**0.832**	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**3.64**	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1935h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**1.25**	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1021h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1705h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1705h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	**0.00753**	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	1.00	**33.5**	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00400	**0.0707**	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1230h	SW6010C	0.0500	**0.0640**	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0058h	SW6020A	0.0250	< 0.0250	*

* - *The reporting limits were raised due to sample matrix interferences.*

~ - *The above result was not performed in accordance with NELAP requirements.*

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 10/27/2011 1800h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00500	**0.00929**	
Arsenic	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00300	**0.0391**	
Barium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	**0.0410**	
Beryllium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00300	< 0.00300	*
Boron	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.500	**0.878**	
Cadmium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.000900	< 0.000900	*
Calcium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	**3.48**	
Chromium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	< 0.00400	*
Iron	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.100	< 0.100	
Lead	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Lithium	mg/L	10/28/2011 1422h	11/1/2011 1937h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00600	< 0.00600	*
Mercury	mg/L	10/28/2011 1400h	10/31/2011 1023h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/28/2011 1422h	10/31/2011 1709h	SW6010C	0.0200	**0.159**	
Nickel	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	< 0.00400	*
Potassium	mg/L	10/28/2011 1422h	10/31/2011 1709h	SW6010C	1.00	**4.28**	
Selenium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	**0.00725**	
Silver	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Sodium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	1.00	**37.4**	
Strontium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00400	**0.0640**	
Thallium	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.00200	< 0.00200	*
Tin	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/28/2011 1422h	10/31/2011 1234h	SW6010C	0.0500	**0.0666**	
Zinc	mg/L	10/28/2011 1422h	10/29/2011 0103h	SW6020A	0.0250	< 0.0250	*

** - The reporting limits were raised due to sample matrix interferences.*

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	**68.9**	
Chloride	mg/L		11/1/2011 1321h	SM4500-Cl-E	5.00	< 5.00	'@
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	**1.56**	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1148h	E353.2	0.0100	**0.0106**	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	**9.92**	
Sulfate	mg/L		10/29/2011 0940h	SM4500-SO4-E	5.00	**17.4**	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	**172**	

Analysis performed on an SPLP extract.
@ - High RPD due to suspected sample non-homogeneity or matrix interference.
' - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client:	IGES	**Contact:**	John Wallace
Project:	Red Leaf ECOSHALE / 01109-013		
Lab Sample ID:	1110545-002		
Client Sample ID:	R11-122 #2		
Collection Date:	10/27/2011 0935h		
Received Date:	10/27/2011 1346h		

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	**82.0**	
Chloride	mg/L		11/1/2011 1324h	SM4500-Cl-E	5.00	< 5.00	
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	**1.64**	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1152h	E353.2	0.0100	**0.0251**	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	**9.99**	
Sulfate	mg/L		10/29/2011 0940h	SM4500-SO4-E	5.00	**18.5**	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	**220**	

Analysis performed on an SPLP extract.

B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/31/2011 0730h	SM2320B	40.0	**78.7**	
Chloride	mg/L		11/1/2011 1325h	SM4500-Cl-E	5.00	< 5.00	
Fluoride	mg/L		10/31/2011 0840h	SM4500-F-C	0.100	**1.84**	
Nitrate/Nitrite (as N)	mg/L		10/31/2011 1153h	E353.2	0.0100	**0.0142**	B
Oil & Grease	mg/L		10/28/2011 1250h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/28/2011 1715h	SM4500-H+B	1.00	**10.2**	
Sulfate	mg/L		10/29/2011 1045h	SM4500-SO4-E	5.00	**19.8**	
Total Dissolved Solids	mg/L		10/28/2011 1300h	SM2540C	20.0	**220**	

Analysis performed on an SPLP extract.

B - This analyte was also detected in the SPLP blank at 0.0189 mg/L.

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3′-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3′-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	**0.0326**	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	**65.6**	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	**46.9**	
Surr: 2-Fluorophenol	367-12-4	14-106	**31.8**	
Surr: Nitrobenzene-d5	4165-60-0	10-180	**43.6**	

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/4/2011 1759h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	**24.8**	
Surr: Terphenyl-d14	1718-51-0	10-199	**114**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client:	IGES	**Contact:**	John Wallace
Project:	Red Leaf ECOSHALE / 01109-013		
Lab Sample ID:	1110545-002A		
Client Sample ID:	R11-122 #2		
Collection Date:	10/27/2011 0935h		
Received Date:	10/27/2011 1346h	**Method:**	SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h

Units: mg/L

Dilution Factor: 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3′-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3′-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	**0.0354**	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	**85.9**	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	**42.7**	
Surr: 2-Fluorophenol	367-12-4	14-106	**31.6**	
Surr: Nitrobenzene-d5	4165-60-0	10-180	**65.6**	

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/4/2011 1825h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	**22.3**	
Surr: Terphenyl-d14	1718-51-0	10-199	**106**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3
Collection Date: 10/27/2011 0940h
Received Date: 10/27/2011 1346h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0200	< 0.0200	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	
2-Nitrophenol	88-75-5	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3´-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3´-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	**0.0259**	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	
Surr: 2,4,6-Tribromophenol	118-79-6	10-159	**90.4**	
Surr: 2-Fluorobiphenyl	321-60-8	10-124	**40.5**	
Surr: 2-Fluorophenol	367-12-4	14-106	**32.3**	
Surr: Nitrobenzene-d5	4165-60-0	10-180	**45.2**	

American West ANALYTICAL LABORATORIES

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/4/2011 1851h **Extracted:** 11/4/2011 1050h **SPLP Prep Date:** 11/3/2011 1700h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: Phenol-d6	13127-88-3	10-122	**25.2**	
Surr: Terphenyl-d14	1718-51-0	10-199	**110**	

[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: IGES **Contact:** John Wallace
Project: Red Leaf ECOSHALE / 01109-013
Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
Received Date: 10/27/2011 1346h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0195**	
Acetonitrile	75-05-8	0.00500	**0.0171**	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

American West
ANALYTICAL LABORATORIES

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h | **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

Lab Sample ID: 1110545-001A
Client Sample ID: R11-122 #1

Analyzed: 11/3/2011 0435h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	**109**	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	**97.7**	
Surr: Dibromofluoromethane	1868-53-7	80-124	**98.7**	
Surr: Toluene-d8	2037-26-5	80-125	**102**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client:	IGES	**Contact:**	John Wallace
Project:	Red Leaf ECOSHALE / 01109-013		
Lab Sample ID:	1110545-002A		
Client Sample ID:	R11-122 #2		
Collection Date:	10/27/2011 0935h		
Received Date:	10/27/2011 1346h	**Method:**	SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h

Units: mg/L

Dilution Factor: 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0178**	
Acetonitrile	75-05-8	0.00500	**0.0134**	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

American West
ANALYTICAL LABORATORIES

Lab Sample ID: 1110545-002A
Client Sample ID: R11-122 #2

Analyzed: 11/3/2011 0457h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	**111**	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	**98.0**	
Surr: Dibromofluoromethane	1868-53-7	80-124	**99.2**	
Surr: Toluene-d8	2037-26-5	80-125	**101**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

Client:	IGES	**Contact:**	John Wallace
Project:	Red Leaf ECOSHALE / 01109-013		
Lab Sample ID:	1110545-003A		
Client Sample ID:	R11-122 #3		
Collection Date:	10/27/2011 0940h		
Received Date:	10/27/2011 1346h	**Method:**	SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h

Units: mg/L

Dilution Factor: 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

American West Analytical Laboratories

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0152**	
Acetonitrile	75-05-8	0.00500	**0.0118**	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1110545-003A
Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h **SPLP Prep Date:** 10/28/2011 1600h
Units: mg/L
Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	

Lab Sample ID: 1110545-003A

Client Sample ID: R11-122 #3

Analyzed: 11/3/2011 0519h | **SPLP Prep Date:** 10/28/2011 1600h

Units: mg/L

Dilution Factor: 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Surr: 1,2-Dichloroethane-d4	17060-07-0	77-144	**112**	
Surr: 4-Bromofluorobenzene	460-00-4	80-123	**99.1**	
Surr: Dibromofluoromethane	1868-53-7	80-124	**99.2**	
Surr: Toluene-d8	2037-26-5	80-125	**99.4**	

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15285	Boron	mg/L	SW6010C	2.03	2.000	0	102	80-120				10/31/2011 1201h
LCS-15285	Calcium	mg/L	SW6010C	20.1	20.00	0	101	80-120				10/31/2011 1201h
LCS-15285	Chromium	mg/L	SW6010C	0.391	0.4000	0	97.8	80-120				10/31/2011 1201h
LCS-15285	Iron	mg/L	SW6010C	2.01	2.000	0	101	80-120				10/31/2011 1201h
LCS-15285	Magnesium	mg/L	SW6010C	19.8	20.00	0	99.0	80-120				10/31/2011 1201h
LCS-15285	Molybdenum	mg/L	SW6010C	0.410	0.4000	0	103	80-120				10/31/2011 1632h
LCS-15285	Potassium	mg/L	SW6010C	19.2	20.00	0	95.9	80-120				10/31/2011 1632h
LCS-15285	Sodium	mg/L	SW6010C	20.2	20.00	0	101	80-120				10/31/2011 1201h
LCS-15285	Tin	mg/L	SW6010C	1.83	2.000	0	91.5	80-120				10/31/2011 1201h
LCS-15285	Vanadium	mg/L	SW6010C	0.403	0.4000	0	101	80-120				10/31/2011 1201h
LCS-15285	Antimony	mg/L	SW6020A	0.403	0.4000	0	101	85-115				10/29/2011 0023h
LCS-15285	Arsenic	mg/L	SW6020A	0.400	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Barium	mg/L	SW6020A	0.402	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Beryllium	mg/L	SW6020A	0.399	0.4000	0	99.7	85-115				10/29/2011 0023h
LCS-15285	Cadmium	mg/L	SW6020A	0.401	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Copper	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h
LCS-15285	Lead	mg/L	SW6020A	0.402	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Manganese	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h
LCS-15285	Nickel	mg/L	SW6020A	0.399	0.4000	0	99.7	85-115				10/29/2011 0023h
LCS-15285	Selenium	mg/L	SW6020A	0.400	0.4000	0	99.9	85-115				10/29/2011 0023h
LCS-15285	Silver	mg/L	SW6020A	0.400	0.4000	0	100	85-115				10/29/2011 0023h
LCS-15285	Strontium	mg/L	SW6020A	0.396	0.4000	0	98.9	85-115				10/29/2011 0023h
LCS-15285	Thallium	mg/L	SW6020A	0.398	0.4000	0	99.6	85-115				10/29/2011 0023h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15285	Zinc	mg/L	SW6020A	2.05	2.000	0	102	85-115				10/29/2011 0023h
LCS-15289	Mercury	mg/L	SW7470A	0.00339	0.003330	0	102	80-120				10/31/2011 1006h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15285	Boron	mg/L	SW6010C	< 0.500				-				10/31/2011 1157h
MB-15285	Calcium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Chromium	mg/L	SW6010C	< 0.0100				-				10/31/2011 1157h
MB-15285	Iron	mg/L	SW6010C	< 0.100				-				10/31/2011 1157h
MB-15285	Lithium	mg/L	SW6010C	< 0.100				-				11/1/2011 1926h
MB-15285	Magnesium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/31/2011 1628h
MB-15285	Potassium	mg/L	SW6010C	< 1.00				-				10/31/2011 1628h
MB-15285	Sodium	mg/L	SW6010C	< 1.00				-				10/31/2011 1157h
MB-15285	Tin	mg/L	SW6010C	< 0.500				-				10/31/2011 1157h
MB-15285	Vanadium	mg/L	SW6010C	< 0.0500				-				10/31/2011 1157h
MB-SPLP-15271	Boron	mg/L	SW6010C	< 0.500				-				10/31/2011 1205h
MB-SPLP-15271	Calcium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Chromium	mg/L	SW6010C	< 0.0100				-				10/31/2011 1205h
MB-SPLP-15271	Iron	mg/L	SW6010C	< 0.100				-				10/31/2011 1205h
MB-SPLP-15271	Lithium	mg/L	SW6010C	< 0.100				-				11/1/2011 1929h
MB-SPLP-15271	Magnesium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/31/2011 1636h
MB-SPLP-15271	Potassium	mg/L	SW6010C	< 1.00				-				10/31/2011 1636h
MB-SPLP-15271	Sodium	mg/L	SW6010C	< 1.00				-				10/31/2011 1205h
MB-SPLP-15271	Tin	mg/L	SW6010C	< 0.500				-				10/31/2011 1205h
MB-SPLP-15271	Vanadium	mg/L	SW6010C	< 0.0500				-				10/31/2011 1205h
MB-15285	Antimony	mg/L	SW6020A	< 0.00500				-				10/29/2011 0018h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15285	Arsenic	mg/L	SW6020A	< 0.00300				-				10/29/2011 0018h
MB-15285	Barium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Beryllium	mg/L	SW6020A	< 0.00300				-				10/29/2011 0018h
MB-15285	Cadmium	mg/L	SW6020A	< 0.000900				-				10/29/2011 0018h
MB-15285	Copper	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Lead	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Manganese	mg/L	SW6020A	< 0.00600				-				10/29/2011 0018h
MB-15285	Nickel	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Selenium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Silver	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Strontium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0018h
MB-15285	Thallium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0018h
MB-15285	Zinc	mg/L	SW6020A	< 0.0250				-				10/29/2011 0018h
MB-SPLP-15271	Antimony	mg/L	SW6020A	< 0.00500				-				10/29/2011 0012h
MB-SPLP-15271	Arsenic	mg/L	SW6020A	< 0.00300				-				10/29/2011 0012h
MB-SPLP-15271	Barium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Beryllium	mg/L	SW6020A	< 0.00300				-				10/29/2011 0012h
MB-SPLP-15271	Cadmium	mg/L	SW6020A	< 0.000900				-				10/29/2011 0012h
MB-SPLP-15271	Copper	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Lead	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Manganese	mg/L	SW6020A	< 0.00600				-				10/29/2011 0012h
MB-SPLP-15271	Nickel	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Selenium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West
ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15271	Silver	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Strontium	mg/L	SW6020A	< 0.00400				-				10/29/2011 0012h
MB-SPLP-15271	Thallium	mg/L	SW6020A	< 0.00200				-				10/29/2011 0012h
MB-SPLP-15271	Zinc	mg/L	SW6020A	< 0.0250				-				10/29/2011 0012h
MB-15289	Mercury	mg/L	SW7470A	< 0.00100				-				10/31/2011 1005h
MB-SPLP-15271	Mercury	mg/L	SW7470A	< 0.00100				-				10/31/2011 1025h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMS	Boron	mg/L	SW6010C	2.80	2.000	0.8400	98.0	75-125				10/31/2011 1222h
1110545-001AMS	Calcium	mg/L	SW6010C	23.1	20.00	3.440	98.3	75-125				10/31/2011 1222h
1110545-001AMS	Chromium	mg/L	SW6010C	0.373	0.4000	0	93.2	75-125				10/31/2011 1222h
1110545-001AMS	Iron	mg/L	SW6010C	2.02	2.000	0	101	75-125				10/31/2011 1222h
1110545-001AMS	Magnesium	mg/L	SW6010C	20.9	20.00	1.140	98.8	75-125				10/31/2011 1222h
1110545-001AMS	Molybdenum	mg/L	SW6010C	0.527	0.4000	0.1290	99.6	75-125				10/31/2011 1644h
1110545-001AMS	Potassium	mg/L	SW6010C	23.0	20.00	4.226	93.8	75-125				10/31/2011 1644h
1110545-001AMS	Sodium	mg/L	SW6010C	55.3	20.00	36.90	92.0	75-125				10/31/2011 1222h
1110545-001AMS	Tin	mg/L	SW6010C	1.81	2.000	0	90.5	75-125				10/31/2011 1222h
1110545-001AMS	Vanadium	mg/L	SW6010C	0.447	0.4000	0.06380	95.8	75-125				10/31/2011 1222h
1110545-001AMS	Antimony	mg/L	SW6020A	0.403	0.4000	0.009231	98.5	75-125				10/29/2011 0046h
1110545-001AMS	Arsenic	mg/L	SW6020A	0.436	0.4000	0.03671	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Barium	mg/L	SW6020A	0.443	0.4000	0.04833	98.7	75-125				10/29/2011 0046h
1110545-001AMS	Beryllium	mg/L	SW6020A	0.402	0.4000	0	101	75-125				10/29/2011 0046h
1110545-001AMS	Cadmium	mg/L	SW6020A	0.399	0.4000	0	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Copper	mg/L	SW6020A	0.400	0.4000	0	100	75-125				10/29/2011 0046h
1110545-001AMS	Lead	mg/L	SW6020A	0.401	0.4000	0	100	75-125				10/29/2011 0046h
1110545-001AMS	Manganese	mg/L	SW6020A	0.393	0.4000	0	98.4	75-125				10/29/2011 0046h
1110545-001AMS	Nickel	mg/L	SW6020A	0.395	0.4000	0	98.9	75-125				10/29/2011 0046h
1110545-001AMS	Selenium	mg/L	SW6020A	0.407	0.4000	0.007856	99.7	75-125				10/29/2011 0046h
1110545-001AMS	Silver	mg/L	SW6020A	0.400	0.4000	0	99.9	75-125				10/29/2011 0046h
1110545-001AMS	Strontium	mg/L	SW6020A	0.459	0.4000	0.06864	97.6	75-125				10/29/2011 0046h
1110545-001AMS	Thallium	mg/L	SW6020A	0.398	0.4000	0.0001900	99.5	75-125				10/29/2011 0046h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMS	Zinc	mg/L	SW6020A	2.07	2.000	0.01842	102	75-125				10/29/2011 0046h
1110545-001AMS	Mercury	mg/L	SW7470A	0.00313	0.003330	0	94.1	80-120				10/31/2011 1014h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMSD	Boron	mg/L	SW6010C	2.88	2.000	0.8400	102	75-125	2.82	20		10/31/2011 1226h
1110545-001AMSD	Calcium	mg/L	SW6010C	22.8	20.00	3.440	96.8	75-125	1.31	20		10/31/2011 1226h
1110545-001AMSD	Chromium	mg/L	SW6010C	0.383	0.4000	0	95.8	75-125	2.65	20		10/31/2011 1226h
1110545-001AMSD	Iron	mg/L	SW6010C	1.99	2.000	0	99.5	75-125	1.5	20		10/31/2011 1226h
1110545-001AMSD	Magnesium	mg/L	SW6010C	20.5	20.00	1.140	96.8	75-125	1.93	20		10/31/2011 1226h
1110545-001AMSD	Molybdenum	mg/L	SW6010C	0.533	0.4000	0.1290	101	75-125	1.05	20		10/31/2011 1701h
1110545-001AMSD	Potassium	mg/L	SW6010C	22.8	20.00	4.226	92.6	75-125	0.997	20		10/31/2011 1701h
1110545-001AMSD	Sodium	mg/L	SW6010C	53.7	20.00	36.90	84.0	75-125	2.94	20		10/31/2011 1226h
1110545-001AMSD	Tin	mg/L	SW6010C	1.82	2.000	0	91.0	75-125	0.551	20		10/31/2011 1226h
1110545-001AMSD	Vanadium	mg/L	SW6010C	0.457	0.4000	0.06380	98.3	75-125	2.21	20		10/31/2011 1226h
1110545-001AMSD	Antimony	mg/L	SW6020A	0.406	0.4000	0.009231	99.2	75-125	0.685	20		10/29/2011 0052h
1110545-001AMSD	Arsenic	mg/L	SW6020A	0.436	0.4000	0.03671	99.7	75-125	0.0181	20		10/29/2011 0052h
1110545-001AMSD	Barium	mg/L	SW6020A	0.445	0.4000	0.04833	99.2	75-125	0.456	20		10/29/2011 0052h
1110545-001AMSD	Beryllium	mg/L	SW6020A	0.405	0.4000	0	101	75-125	0.763	20		10/29/2011 0052h
1110545-001AMSD	Cadmium	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.476	20		10/29/2011 0052h
1110545-001AMSD	Copper	mg/L	SW6020A	0.402	0.4000	0	100	75-125	0.406	20		10/29/2011 0052h
1110545-001AMSD	Lead	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.156	20		10/29/2011 0052h
1110545-001AMSD	Manganese	mg/L	SW6020A	0.398	0.4000	0	99.4	75-125	1.08	20		10/29/2011 0052h
1110545-001AMSD	Nickel	mg/L	SW6020A	0.396	0.4000	0	99.0	75-125	0.149	20		10/29/2011 0052h
1110545-001AMSD	Selenium	mg/L	SW6020A	0.406	0.4000	0.007856	99.7	75-125	0.016	20		10/29/2011 0052h
1110545-001AMSD	Silver	mg/L	SW6020A	0.401	0.4000	0	100	75-125	0.29	20		10/29/2011 0052h
1110545-001AMSD	Strontium	mg/L	SW6020A	0.461	0.4000	0.06864	98.2	75-125	0.445	20		10/29/2011 0052h
1110545-001AMSD	Thallium	mg/L	SW6020A	0.400	0.4000	0.0001900	100	75-125	0.48	20		10/29/2011 0052h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-001AMSD	Zinc	mg/L	SW6020A	2.07	2.000	0.01842	102	75-125	0.0715	20		10/29/2011 0052h
1110545-001AMSD	Mercury	mg/L	SW7470A	0.00325	0.003330	0	97.5	80-120	3.57	20		10/31/2011 1015h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: DUP

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110572-001EDUP	pH @ 25° C	pH Units	SM4500-H+B	6.83		6.820		-	0.147	5		10/28/2011 1715h
1110504-003FDUP	Total Dissolved Solids	mg/L	SM2540C	9,900		9,500		-	4.12	5		10/28/2011 1300h
1110506-002ADUP	Total Dissolved Solids	mg/L	SM2540C	440		436.0		-	0.913	5		10/28/2011 1300h
1110526-015BDUP	Total Dissolved Solids	mg/L	SM2540C	8,780		8,440		-	3.95	5		10/28/2011 1300h
1110544-002DDUP	Total Dissolved Solids	mg/L	SM2540C	4,700		4,400		-	6.59	5	@	10/28/2011 1300h

@ - High RPD due to suspected sample non-homogeneity or matrix interference.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-R33139	Alkalinity (as CaCO3)	mg/L	SM2320B	48,400	50,000	0	96.8	90-110				10/31/2011 0730h
LCS-R33224	Chloride	mg/L	SM4500-Cl-E	26.2	25.00	0	105	90-110				11/1/2011 1318h
LCS-R33153	Fluoride	mg/L	SM4500-F-C	0.995	1.000	0	99.5	90-110				10/31/2011 0840h
LCS-R33166	Nitrate/Nitrite (as N)	mg/L	E353.2	1.05	1.000	0	105	90-110				10/31/2011 1145h
LCS-R33114	Oil & Grease	mg/L	E1664A	38.3	40.00	0	95.8	78-114				10/28/2011 1250h
LCS-R33097	pH @ 25° C	pH Units	SM4500-H+B	9.03	9.000	0	100	98-102				10/28/2011 1715h
LCS-R33116	Sulfate	mg/L	SM4500-SO4-E	1,020	1,000	0	102	90-110				10/29/2011 0940h
LCS-R33118	Sulfate	mg/L	SM4500-SO4-E	957	1,000	0	95.7	90-110				10/29/2011 1045h
LCS-R33228	Total Dissolved Solids	mg/L	SM2540C	204	205.0	0	99.5	80-120				10/28/2011 1300h
LCS-R33231	Total Dissolved Solids	mg/L	SM2540C	200	205.0	0	97.6	80-120				10/28/2011 1300h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-R33139	Alkalinity (as CaCO3)	mg/L	SM2320B	< 10.0				-				10/31/2011 0730h
MB-SPLP-15271	Alkalinity (as CaCO3)	mg/L	SM2320B	< 40.0				-				10/31/2011 0730h
MB-R33224	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				11/1/2011 1317h
MB-SPLP-15271	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				11/1/2011 1319h
MB-R33153	Fluoride	mg/L	SM4500-F-C	< 0.100				-				10/31/2011 0840h
MB-SPLP-15271	Fluoride	mg/L	SM4500-F-C	< 0.100				-				10/31/2011 0840h
MB-R33166	Nitrate/Nitrite (as N)	mg/L	E353.2	< 0.0100				-				10/31/2011 1143h
MB-SPLP-15271	Nitrate/Nitrite (as N)	mg/L	E353.2	0.0189				-			B^	10/31/2011 1146h
MB-R33114	Oil & Grease	mg/L	E1664A	< 3.00				-				10/28/2011 1250h
MB-SPLP-15271	Oil & Grease	mg/L	E1664A	< 3.00				-				10/28/2011 1250h
MB-R33116	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 0940h
MB-R33118	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 1045h
MB-SPLP-15271	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/29/2011 1045h
MB-R33228	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/28/2011 1300h
MB-R33231	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/28/2011 1300h

B - This analyte was detected in the method blank above the PQL as expected becuase of the nitric acid used in the SPLP fluid.
^ - Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110567-002AMS	Alkalinity (as CaCO3)	mg/L	SM2320B	479	200.0	291.9	93.5	80-120				10/31/2011 0730h
1110545-001AMS	Chloride	mg/L	SM4500-Cl-E	14.8	10.00	3.091	117	90-110			1	11/1/2011 1322h
1110545-003AMS	Fluoride	mg/L	SM4500-F-C	2.88	1.000	1.840	104	80-120				10/31/2011 0840h
1110545-001AMS	Nitrate/Nitrite (as N)	mg/L	E353.2	1.02	1.000	0.01060	101	90-110				10/31/2011 1149h
1110504-003DMS	Sulfate	mg/L	SM4500-SO4-E	143	100.0	50.75	92.1	80-120				10/29/2011 1045h
1110545-001AMS	Sulfate	mg/L	SM4500-SO4-E	36.9	20.00	17.45	97.2	80-120				10/29/2011 0940h

1 - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110567-002AMSD	Alkalinity (as CaCO3)	mg/L	SM2320B	479	200.0	291.9	93.5	80-120	0	10		10/31/2011 0730h
1110545-001AMSD	Chloride	mg/L	SM4500-Cl-E	12.4	10.00	3.091	92.7	90-110	18	10	@	11/1/2011 1323h
1110545-003AMSD	Fluoride	mg/L	SM4500-F-C	2.80	1.000	1.840	96.0	80-120	2.82	10		10/31/2011 0840h
1110545-001AMSD	Nitrate/Nitrite (as N)	mg/L	E353.2	1.00	1.000	0.01060	99.0	90-110	2.1	10		10/31/2011 1150h
1110504-003DMSD	Sulfate	mg/L	SM4500-SO4-E	138	100.0	50.75	87.3	80-120	3.45	10		10/29/2011 1045h
1110545-001AMSD	Sulfate	mg/L	SM4500-SO4-E	37.9	20.00	17.45	102	80-120	2.73	10		10/29/2011 0940h

@ - High RPD due to suspected sample non-homogeneity or matrix interference.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: QCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCS-R33114	Oil & Grease	mg/L	E1664A	40.3	40.00	2.200	95.3	78-114				10/28/2011 1250h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: WC
QC Type: QCSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCSD-R33114	Oil & Grease	mg/L	E1664A	41.5	40.00	2.200	98.2	78-114	2.93	18		10/28/2011 1250h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-15421	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0270	0.08000	0	33.7	10-104				11/4/2011 1733h
LCS-15421	1,4-Dichlorobenzene	mg/L	SW8270D	0.0156	0.08000	0	19.5	10-118				11/4/2011 1733h
LCS-15421	2,4,6-Trichlorophenol	mg/L	SW8270D	0.0668	0.08000	0	83.5	17-119				11/4/2011 1733h
LCS-15421	2,4-Dimethylphenol	mg/L	SW8270D	0.0687	0.08000	0	85.9	10-131				11/4/2011 1733h
LCS-15421	2,4-Dinitrotoluene	mg/L	SW8270D	0.0901	0.08000	0	113	42-219				11/4/2011 1733h
LCS-15421	2-Chloronaphthalene	mg/L	SW8270D	0.0398	0.08000	0	49.8	23-126				11/4/2011 1733h
LCS-15421	2-Chlorophenol	mg/L	SW8270D	0.0463	0.08000	0	57.9	15-128				11/4/2011 1733h
LCS-15421	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.103	0.08000	0	128	30-198				11/4/2011 1733h
LCS-15421	4-Chloro-3-methylphenol	mg/L	SW8270D	0.0694	0.08000	0	86.8	29-148				11/4/2011 1733h
LCS-15421	4-Nitrophenol	mg/L	SW8270D	0.0428	0.08000	0	53.5	10-157				11/4/2011 1733h
LCS-15421	Acenaphthene	mg/L	SW8270D	0.0476	0.08000	0	59.6	20-116				11/4/2011 1733h
LCS-15421	Benzo(a)pyrene	mg/L	SW8270D	0.0923	0.08000	0	115	10-221				11/4/2011 1733h
LCS-15421	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0408	0.08000	0	51.0	20-148				11/4/2011 1733h
LCS-15421	Pentachlorophenol	mg/L	SW8270D	0.0985	0.08000	0	123	21-153				11/4/2011 1733h
LCS-15421	Phenol	mg/L	SW8270D	0.0208	0.08000	0	26.0	10-131				11/4/2011 1733h
LCS-15421	Pyrene	mg/L	SW8270D	0.0870	0.08000	0	109	37-150				11/4/2011 1733h
LCS-15421	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0885	0.08000		111	10-165				11/4/2011 1733h
LCS-15421	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0197	0.04000		49.2	32-128				11/4/2011 1733h
LCS-15421	Surr: 2-Fluorophenol	%REC	SW8270D	0.0268	0.08000		33.5	10-121				11/4/2011 1733h
LCS-15421	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0227	0.04000		56.7	10-127				11/4/2011 1733h
LCS-15421	Surr: Phenol-d6	%REC	SW8270D	0.0216	0.08000		26.9	10-124				11/4/2011 1733h
LCS-15421	Surr: Terphenyl-d14	%REC	SW8270D	0.0444	0.04000		111	51-221				11/4/2011 1733h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

American West Analytical Laboratories

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	1,1´-Biphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2,4,5-Tetrachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2,4-Trichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,2-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3,5-Trinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,3-Dinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Naphthoquinone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1,4-Phenylenediamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	1-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,3,4,6-Tetrachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4,5-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4,6-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dimethylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,4-Dinitrophenol	mg/L	SW8270D	< 0.0200				-				11/4/2011 1708h
MB-15421	2,4-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,6-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2,6-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Acetylaminofluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	2-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Chlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	2-Picoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3&4-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3,3´-Dichlorobenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3,3´-Dimethylbenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3-Methylcholanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	3-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Aminobiphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Bromophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chloro-3-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chloroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Chlorophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	4-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	5-Nitro-o-toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	7,12-Dimethylbenz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	a,a-Dimethylphenethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acenaphthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acenaphthylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Acetophenone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	alpha-Terpineol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Aniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Aramite	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Azobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(a)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(b)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(g,h,i)perylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzo(k)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Benzoic acid	mg/L	SW8270D	< 0.0200				-				11/4/2011 1708h
MB-15421	Benzyl alcohol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroethoxy)methane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroethyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-chloroisopropyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Bis(2-ethylhexyl) phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	bis(2-ethylhexyl)adipate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Butyl benzyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Carbazole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Chlorobenzilate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Chrysene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diallate (cis or trans)	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dibenz(a,h)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dibenzofuran	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethoate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dimethylaminoazobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Di-n-butyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Di-n-octyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Dinoseb	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Diphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Disulfoton	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Ethyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Famphur	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Fluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorobutadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachlorocyclopentadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachloroethane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West
ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Hexachlorophene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Hexachloropropene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Indene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Indeno(1,2,3-cd)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isodrin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isophorone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Isosafrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Kepone	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methapyrilene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Naphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	n-Decane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Nitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Nitroquinoline-1-oxide	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodiethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodimethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodi-n-butylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodiphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosodi-n-propylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosomethylethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosomorpholine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosopiperidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	N-Nitrosopyrrolidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	n-Octadecane	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	O,O,O-Triethyl phosphorothioate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	o-Toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Methyl parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachloronitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pentachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenacetin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Phorate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pronamide	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Pyridine	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Quinoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Safrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Tetraethyl dithiopyrophosphate	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Thionazin	mg/L	SW8270D	< 0.0100				-				11/4/2011 1708h
MB-15421	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0657	0.08000		82.1	10-165				11/4/2011 1708h
MB-15421	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0187	0.04000		46.7	18-108				11/4/2011 1708h
MB-15421	Surr: 2-Fluorophenol	%REC	SW8270D	0.0236	0.08000		29.5	10-121				11/4/2011 1708h
MB-15421	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0217	0.04000		54.2	10-127				11/4/2011 1708h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-15421	Surr: Phenol-d6	%REC	SW8270D	0.0203	0.08000		25.4	10-124				11/4/2011 1708h
MB-15421	Surr: Terphenyl-d14	%REC	SW8270D	0.0403	0.04000		101	10-133				11/4/2011 1708h
MB-SPLP-15423	1,1´-Biphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2,4,5-Tetrachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2,4-Trichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,2-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3,5-Trinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,3-Dinitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Dichlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Naphthoquinone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1,4-Phenylenediamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	1-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,3,4,6-Tetrachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4,5-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4,6-Trichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dimethylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dinitrophenol	mg/L	SW8270D	< 0.0200				-				11/4/2011 2008h
MB-SPLP-15423	2,4-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2,6-Dichlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	2,6-Dinitrotoluene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Acetylaminofluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Chloronaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Chlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Methylnaphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Naphthylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	2-Picoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3&4-Methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3,3´-Dichlorobenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3,3´-Dimethylbenzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3-Methylcholanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	3-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Aminobiphenyl	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Bromophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chloro-3-methylphenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chloroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Chlorophenyl phenyl ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Nitroaniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	4-Nitrophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	5-Nitro-o-toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	7,12-Dimethylbenz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	a,a-Dimethylphenethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acenaphthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acenaphthylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Acetophenone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	alpha-Terpineol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Aniline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Aramite	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Azobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benz(a)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(a)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(b)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(g,h,i)perylene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzo(k)fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Benzoic acid	mg/L	SW8270D	< 0.0200				-				11/4/2011 2008h
MB-SPLP-15423	Benzyl alcohol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroethoxy)methane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroethyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-chloroisopropyl) ether	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Bis(2-ethylhexyl) phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West
ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	bis(2-ethylhexyl)adipate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Butyl benzyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Carbazole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Chlorobenzilate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Chrysene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diallate (cis or trans)	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dibenz(a,h)anthracene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dibenzofuran	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethoate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dimethylaminoazobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Di-n-butyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Di-n-octyl phthalate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Dinoseb	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Diphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Disulfoton	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Ethyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Famphur	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Fluoranthene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Fluorene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorobutadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	Hexachlorocyclopentadiene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachloroethane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachlorophene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Hexachloropropene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Indene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Indeno(1,2,3-cd)pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isodrin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isophorone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Isosafrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Kepone	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methapyrilene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methyl methanesulfonate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Naphthalene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	n-Decane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Nitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Nitroquinoline-1-oxide	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodiethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodimethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodi-n-butylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodiphenylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosodi-n-propylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosomethylethylamine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosomorpholine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	N-Nitrosopiperidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	N-Nitrosopyrrolidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	n-Octadecane	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	O,O,O-Triethyl phosphorothioate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	o-Toluidine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Methyl parathion	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachlorobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachloronitrobenzene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pentachlorophenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenacetin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenanthrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phenol	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Phorate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pronamide	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pyrene	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Pyridine	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Quinoline	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Safrole	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Tetraethyl dithiopyrophosphate	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Thionazin	mg/L	SW8270D	< 0.0100				-				11/4/2011 2008h
MB-SPLP-15423	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.0601	0.08000		75.1	10-165				11/4/2011 2008h
MB-SPLP-15423	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0137	0.04000		34.3	18-108				11/4/2011 2008h

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15423	Surr: 2-Fluorophenol	%REC	SW8270D	0.0204	0.08000		25.5	10-121				11/4/2011 2008h
MB-SPLP-15423	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0146	0.04000		36.5	10-127				11/4/2011 2008h
MB-SPLP-15423	Surr: Phenol-d6	%REC	SW8270D	0.0169	0.08000		21.2	10-124				11/4/2011 2008h
MB-SPLP-15423	Surr: Terphenyl-d14	%REC	SW8270D	0.0430	0.04000		107	10-133				11/4/2011 2008h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-003AMS	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0342	0.1600	0	21.4	20-107				11/4/2011 1917h
1110545-003AMS	1,4-Dichlorobenzene	mg/L	SW8270D	0.0195	0.1600	0	12.2	11-90				11/4/2011 1917h
1110545-003AMS	2,4,6-Trichlorophenol	mg/L	SW8270D	0.178	0.1600	0	111	17-128				11/4/2011 1917h
1110545-003AMS	2,4-Dimethylphenol	mg/L	SW8270D	0.120	0.1600	0	75.1	10-176				11/4/2011 1917h
1110545-003AMS	2,4-Dinitrotoluene	mg/L	SW8270D	0.189	0.1600	0	118	21-191				11/4/2011 1917h
1110545-003AMS	2-Chloronaphthalene	mg/L	SW8270D	0.0793	0.1600	0	49.6	12-132				11/4/2011 1917h
1110545-003AMS	2-Chlorophenol	mg/L	SW8270D	0.0922	0.1600	0	57.6	20-107				11/4/2011 1917h
1110545-003AMS	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.216	0.1600	0	135	20-250				11/4/2011 1917h
1110545-003AMS	4-Chloro-3-methylphenol	mg/L	SW8270D	0.145	0.1600	0	90.6	10-136				11/4/2011 1917h
1110545-003AMS	4-Nitrophenol	mg/L	SW8270D	0.0839	0.1600	0	52.5	10-135				11/4/2011 1917h
1110545-003AMS	Acenaphthene	mg/L	SW8270D	0.104	0.1600	0	65.3	21-113				11/4/2011 1917h
1110545-003AMS	Benzo(a)pyrene	mg/L	SW8270D	0.186	0.1600	0	116	15-169				11/4/2011 1917h
1110545-003AMS	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0914	0.1600	0	57.1	10-133				11/4/2011 1917h
1110545-003AMS	Pentachlorophenol	mg/L	SW8270D	0.191	0.1600	0	119	10-131				11/4/2011 1917h
1110545-003AMS	Phenol	mg/L	SW8270D	0.0455	0.1600	0	28.5	10-71				11/4/2011 1917h
1110545-003AMS	Pyrene	mg/L	SW8270D	0.175	0.1600	0	110	23-150				11/4/2011 1917h
1110545-003AMS	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.183	0.1600		114	14-159				11/4/2011 1917h
1110545-003AMS	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0501	0.08000		62.6	10-124				11/4/2011 1917h
1110545-003AMS	Surr: 2-Fluorophenol	%REC	SW8270D	0.0504	0.1600		31.5	10-106				11/4/2011 1917h
1110545-003AMS	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0412	0.08000		51.4	10-180				11/4/2011 1917h
1110545-003AMS	Surr: Phenol-d6	%REC	SW8270D	0.0445	0.1600		27.8	10-122				11/4/2011 1917h
1110545-003AMS	Surr: Terphenyl-d14	%REC	SW8270D	0.0871	0.08000		109	10-199				11/4/2011 1917h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSSV
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1110545-003AMSD	1,2,4-Trichlorobenzene	mg/L	SW8270D	0.0301	0.1600	0	18.8	20-107	12.7	25	1	11/4/2011 1943h
1110545-003AMSD	1,4-Dichlorobenzene	mg/L	SW8270D	0.0181	0.1600	0	11.3	11-90	7.02	25		11/4/2011 1943h
1110545-003AMSD	2,4,6-Trichlorophenol	mg/L	SW8270D	0.173	0.1600	0	108	17-128	2.92	25		11/4/2011 1943h
1110545-003AMSD	2,4-Dimethylphenol	mg/L	SW8270D	0.114	0.1600	0	71.1	10-176	5.47	25		11/4/2011 1943h
1110545-003AMSD	2,4-Dinitrotoluene	mg/L	SW8270D	0.196	0.1600	0	122	21-191	3.44	25		11/4/2011 1943h
1110545-003AMSD	2-Chloronaphthalene	mg/L	SW8270D	0.0702	0.1600	0	43.9	12-132	12.1	25		11/4/2011 1943h
1110545-003AMSD	2-Chlorophenol	mg/L	SW8270D	0.0817	0.1600	0	51.1	20-107	12	25		11/4/2011 1943h
1110545-003AMSD	4,6-Dinitro-2-methylphenol	mg/L	SW8270D	0.226	0.1600	0	141	20-250	4.34	25		11/4/2011 1943h
1110545-003AMSD	4-Chloro-3-methylphenol	mg/L	SW8270D	0.140	0.1600	0	87.4	10-136	3.64	25		11/4/2011 1943h
1110545-003AMSD	4-Nitrophenol	mg/L	SW8270D	0.0800	0.1600	0	50.0	10-135	4.76	25		11/4/2011 1943h
1110545-003AMSD	Acenaphthene	mg/L	SW8270D	0.0960	0.1600	0	60.0	21-113	8.42	25		11/4/2011 1943h
1110545-003AMSD	Benzo(a)pyrene	mg/L	SW8270D	0.190	0.1600	0	118	15-169	1.72	25		11/4/2011 1943h
1110545-003AMSD	N-Nitrosodi-n-propylamine	mg/L	SW8270D	0.0885	0.1600	0	55.3	10-133	3.25	25		11/4/2011 1943h
1110545-003AMSD	Pentachlorophenol	mg/L	SW8270D	0.192	0.1600	0	120	10-131	0.481	25		11/4/2011 1943h
1110545-003AMSD	Phenol	mg/L	SW8270D	0.0392	0.1600	0	24.5	10-71	14.9	25		11/4/2011 1943h
1110545-003AMSD	Pyrene	mg/L	SW8270D	0.180	0.1600	0	113	23-150	2.69	25		11/4/2011 1943h
1110545-003AMSD	Surr: 2,4,6-Tribromophenol	%REC	SW8270D	0.180	0.1600		112	14-159				11/4/2011 1943h
1110545-003AMSD	Surr: 2-Fluorobiphenyl	%REC	SW8270D	0.0460	0.08000		57.4	10-124				11/4/2011 1943h
1110545-003AMSD	Surr: 2-Fluorophenol	%REC	SW8270D	0.0464	0.1600		29.0	10-106				11/4/2011 1943h
1110545-003AMSD	Surr: Nitrobenzene-d5	%REC	SW8270D	0.0379	0.08000		47.4	10-180				11/4/2011 1943h
1110545-003AMSD	Surr: Phenol-d6	%REC	SW8270D	0.0403	0.1600		25.2	10-122				11/4/2011 1943h
1110545-003AMSD	Surr: Terphenyl-d14	%REC	SW8270D	0.0896	0.08000		112	10-199				11/4/2011 1943h

[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS VOC 110211B	1,1,1-Trichloroethane	mg/L	SW8260C	0.0188	0.02000	0	94.0	49.9-140				11/2/2011 2219h
LCS VOC 110211B	1,1-Dichloroethene	mg/L	SW8260C	0.0166	0.02000	0	82.8	46-171				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichlorobenzene	mg/L	SW8260C	0.0183	0.02000	0	91.4	67-135				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichloroethane	mg/L	SW8260C	0.0174	0.02000	0	86.9	60-137				11/2/2011 2219h
LCS VOC 110211B	1,2-Dichloropropane	mg/L	SW8260C	0.0178	0.02000	0	88.8	59-135				11/2/2011 2219h
LCS VOC 110211B	Benzene	mg/L	SW8260C	0.0186	0.02000	0	93.1	62-127				11/2/2011 2219h
LCS VOC 110211B	Chlorobenzene	mg/L	SW8260C	0.0189	0.02000	0	94.5	63-140				11/2/2011 2219h
LCS VOC 110211B	Chloroform	mg/L	SW8260C	0.0175	0.02000	0	87.4	67-132				11/2/2011 2219h
LCS VOC 110211B	Ethylbenzene	mg/L	SW8260C	0.0190	0.02000	0	94.8	55-133				11/2/2011 2219h
LCS VOC 110211B	Isopropylbenzene	mg/L	SW8260C	0.0199	0.02000	0	99.5	60-147				11/2/2011 2219h
LCS VOC 110211B	Methyl tert-butyl ether	mg/L	SW8260C	0.0179	0.02000	0	89.4	37-189				11/2/2011 2219h
LCS VOC 110211B	Methylene chloride	mg/L	SW8260C	0.0181	0.02000	0	90.4	57-162				11/2/2011 2219h
LCS VOC 110211B	Naphthalene	mg/L	SW8260C	0.0154	0.02000	0	77.0	28-136				11/2/2011 2219h
LCS VOC 110211B	Tetrahydrofuran	mg/L	SW8260C	0.0164	0.02000	0	81.9	43-146				11/2/2011 2219h
LCS VOC 110211B	Toluene	mg/L	SW8260C	0.0190	0.02000	0	95.1	67-128				11/2/2011 2219h
LCS VOC 110211B	Trichloroethene	mg/L	SW8260C	0.0183	0.02000	0	91.6	54-152				11/2/2011 2219h
LCS VOC 110211B	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0476	0.05000		95.2	69-132				11/2/2011 2219h
LCS VOC 110211B	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0484	0.05000		96.7	85-118				11/2/2011 2219h
LCS VOC 110211B	Surr: Dibromofluoromethane	%REC	SW8260C	0.0465	0.05000		93.0	80-120				11/2/2011 2219h
LCS VOC 110211B	Surr: Toluene-d8	%REC	SW8260C	0.0516	0.05000		103	81-120				11/2/2011 2219h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	2-Butanone	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	2-Hexanone	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acetone	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Acetonitrile	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acrolein	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Allyl chloride	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Benzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Bromobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromoform	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Bromomethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	Butyl acetate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloroethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloroform	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Chloromethane	mg/L	SW8260C	< 0.00300				-				11/2/2011 2304h
MB VOC 110211B	Chloroprene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Cyclohexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Dibromomethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Ethyl ether	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Iodomethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				11/2/2011 2304h
MB VOC 110211B	Isopropyl acetate	mg/L	SW8260C	< 0.0200				-				11/2/2011 2304h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	Isopropyl alcohol	mg/L	SW8260C	< 0.0250				-				11/2/2011 2304h
MB VOC 110211B	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	m,p-Xylene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methylcyclohexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Methylene chloride	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Amyl acetate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Naphthalene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Butyl alcohol	mg/L	SW8260C	< 0.0500				-				11/2/2011 2304h
MB VOC 110211B	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Hexane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Octane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	o-Xylene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				11/2/2011 2304h
MB VOC 110211B	Propionitrile	mg/L	SW8260C	< 0.0250				-				11/2/2011 2304h
MB VOC 110211B	Propyl acetate	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Styrene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				11/2/2011 2304h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 110211B	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Toluene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Trichloroethene	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				11/2/2011 2304h
MB VOC 110211B	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				11/2/2011 2304h
MB VOC 110211B	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				11/2/2011 2304h
MB VOC 110211B	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0493	0.05000		98.7	69-132				11/2/2011 2304h
MB VOC 110211B	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0499	0.05000		99.8	85-118				11/2/2011 2304h
MB VOC 110211B	Surr: Dibromofluoromethane	%REC	SW8260C	0.0485	0.05000		97.0	80-120				11/2/2011 2304h
MB VOC 110211B	Surr: Toluene-d8	%REC	SW8260C	0.0520	0.05000		104	81-120				11/2/2011 2304h
MB-SPLP-15304	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	2-Butanone	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	2-Hexanone	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acetone	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Acetonitrile	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acrolein	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Allyl chloride	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Benzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Bromobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromoform	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Bromomethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Butyl acetate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloroethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloroform	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Chloromethane	mg/L	SW8260C	< 0.00300				-				11/3/2011 0413h
MB-SPLP-15304	Chloroprene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Cyclohexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Dibromomethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl ether	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Iodomethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				11/3/2011 0413h
MB-SPLP-15304	Isopropyl acetate	mg/L	SW8260C	< 0.0200				-				11/3/2011 0413h
MB-SPLP-15304	Isopropyl alcohol	mg/L	SW8260C	< 0.0250				-				11/3/2011 0413h
MB-SPLP-15304	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	m,p-Xylene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Methylcyclohexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

American West Analytical Laboratories

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	Methylene chloride	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Amyl acetate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Naphthalene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Butyl alcohol	mg/L	SW8260C	< 0.0500				-				11/3/2011 0413h
MB-SPLP-15304	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Hexane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Octane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	o-Xylene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				11/3/2011 0413h
MB-SPLP-15304	Propionitrile	mg/L	SW8260C	< 0.0250				-				11/3/2011 0413h
MB-SPLP-15304	Propyl acetate	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Styrene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				11/3/2011 0413h
MB-SPLP-15304	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Toluene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Trichloroethene	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-15304	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				11/3/2011 0413h
MB-SPLP-15304	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				11/3/2011 0413h
MB-SPLP-15304	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				11/3/2011 0413h
MB-SPLP-15304	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0552	0.05000		110	69-132				11/3/2011 0413h
MB-SPLP-15304	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0487	0.05000		97.5	85-118				11/3/2011 0413h
MB-SPLP-15304	Surr: Dibromofluoromethane	%REC	SW8260C	0.0495	0.05000		99.0	80-120				11/3/2011 0413h
MB-SPLP-15304	Surr: Toluene-d8	%REC	SW8260C	0.0504	0.05000		101	81-120				11/3/2011 0413h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1111038-005AMS	1,1,1-Trichloroethane	mg/L	SW8260C	0.0209	0.02000	0	104	67-147				11/3/2011 0307h
1111038-005AMS	1,1-Dichloroethene	mg/L	SW8260C	0.0159	0.02000	0	79.3	51-152				11/3/2011 0307h
1111038-005AMS	1,2-Dichlorobenzene	mg/L	SW8260C	0.0185	0.02000	0	92.6	70-130				11/3/2011 0307h
1111038-005AMS	1,2-Dichloroethane	mg/L	SW8260C	0.0203	0.02000	0	101	39-162				11/3/2011 0307h
1111038-005AMS	1,2-Dichloropropane	mg/L	SW8260C	0.0195	0.02000	0	97.5	59-135				11/3/2011 0307h
1111038-005AMS	Benzene	mg/L	SW8260C	0.0197	0.02000	0	98.6	66-145				11/3/2011 0307h
1111038-005AMS	Chlorobenzene	mg/L	SW8260C	0.0183	0.02000	0	91.7	63-140				11/3/2011 0307h
1111038-005AMS	Chloroform	mg/L	SW8260C	0.0183	0.02000	0	91.6	50-146				11/3/2011 0307h
1111038-005AMS	Ethylbenzene	mg/L	SW8260C	0.0183	0.02000	0	91.4	69-133				11/3/2011 0307h
1111038-005AMS	Isopropylbenzene	mg/L	SW8260C	0.0194	0.02000	0	97.1	60-147				11/3/2011 0307h
1111038-005AMS	Methyl tert-butyl ether	mg/L	SW8260C	0.0184	0.02000	0	91.9	37-189				11/3/2011 0307h
1111038-005AMS	Methylene chloride	mg/L	SW8260C	0.0196	0.02000	0	98.2	55-176				11/3/2011 0307h
1111038-005AMS	Naphthalene	mg/L	SW8260C	0.0147	0.02000	0	73.6	41-131				11/3/2011 0307h
1111038-005AMS	Tetrahydrofuran	mg/L	SW8260C	0.0213	0.02000	0	107	43-146				11/3/2011 0307h
1111038-005AMS	Toluene	mg/L	SW8260C	0.0182	0.02000	0	91.0	18-192				11/3/2011 0307h
1111038-005AMS	Trichloroethene	mg/L	SW8260C	0.0182	0.02000	0	91.0	61-153				11/3/2011 0307h
1111038-005AMS	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0549	0.05000		110	77-144				11/3/2011 0307h
1111038-005AMS	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0463	0.05000		92.6	80-123				11/3/2011 0307h
1111038-005AMS	Surr: Dibromofluoromethane	%REC	SW8260C	0.0482	0.05000		96.3	80-124				11/3/2011 0307h
1111038-005AMS	Surr: Toluene-d8	%REC	SW8260C	0.0485	0.05000		97.1	80-125				11/3/2011 0307h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
Project: Red Leaf ECOSHALE / 01109-013

Contact: John Wallace
Dept: MSVOA
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1111038-005AMSD	1,1,1-Trichloroethane	mg/L	SW8260C	0.0212	0.02000	0	106	67-147	1.38	25		11/3/2011 0329h
1111038-005AMSD	1,1-Dichloroethene	mg/L	SW8260C	0.0174	0.02000	0	87.2	51-152	9.55	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichlorobenzene	mg/L	SW8260C	0.0186	0.02000	0	93.0	70-130	0.485	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichloroethane	mg/L	SW8260C	0.0203	0.02000	0	102	39-162	0.0985	25		11/3/2011 0329h
1111038-005AMSD	1,2-Dichloropropane	mg/L	SW8260C	0.0200	0.02000	0	99.8	59-135	2.33	25		11/3/2011 0329h
1111038-005AMSD	Benzene	mg/L	SW8260C	0.0203	0.02000	0	102	66-145	2.85	25		11/3/2011 0329h
1111038-005AMSD	Chlorobenzene	mg/L	SW8260C	0.0188	0.02000	0	94.0	63-140	2.42	25		11/3/2011 0329h
1111038-005AMSD	Chloroform	mg/L	SW8260C	0.0188	0.02000	0	93.9	50-146	2.53	25		11/3/2011 0329h
1111038-005AMSD	Ethylbenzene	mg/L	SW8260C	0.0190	0.02000	0	94.8	69-133	3.65	25		11/3/2011 0329h
1111038-005AMSD	Isopropylbenzene	mg/L	SW8260C	0.0198	0.02000	0	99.1	60-147	2.04	25		11/3/2011 0329h
1111038-005AMSD	Methyl tert-butyl ether	mg/L	SW8260C	0.0187	0.02000	0	93.7	37-189	1.94	25		11/3/2011 0329h
1111038-005AMSD	Methylene chloride	mg/L	SW8260C	0.0214	0.02000	0	107	55-176	8.81	25		11/3/2011 0329h
1111038-005AMSD	Naphthalene	mg/L	SW8260C	0.0149	0.02000	0	74.5	41-131	1.28	25		11/3/2011 0329h
1111038-005AMSD	Tetrahydrofuran	mg/L	SW8260C	0.0215	0.02000	0	108	43-146	0.841	25		11/3/2011 0329h
1111038-005AMSD	Toluene	mg/L	SW8260C	0.0188	0.02000	0	94.2	18-192	3.51	25		11/3/2011 0329h
1111038-005AMSD	Trichloroethene	mg/L	SW8260C	0.0185	0.02000	0	92.3	61-153	1.47	25		11/3/2011 0329h
1111038-005AMSD	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0550	0.05000		110	77-144				11/3/2011 0329h
1111038-005AMSD	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0474	0.05000		94.9	80-123				11/3/2011 0329h
1111038-005AMSD	Surr: Dibromofluoromethane	%REC	SW8260C	0.0492	0.05000		98.3	80-124				11/3/2011 0329h
1111038-005AMSD	Surr: Toluene-d8	%REC	SW8260C	0.0491	0.05000		98.2	80-125				11/3/2011 0329h

Reissue of a previously generated report. Information has been added, updated, or revised. Information herein supersedes that of previously issued reports.

REVISED 10/31/11 TOC's sent out

American West Analytical Laboratories

WORK ORDER Summary

Work Order: 1110545

 10/31/2011

Client: IGES

Client ID: IGE100 **Contact:** John Wallace

Project: Red Leaf ECOSHALE / 01109-013 **QC Level:** LEVEL I **WO Type:** Standard

Comments: 3 Day Rush - see instructions of where report is to be sent. DO NOT send report to IGES, invoice only. All work is to be done on the SPLP leachate. / 10-31-11 TOC's sent out, instrument problems.;

el

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-001A	R11-122 #1	10/27/2011 0930h	10/27/2011 1346h	11/1/2011	Solid	1312LM-PR	☐	TCLPFridge	1
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
1110545-002A	R11-122 #2	10/27/2011 0935h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Work Order: **1110545**

Client: IGES

 10/31/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-002A	R11-122 #2	10/27/2011 0935h	10/27/2011 1346h	11/1/2011	Solid	3510-SVOA-TCLP-PR	☐	TCLPFridge	1
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
1110545-003A	R11-122 #3	10/27/2011 0940h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	

WORK ORDER Summary

Work Order: **1110545**

Client: IGES

 10/31/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-003A	R11-122 #3	10/27/2011 0940h	10/27/2011 1346h	11/1/2011	Solid	HG-SPLP-7470A	☐	TCLPFridge	1
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						OUTSIDE LAB	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	

American West Analytical Laboratories

RUSH

WORK ORDER Summary

Work Order: 1110545
 10/28/2011

Client: IGES

Client ID: IGE100 **Contact:** John Wallace

Project: Red Leaf ECOSHALE / 01109-013 **QC Level:** LEVEL I +SPLP **WO Type:** Standard

Comments: 3 Day Rush - see instructions of where report is to be sent. DO NOT send report to IGES, invoice only. All work is to be done on the SPLP leachate.;

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-001A	R11-122 #1	10/27/2011 0930h	10/27/2011 1346h	11/1/2011	Solid	1312LM-PR	☐	TCLPFridge	1
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	
1110545-002A	R11-122 #2	10/27/2011 0935h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Client: IGES

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-002A	R11-122 #2	10/27/2011 0935h	10/27/2011 1346h	11/1/2011	Solid	6010C-SPLP	☑	TCLPFridge	1
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	
						NO2/NO3-W-353.2	☐	TCLPFridge	
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	
1110545-003A	R11-122 #3	10/27/2011 0940h				1312LM-PR	☐	TCLPFridge	
						1312LO-PR	☐	TCLPFridge	
						1312ZHE-PR	☐	TCLPFridge	
						3005A-SPLP-PR	☐	TCLPFridge	
						3510-SVOA-TCLP-PR	☐	TCLPFridge	
						6010C-SPLP	☑	TCLPFridge	
	SEL Analytes: B CA CR FE MG MO K NA SN V								
						6020-SPLP	☑	TCLPFridge	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG SR TL ZN								
						8260-W-SPLP	☑	TCLPFridge	
						8270-W-SPLP	☑	TCLPFridge	
						ALK-W-2320B	☑	TCLPFridge	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	TCLPFridge	
						F-W-4500FC	☐	TCLPFridge	
						HG-SPLP-7470A	☐	TCLPFridge	
						HG-SPLP-PR	☐	TCLPFridge	

WORK ORDER Summary

Client: IGES

10/28/2011

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1110545-003A	R11-122 #3	10/27/2011 0940h	10/27/2011 1346h	11/1/2011	Solid	NO2/NO3-W-353.2	☐	TCLPFridge	1
						OGB-W-1664A	☐	TCLPFridge	
						PH-4500H+B	☐	TCLPFridge	
						SO4-W-4500SO4E	☐	TCLPFridge	
						TDS-W-2540C	☐	TCLPFridge	
						TOC-W-5310B	☐	TCLPFridge	

Client IGES, Inc
Address 4153 Commerce Dr
SLC (City) UT (State) 84107 (Zip)
Phone 801-270-9400 Fax 801-270-9401
Contact John Wallace
E-mail johnw@igesinc.com
Project Name Redleaf ECOSHALE
Project Number/P.O.# 01109-013
Sampler Name J. Wallace

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115
(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email:awal@awal-labs.com

CHAIN OF CUSTODY

Lab Sample Set # 1110545
Page ______ of ______

Turn Around Time (Circle One)
1 day 2 day 3 day 4 day 5 day Standard

Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	TESTS REQUIRED	QC LEVEL 1 2 2+ 3 3+ 4 COMMENTS
R11-122 #1	10/27/11 0930		1	SEE ATTACHED MEMO	
R11-122 #2	10/27/11 0935		1		
R11-122 #3	10/27/11 0940		1		

EMAIL RESULTS TO Jim Holtcamp PER MEMO

Relinquished By: Signature	Date	Received By: Signature	Date
John F. Wallace	10/27/11	Elma Hoyland	10/27/11
PRINT NAME John F. Wallace	Time 1346	PRINT NAME Elma Hoyland	Time 1346
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time

Special Instructions:

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes: on ice
3 Temperature 10°
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes:
5 Properly Preserved
Y N
Checked at Bench
Y N
Notes:
6 Received Within Holding Times
Y N
Notes:

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

Memo

IGES®
4153 South 300 West
Salt Lake City, UT 84107
(801) 270-9400 Telephone
(801) 270-9401 FAX

Attention:	Info:	File: 01109-013
Pat Noteboom - AWAL		Redleaf SPLP Testing

From: John F. Wallace, P.E.
Date: October 27, 2011
Subject: SPLP Testing Requirements

Pat,

Please find accompanying this request, 3 samples identified as R11-122 210 day run #1, 2 & 3. Please perform the following tests on each of the samples in accordance with all applicable EPA methods. Samples were taken the morning of 10/27/11 between 9:30 and 10:00 am as indicated on the accompanying COC.

SPLP analyses as follows-
Three discrete samples will be developed for Synthetic Precipitation Leaching Procedure analysis (SPLP, EPA Method 1312). As requested by the State WQD, leachate developed from each of the three samples tested will be analyzed for the following suite of constituents:

- General Chemistry: pH, total dissolved solids (TDS), major ions including Ca, Cl, K, Mg, Na, SO_4 and alkalinity;
- Organics: total organic carbon, oil and grease, volatile organic compounds (Complete VOC List) and semi-volatile organic compounds (Complete SVOC List);
- Metals: Ag, As, B, Ba, Be, Cd, Cr, Cu, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sn, Tl(Thalium), V, Zn; and * *Fluoride * * *
- Miscellaneous: Nitrate + nitrite, ~~fluorine~~ and strontium

Results will be directed to Mr. James Holtcamp, Esq. in order to maintain attorney client privilege for the data at the following:

Holland & Hart, LLP
60 East South Temple, Suite 2000
Salt Lake City, UT 84111 Ph – 801-799-5847 Email – jholtcamp@hollandhart.com

Please rush testing so that results will be available by next Wednesday 11/2/11. As always, call with any questions.
Regards,

Li not on lists —

APPENDIX H

RECLAMATION COVER PERFORMANCE MODELING

NORWEST
CORPORATION

950 South Cherry Street, Suite 800
Denver, CO 80246
Tel: (303) 782-0164 Fax: (303) 782-2560

MEMORANDUM

To:	The Oil Mining Company Inc.	**Ref #**	228-6-3
CC:		**Date:**	December 3, 2014
From:	Norwest Corporation		
Subject:	Addendum to Reclamation Cover Performance Modeling Report		

Norwest Corporation (Norwest) submitted the Reclamation Cover Performance Modeling Report (report) to The Oil Mining Company Inc. on February 6, 2014. The report discussed the modeled performance of the designed cap for the EPS capsule using the Hydrologic Evaluation of Landfill Performance (HELP) model. The modeled capsule geometry of 385 ft wide and 695 ft long with 61 ft of spent oil shale ore was consistent with the EPS capsule design at the time the modeling was done. The capsule design has progressed, and this addendum discusses the potential for changes in the modeled cover performance using the revised capsule geometry of 360 ft wide and 705 ft long with 90 to 102 ft of spent oil shale ore.

The modeled drainage length for the coarse material drainage layer (Layer 3) was set to the longest south to north dimension of the capsule at 695 ft, to be conservative. Increasing this dimension to 705 ft is a change of approximately 1.4%. This minor increase in flow path length is expected to have a negligible effect on modeled lateral drainage through the gravel layer, and Norwest expects the modeled average annual lateral drainage to remain at approximately 0.043 inches per year.

The focus of the HELP model work was to evaluate the representative performance of the capsule cover as designed. The report presented an average annual total modeled percolation through the BAS cap (Layer 4) and into the capsule over a 100 year model run. The entirety of the spent oil shale ore is located below the BAS cap, and a revised spent ore thickness of up to 102 ft will not impact modeled percolation through the cap. Modeled average annual percolation through the BAS cap is expected to remain at 0.070 inches per year.

RECLAMATION COVER PERFORMANCE MODELING

THE OIL MINING COMPANY INC. (TOMCO)

Submitted to:
TOMCO

February 6, 2014

Norwest Corporation
950 So. Cherry St., Suite 800
Denver, Colorado 80246
Tel: (303) 782-0164
Fax: (303) 782-2560

www.norwestcorp.com

NORWEST CORPORATION

NORWEST
CORPORATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

1 BACKGROUND

The Oil Mining Company, Inc. (TomCo) holds an oil shale mineral lease on roughly 1,200 acres in the Uintah Basin in an area called the "Holliday Block". TomCo proposes to develop oil shale mining and processing operations in this area using Red Leaf Resources' (RLR's) Eco-Shale Mining process which TomCo has a contractual agreement to use. The Eco-Shale process uses heat to extract kerogen deposits from sedimentary shale deposits. The proposed mining process consists of the simultaneous mining of the oil shale and the creation of heating capsules.

The Eco-Shale process is being demonstrated and tested using a single Early Production System (EPS) capsule at the site. The EPS capsule will have dimensions of 385 feet wide and 695 feet long. Once enough overburden and ore are removed from the mine to create a capsule, a liner of Bentonite Amended Soil (BAS) – made from fines available on site, bentonite, and water is placed on the bottom of the capsule site. The BAS layer surrounds the capsule interior to prevent impacts to groundwater and the surrounding ecosystem. The BAS walls are built up as the inside layers of the capsule is constructed. Within the capsule, from the ground up, is a layer of gravel insulation, followed a collection pan and pipes. The mined ore is placed above the collection pipes, followed by a series of heating pipes to heat the material to extract the kerogen. The mined ore and heating pipes are incrementally stacked on top of each other in the heating capsules. The heating rods heat the material to volatize the kerogen deposits into gas and liquefy the kerogen into a solution which flows through the collection pipes to a central location to eventually undergo further processing. Above the ore, a second layer of gravel insulation is applied, followed by a cap layer of BAS and a layer of coarse, high-permeability gravel or run of mine (ROM) material.

The Eco-Shale process includes a capsule reclamation phase once the kerogen liquid and gas deposits are extracted and the EPS capsule cools. The final cover on the capsules consists of a BAS cap overlain by a layer of coarse overburden, 2 feet of crushed fines, 6 inches of Plant Growth Material (PGM), and a native seed mix designed to result in a vegetated soil layer. This is a common form of a closure cap designed to minimize the potential for infiltration into the capsules with precipitation running off of the cap, being removed by evapotranspiration (ET) from the vegetated cover, or horizontally drained through the coarse overburden layer.

The performance of the designed cap for the EPS capsule was evaluated using the Hydrologic Evaluation of Landfill Performance (HELP) model V 3.07[1] (Schroeder et al., 1994). The HELP model is widely used in evaluating landfill cap and liner performance. The EPS capsule cap was modeled as designed, with the cap design being described more fully in the application. This text describes the assumptions and limitations of the HELP model code, summarizes the pertinent features of the capsule design, the parameters needed for the HELP model, the basis for the parameters used, and the model results.

[1] Available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill

2 ASSUMPTIONS AND LIMITATIONS OF THE HELP MODEL CODE

The HELP model code is documented with both a User's Guide[2] (guide) and Engineering Documentation[3] (documentation). It is important to note that the purpose of the modeling was to evaluate the representative performance of the **capsule cover as designed**.

Section 5 of the model documentation details the assumptions and limitations of the model code. This section is included as Attachment 1 of this report. Particularly relevant assumptions and limitations for this modeling include:

1. The program assumes Darcian flow for vertical drainage through homogeneous and temporally uniform model layers.
2. Any soil barrier layer is considered fully saturated at all times with leakage occurring when the soil moisture of the layer above the barrier layer is greater than the field capacity.
3. The code can simulate water routing through or storage in up to twenty layers for a period of 1 to 100 years.
4. The initial soil moisture content cannot be greater than the porosity or less than the wilting point.
5. Program default initial moisture of layers below the top liner system or cover system are generally specified too high for arid and semi-arid locations and too low for very wet locations, particularly when thick profiles are being modeled.
6. The program performs water balance analysis for a minimum period of one year. All simulations start on January 1 and end on December 31. The conditions of the landfill, cap, soil properties, layer thicknesses, maximum level of vegetation, etc., are assumed to be constant throughout the simulation period.

[2] "The Hydrologic Evaluation of Landfill Performance (HELP) Model – User's Guide for Version 3"
[3] "The Hydrologic Evaluation of Landfill Performance (HELP) Model – Engineering Documentation for Version 3"

3 CLOSED CAPSULE SIZE AND DESCRIPTION

The closed EPS capsule is 385 ft wide and 695 ft long with a surface area of approximately 6 acres over the BAS cap. The capsule has 9 layers with the upper four being the BAS cap, coarse overburden layer, crushed fines layer, and growth layer. The 9 layers are shown in Table 3-1.

TABLE 3-1
MODEL LAYERS

Model Layer	Represents	Thickness (feet)	Notes
1	Topsoil	0.5	Six inches of Plant Growth Material (PGM) from the site
2	Crushed fines layer	2	Finely crushed site material
3	Overburden layer	2	Coarse high permeability gravel or ROM material
4	BAS cap	3	Low permeability cap
5	Gravel insulation layer	13	High permeability
6	Spent ore layer	61	Spent oil shale
7	Gravel insulation layer	13	High permeability
8	Steel Plate	0.01	Oil collection system
9	BAS liner	3	Low permeability liner

The EPS capsule has a cap, sides, and liner consisting of BAS with an in situ permeability of $1x10^{-7}$ cm/sec or less. Model layers 4 and 9 are of this material. The gravel insulation layers will be higher conductivity material. The spent oil shale is represented with a moderate conductivity material. The BAS cap will be covered and protected with a 2 foot thick layer of coarse overburden material from the site which is model layer 3. The overburden will be overlain by 2 foot thick layer of finely crushed site material which is model layer 2 and a six inch (0.5 ft) thick layer of soil, otherwise known as plant growth material (PGM) which is model layer 1.

The PGM will be gathered during the stripping portion of site preparation with the soil being primarily a silty loam. The crushed fines layer will be 2 feet thick of finely crushed site material. The overburden layer will be a lift of 2 feet of coarse gravel or ROM material with a horizontal permeability equal to or greater than the gravel insulation layers. The cover will be compacted from equipment during the spreading operation. Compaction in the soil will be alleviated by scarification using ripper shanks on a grader.

4 CLIMATE DATA

The water budget for the capsule cap is strongly influenced by the weather regime and growing season at the site. There is a weather station with 15 or more years of data located approximately 14 miles SW (at N 39^{o} 42' 49" West 109^{o} 26' 46" with an elevation of 6,300 ft) from the site with a similar altitude and elevation as the TomCo EPS site which has a surface elevation in the 6,250 to 6,300 ft range This Upper Sand Wash (USW) RAWS meteorological station had a data analysis period of 15 years from June 1, 1995, to June 30, 2010 in the Hatch report for the RLR site[4]. The summary table of monthly and annual averages from the Hatch report is included as Attachment 2. Some meteorological quantities such as temperature had longer periods of record, but the data set was not complete for all of the quantities shown on Attachment 2.

Given the relatively short period of record for the USW site, Norwest decided to use the HELP model capabilities to generate a longer synthetic weather record as model input to better capture the anticipated long-term variability, especially for periods of higher precipitation. This longer synthetic weather record could be up to 100 years in length. Per the HELP documentation (p. 9), "This generating routine is designed to preserve the dependence in time, the correlation between variables, and the seasonal characteristics in actual weather data at the specified location. Coefficients for weather generation are available for up to 183 cities in the United States."

Three types of daily weather data are required as inputs for the HELP model:

a. Precipitation
b. Temperature
c. Solar Radiation

The HELP model calculates evapotranspiration from the daily weather data, state of the landfill cover, and other model inputs.

There are a number of cities with weather data available in the HELP model. The nearest cities to the TomCo site in the HELP model database are Grand Junction, CO, Salt Lake City UT, Pocatello ID, and Lander, WY. Norwest reviewed the available data from these four cities and compared the available data from the site and the nearby USW station.

The HELP model can generate from 1 to 100 years of data stochastically for selected locations using a synthetic weather generator. The program can improve the statistical characteristics of the resulting daily values by using site specific mean monthly values. Table 4-1 shows the general parameters for the four cities and the USW data.

[4] "Site Climatic Conditions for the Utah Oil Shale Commercial Demonstration Project" Hatch, August 9, 2010.

TABLE 4-1
GENERAL PARAMETERS

Parameter	TomCo (USW) Site	Pocatello, ID	Salt Lake City, UT	Grand Junction, CO	Lander, WY
Latitude (TomCo not USW)	39.80	42.55	40.76	39.07	42.8
Growing season start day	124	132	117	109	136
Growing season end day	243	275	289	293	272
Growing season length (days)	119	143	172	184	136
Average wind speed (mph)	4.9	10.2	8.8	8.1	6.9
First quarter relative humidity	59.8%	70.0%	67.0%	60.0%	60.0%
Second quarter relative humidity	37.6%	52.0%	48.0%	36.0%	50.0%
Third quarter relative humidity	37.2%	43.0%	39.0%	36.0%	41.0%
Fourth quarter relative humidity	55.2%	65.0%	65.0%	57.0%	59.0%
Elevation (not from HELP)	6,414	4,462	4,327	4,593	5,358
Maximum Leaf Area Index (LAI)	1.6	1.6	1.6	1.6	1.6

Norwest took the approach that the coefficients from the city that nearest matched the statistical characteristics of the data available near the site would be used in the synthetic weather generation for model input. Table 4-2 summarizes the primary daily weather data inputs needed for the HELP model and the basis for the data sets used. Precipitation, temperature, solar radiation, and evapotranspiration data are inputs required to develop the synthetic weather model. The basis for the data inputs and the coefficients chosen are described in more detail following the Table 4-2. USW parameters and default parameters for the four cities are shown in Tables 4-3 through 4-5.

Site specific data such as average monthly precipitation, site altitude, and site latitude were input within the HELP model to improve the generation of the synthetic weather record where it was possible. USW data for precipitation, temperature and relative humidity were used with the TOMCO site elevation and latitude in the generation of the synthetic data sets. This resulted in a synthetic weather record for use in the HELP model that was generated using the model available coefficients from different sites since different components of the USW weather record were better approximated by varied HELP sites. This honored the characteristics of the site data as closely as possible while creating a longer, more robust climatic data set. This longer data set enabled the testing of the designed cover against a data set containing a more representative spread of input values (for instance wetter years) than the available 15 year data set from the USW station. The specific parts of the synthetic weather record are discussed below.

TABLE 4-2
HELP MODEL WEATHER DATA INPUT SOURCES

Weather Data Input for HELP Model	Site Data	Coefficients used with Site Data to Generate HELP Model Inputs	Comments
Precipitation	USW Mean Monthly precipitation (from 15 year data summary by Hatch)	Grand Junction, CO	
Temperature	USW Mean Monthly precipitation (from 15 year data summary by Hatch)	Pocatello, ID	
Solar Radiation	TomCo site Latitude, HELP model generated synthetic precipitation data set	Pocatello, ID	A strong function of precipitation which was generated using the USW mean monthly precipitation. Sensitivity HELP model run done using Grand Junction, CO solar radiation coefficients.
Evapotranspiration	TomCo site latitude and elevation. USW average wind speed, relative humidity. Growing season length from City of Vernal, Utah.	Function of previous 3 weather data sets and model state.	Used listed site data plus the synthetic precipitation, temperature, and solar radiation. Did sensitivity run using growing season calculated from USW temperature record.

4.1 PRECIPITATION

The synthetic precipitation generator was used to create the daily precipitation values used in the HELP modeling, given the limited record of precipitation data available. The HELP documentation states (p. 16):

> ***"Synthetic Precipitation Option*** *(Customary or Metric Units)*. The program will generate from 1 to 100 years of daily precipitation data stochastically for the selected location using a synthetic weather generator. The precipitation data will have approximately the same statistical characteristics as the historic data at the selected location. If desired, the user can enter normal mean monthly precipitation values for the specific location to improve the statistical characteristics of the resulting daily values. The user is advised to enter normal mean monthly precipitation values if the project site is located more than a few miles from the city selected from Table 4-2 or if the land use or topography varies between the site and city. The daily values will vary from month to month and from year to year and will not equal the normal values

entered. The same data is produced every time the option is used for a given location. The data required by the synthetic weather generator are:

- Location (select from a list of 139 U.S. cities in Table 4-2)
- Number of years of data to be generated
- Normal mean monthly precipitation (Optional, default values are available.)"

The site is located more than a few miles from the nearest HELP model cities. Therefore, the site mean monthly precipitation was compared to the available cities as shown in Table 4-3. The closest match for the precipitation volumes and pattern of lower winter precipitation and higher precipitation in late summer was judged to be Grand Junction, Colorado. Grand Junction also provides the closest match for relative humidity for the four quarters with an average difference of 0.2% and a maximum difference of -1.8% for the fourth quarter.

TABLE 4-3
MEAN MONTHLY PRECIPITATION (INCHES)

Month	TomCo (USW) Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO
January	0.3	1.13	1.35	0.64
February	0.4	0.86	1.33	0.54
March	0.6	0.94	1.72	0.75
April	0.9	1.16	2.21	0.71
May	0.6	1.2	1.47	0.76
June	0.8	1.06	0.97	0.44
July	0.7	0.47	0.72	0.47
August	1.3	0.6	0.92	0.91
September	1.6	0.65	0.89	0.7
October	1.1	0.92	1.14	0.87
November	0.4	0.91	1.22	0.63
December	0.3	0.96	1.37	0.58
Total	9.0	10.86	15.31	8.00

1. Lander, WY monthly precipitation data not available in HELP model
2. TomCo site data from Upper Sand Wash station

Site specific values of mean monthly precipitation (following the HELP manual) were used with the Grand Junction, CO coefficients to generate 100 years of daily precipitation. Table 4-4 compares the synthetic mean monthly precipitation for the synthetic 100-year period to the data available from the USW station 15-year data set. This table shows the synthetic mean monthly precipitation closely approximating the site data with the 100-year record having approximately 2.2% more average annual precipitation than the site record. The standard deviation is also shown for each month and the annual average, showing the variation in the synthetic data set generated with the USW site data.

TABLE 4-4
MEAN MONTHLY PRECIPITATION – SITE AND MODEL

Month	TomCo (USW[1]) Site	HELP (100 yrs)	HELP STD Deviation
January	0.3	0.30	0.16
February	0.4	0.42	0.24
March	0.6	0.59	0.31
April	0.9	0.93	0.52
May	0.6	0.58	0.44
June	0.8	0.77	0.66
July	0.7	0.77	0.59
August	1.3	1.27	0.66
September	1.6	1.53	1.17
October	1.1	1.28	0.88
November	0.4	0.46	0.31
December	0.3	0.30	0.20
Total	9.0	9.20	1.91

1. TomCo site data from Upper Sand Wash station

The reasonably close match between the synthetic weather data and the best available site data (USW site) in both amount and timing indicates this synthetic precipitation data set is appropriate to use in the HELP modeling.

4.2 TEMPERATURE

The synthetic generator was used to create the daily temperature values used in the HELP modeling, given the limited record of temperature data available. The HELP documentation states (p. 19):

> ***"Synthetic Temperature Option*** *(Customary or Metric Units)*. The program will generate from 1 to 100 years of temperature data stochastically for the selected location. The synthetic generation of daily temperature values is a weak function of precipitation and as such the user must first specify the precipitation. Generation of temperature data is limited to the number of years of precipitation data available. The synthetic temperature data will have approximately the same statistical characteristics as the historic data at the selected location. If desired, the user can enter normal mean monthly temperature values for the specific location to improve the statistical characteristics of the resulting daily values. The user is advised to enter normal mean monthly temperature values if the project site is located more than 100 miles from the city selected from Table 3-1 or if the difference in elevation between the site and the city is more than 500 feet. The data required by the synthetic weather generator are:

- Location (select from a list of 183 U.S. cities in Table 3-1)
- Number of years of data to be generated
- Years of daily precipitation values
- Normal mean monthly temperature (Optional, default values are available.)"

The mean monthly temperature from the USW site is compared to available cities in Table 4-5. The nearest match for USW mean monthly temperatures was judged to be Pocatello, ID, with cold winters and maximum mean monthly temperatures in the low 70s during the summer as shown in Table 4-5. Site specific values of mean monthly temperature were used with the Pocatello, ID coefficients to generate 100 years of daily temperatures.

TABLE 4-5
MEAN MONTHLY TEMPERATURE (FAHRENHEIT)

Month	TomCo (USW[1]) Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO	Lander, WY
January	25.2	23.8	28.6	25.5	19.6
February	29.0	29.5	34.1	33.5	25.7
March	38.2	35.5	40.7	41.9	32.1
April	45.9	44.6	49.2	51.7	42.3
May	56.4	54.0	58.8	62.1	52.6
June	65.9	62.5	68.3	72.3	62.3
July	73.9	71.2	77.5	78.9	70.8
August	70.0	68.9	74.9	75.9	68.6
September	60.4	59.2	65.0	67.1	58.3
October	47.9	48.1	53.0	54.9	46.8
November	35.5	35.2	39.7	39.6	30.8
December	24.6	26.6	30.3	28.3	23.2
Mean Annual	47.7	46.6	51.7	52.6	44.4

1. TomCo site data from Upper Sand Wash station

4.3 SOLAR RADIATION

Given the limited record of solar data available, the synthetic generator was used to create the daily solar radiation values used in the HELP modeling. The HELP documentation states (p. 22):

> ***"Synthetic Solar Radiation Option*** *(Customary or Metric Units)*. The program will generate from 1 to 100 years of daily solar radiation data stochastically for the selected location. The synthetic generation of daily solar radiation values is a strong function of precipitation and as such the user must first specify the precipitation. Generation of solar radiation data is limited to the number of years of precipitation data available. The synthetic solar radiation data will have

approximately the same statistical characteristics as the historic data at the selected location. If desired, the user can enter the latitude for the specific location to improve the computation of potential solar radiation and the resulting daily values. The user is advised to enter the latitude if the project site is more than 50 miles north or south of the city selected from Table 3-1. The data required by the synthetic weather generator are:

- Location (select from a list of 183 U.S. cities in Table 3-1)
- Number of years of data to be generated
- Years of daily precipitation values
- Latitude (optional, default value is available.)"

The coefficients for Pocatello, Idaho were used. This was judged as a conservative choice based on the city being further north from the site with higher precipitation. The site latitude was used following the recommendation in the HELP documentation.

4.4 EVAPOTRANSPIRATION

The HELP model allows either default or manual entering of the necessary parameters for HELP to calculate evapotranspiration along with using the synthetic daily weather data for precipitation, temperature, and solar radiation. Since site specific data was available, the manual entry option was chosen.

Site specific values for evapotranspiration shown in Table 4-6 were used. The growing season for the Vernal area is listed as 119 days by the USBR Central Utah Project – Vernal Unit and Vernal Chamber of Commerce. The HELP documentation states the start of the growing season for grasses in the Julian date is when the normal mean daily temperature rises above 50 to 55 degrees Fahrenheit and ends when it falls below this range with cooler climates having a start and end at lower temperatures. Based on the site average monthly temperatures, higher late summer precipitation, and constrained by the 119 days the start of the growing season was set to June 1 (152) and ended September 28 (271). The evaporative zone depth was set to 36 inches for the reclaimed case with vegetation. The maximum leaf area index was set to 1.0 for the reclaimed case. The 1.0 represents poor grass stands and is less than the maximum LAI suggested by the HELP model based on the shorter growing season.

TABLE 4-6
GENERAL PARAMETERS

Parameter	TomCo (USW Site [1]	Notes
Latitude	39.80	TomCo site latitude
Growing season start day	152	Used months with highest average temperatures
Growing season end day	271	Calculated by adding the growing season length to the growing season start date
Growing season length (days)	119	From City of Vernal, Utah information
Average wind speed (mph)	4.9	USW site – average of 15 yr data set
First quarter relative humidity	59.8%	USW site – average of 15 yr data set
Second quarter relative humidity	37.6%	USW site – average of 15 yr data set
Third quarter relative humidity	37.2%	USW site – average of 15 yr data set
Fourth quarter relative humidity	55.2%	USW site – average of 15 yr data set
Elevation (not from HELP) (ft)	6,300	TomCo site elevation near EPS capsule
Maximum Leaf Area Index (LAI)	1.0	Poor stands of grass
Evaporative Zone Depth	36 inches	Top two model layers and the top 6 inches of the coarse material drainage layer above the BAS cap. HELP documentation guidance shows a maximum Evaporative depth of 48 inches

1. TomCo site data for latitude and elevation

The latitude and elevation are from the TomCo site location. The average wind speed and the relative humidity for each quarter are from the Upper Sand Wash station. The growing season length is from the website for Vernal, Utah with the start date chosen during the months with the highest daily average temperatures. The HELP documentation (p. 14) states: "Typically, the start of the growing season for grasses is the Julian date (day of the year) when the normal mean daily temperature rises above 50 to 55 degrees Fahrenheit. The growing season ends when the normal mean daily temperatures fall below 50 to 55 degrees Fahrenheit. In cooler climates the start and end would be at lower temperatures and in warmer climates at higher temperatures."

5 CAPSULE LAYERS AND PARAMETERS

The capsule cap has four elements as previously described. This section describes the layers in more detail, the associated HELP model parameters, and basis for the parameters used. Default HELP model parameters for the various soil characteristics were used when possible. The model parameters are summarized in Table 5-1.

The PGM is primarily silty loam from the site. The second layer is two feet of crushed fines from site material. For modeling purposes these were represented as silty sands with the fines layer being less permeable than the soil. The third layer is two feet of coarser gravel or ROM material which was represented as a gravel drainage layer. The capsule is being built sloping south to north and also sloping east to west from the capsule centerline. As a conservative assumption, the drainage length for the coarse material drainage layer was set to the longest south to north dimension of the capsule at 695 ft. The BAS layers were represented as barrier soils with low hydraulic conductivity. The gravel insulation layers were represented as permeable gravels. The spent ore layer was represented as a moderate permeability, finer material and the steel plate as an essentially impermeable membrane liner.

TABLE 5-1
MODEL PARAMETERS

Model Layer	Represents	Thickness (feet)	Soil Texture Number	Soil Texture Description	Total Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Initial Soil Water Content (vol/vol)	Saturated Hydraulic Conductivity (cm/sec)
1	Topsoil	0.5	5	silty sand	0.457	0.131	0.058	0.109	1.0×10^{-3}
2	Crushed fines layer	2	6	silty sand	0.453	0.190	0.085	0.092	7.2×10^{-4}
3	Gravel or ROM overburden layer	2	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
4	BAS cap	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}
5	Gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
6	Spent ore layer	61	10	clayey silt	0.398	0.244	0.136	0.136	1.2×10^{-4}
7	Gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
8	Steel plate	0.01	35	simulated as a membrane liner	0.000	0.000	0.000	0.000	1.0×10^{-13}
9	BAS liner	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}

6 MODEL EXECUTION AND RESULTS

The HELP model was run for 100 years for the anticipated climatic, soil, and design data to examine the potential cap performance. The model simulation was for a vegetated landfill cap as designed. This model was run using synthetic data sets described previously.

The model output is summarized in Table 6-1 which shows the average annual values and standard deviations over the 100 year model run. The HELP model was run to evaluate the potential for moisture penetration through the BAS layer into the capsule where it could have the potential to infiltrate the spent shale. The HELP model assumes that any soil barrier such as the BAS layer is at full saturation. Leakage is modeled as saturated Darcian flow and is assumed to occur only as long as there is head on the surface of the liner.

TABLE 6-1
MODEL RESULTS

	Average Annual Totals (inches) for Years 1 through 100					
Scenario	**Precipitation**	**Runoff**	**ET**	**Lateral Drainage**	**Percolation through BAS cap (Layer 4)**	**Average Head on BAS cap (Layer 4)**
Base Reclaimed Case	9.200	0.003	9.063	0.043	0.070	0.002
Standard Deviation of annual averages	1.906	0.009	1.616	0.116	0.122	0.004

The average annual total for percolation through the BAS cap and average head on the cap are shown in Table 6-1. This shows minimal head on the top of Layer 4 and average annual percolation through layer 4 of 0.070 inches per year for the reclaimed EPS capsule. The infiltration is a function of the precipitation and average head on layer 4. The lateral drainage through layer 3 is less than the predicted infiltration (0.043 inches/yr vs 0.070 inches/yr).

Based on these model results, the designed capsule cap and ET cover provides adequate control on infiltration into the capsule using the design parameters.

7 REFERENCES

Hatch, (2010). Site Climatic Conditions for Utah Oil Shale Commercial Demonstration Project.

Schroeder, P.R., Azia N.M., Lloyd, C.M., and Zappi, P.A. (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC. Available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill

ATTACHMENT 1
HELP MODEL LIMITATIONS AND ASSUMPTIONS FROM THE DOCUMENTATION

SECTION 5

ASSUMPTIONS AND LIMITATIONS

5.1 METHODS OF SOLUTION

The modeling procedures documented in the previous section are necessarily based on many simplifying assumptions. Most of these are stated in the sections documenting the individual procedures. Generally, these assumptions are reasonable and consistent with the objectives of the program when applied to standard landfill designs. However, some of these assumptions may not be reasonable for unusual designs. The major assumptions and limitations of the program are summarized below.

Precipitation on days when the mean air temperature is below freezing is assumed to occur as snow. Snowmelt is assumed to be a function of energy from air temperature, solar radiation and rainfall. Solar radiation effects are included in an empirical melt factor. In addition, groundmelt is assumed to occur at a constant rate of 0.5 mm/day as long as the ground is not frozen. Snow and snowmelt are subject to evaporation prior to runoff and infiltration. The program does not consider the effects of aspect angle or drifting in its accounting of snow behavior.

Prediction of frozen soil conditions is a simple, empirical routine based on antecedent air temperatures. Thaws are based on air temperatures and climate data. Soils while frozen are assumed to be sufficiently wet so as to impede infiltration and to promote runoff. Similarly, no evapotranspiration and drainage are permitted from the evaporative zone while frozen.

Runoff is computed using the SCS method based on daily amounts of rainfall and snowmelt. The program assumes that areas adjacent to the landfill do not drain onto the landfill. The time distribution of rainfall intensity is not considered. The program cannot be expected to give accurate estimates of runoff volumes for individual storm events on the basis of daily rainfall data. However, because the SCS rainfall-runoff relationship is based on considerable daily field data, long-term estimates of runoff should be reasonable. One would expect the SCS method to underestimate runoff from short duration, high intensity storms; larger curve numbers could be used to compensate if most of the precipitation is from short duration, high intensity storms. The SCS method does not explicitly consider the length and slope of the surface over which overland flow occurs; however, a routine based on a kinematic wave model was developed to account for surface slope and length.

Potential evapotranspiration is modeled by an energy-based Penman method. As applied, the program uses average quarterly relative humidity and average annual wind speed. It is assumed that these data yield representative monthly results. Similarly, the program assumes that the relative humidity is 100% on days when precipitation occurs. The program uses an albedo of 0.23 for soils and vegetation and 0.60 for snow. The actual evapotranspiration is a function of other data, also. The solar radiation and temperature data are often synthetically generated. The vegetation data is generated by a vegetative growth model. The evaporative zone depth is assumed to be constant throughout the simulation period. However, outside of the growing season, the actual depth of evapotranspiration is limited to the maximum depth of evaporation of soil water, which is a function of the soil saturated hydraulic conductivity.

Vegetative growth is based on a crop growth model. Growth is assumed to occur during the first 75% of the growing season based on heating units. Recommendations for the growing season are based primarily for summer grasses and assume that the growing season is that portion of the year when the temperature is above 50 to 55 °F. However, the user may specify a more appropriate growing season for different vegetation. The optimal growth temperature and the base temperature are based on a mixture of winter and summer perennial grasses. It is assumed that other vegetation have similar growth constraints and conditions. It is further assumed that the vegetation is not harvested.

The HELP program assumes Darcian flow for vertical drainage through homogeneous, temporally uniform soil and waste layers. It does not consider preferential flow through channels such as cracks, root holes or animal burrows. As such, the program will tend to overestimate the storage of water during the early part of the simulation and overestimate the time required for leachate to be generated. The effects of these limitations can be minimized by specifying a larger effective saturated hydraulic conductivity and a smaller field capacity. The program does increase the effective saturated hydraulic conductivity of default soils for vegetation effects.

Vertical drainage is assumed to be driven by gravity alone and is limited only by the saturated hydraulic conductivity and available storage of lower segments. If unrestricted, the vertical drainage rate out of a segment is assumed to equal the unsaturated hydraulic conductivity of the segment corresponding to its moisture content, provided that moisture content is greater than the field capacity or the soil suction of the segment is less than the suction of the segment directly below. The unsaturated hydraulic conductivity is computed by Campbell hydraulic equation using Brooks-Corey parameters. It is assumed that all materials conducting unsaturated vertical drainage have moisture retention characteristics that can be well represented by Brooks-Corey parameters and the Campbell equation. The pressure or soil suction gradient is ignored when applying the Campbell equation; therefore, the unsaturated drainage and velocity of the wetting front may be underestimated. This is more limiting for dry conditions in the lower portion of the landfill; the effects of this limitation can be reduced by specifying a larger saturated hydraulic conductivity. For steady-state conditions, this limitation has little or no effect.

The vertical drainage routine does not permit capillary rise of water from below the evaporative zone depth. Evapotranspiration is not modeled as capillary rise, but rather as a distributed extraction that emulates capillary rise. This is limiting for dry conditions where the storage of water to satisfy evaporative demand is critical and for designs where the depth to the liner is shallow. This limitation can be reduced by increasing the field capacity in the evaporative zone and the evaporative zone depth.

Percolation through soil liners is modeled by Darcy's law, assuming free drainage from the bottom of the liner. The liners are assumed to be saturated at all times, but leakage occurs only when the soil moisture of the layer above the liner is greater than the field capacity. The program assumes that an average hydraulic head can be computed from the soil moisture and that this head is applied over the entire surface of the liner. As such, when the liner is leaking, the entire liner is leaking at the same rate. The liners are assumed to be homogeneous and temporally uniform.

Leakage through geomembrane is modeled by a family of theoretical and empirical equations. In all cases, leakage is a function of hydraulic head. The program assumes that holes in the geomembrane are dispersed uniformly and that the average hydraulic head is representative of the head at the holes. The program further assumes that the holes are predominantly circular and consist of two sizes. Pinholes are assumed to be 1 mm in diameter while installation defects are assumed to have an cross-sectional area of 1 cm^2. It is assumed that holes of other shapes and sizes could be represented as some quantity of these characteristic defects. Leakage through holes in geomembranes is often restricted by an adjacent layer or soil or material termed the controlling soil layer. Materials having a saturated hydraulic conductivity greater than or equal to $1x10^{-1}$ cm/sec are considered to be a high permeability material; materials having a saturated hydraulic conductivity greater than or equal to $1x10^{-4}$ cm/sec but less than $1x10^{-1}$ cm/sec are considered to be a medium permeability material; and materials having a saturated hydraulic conductivity less than $1x10^{-4}$ cm/sec are considered to be a low permeability material. The program assumes that no aging of the liner occurs during a simulation.

The lateral drainage model is based on the assumption that the lateral drainage rate and average saturated depth relationship that exists for steady-state drainage also holds for unsteady drainage. This assumption is reasonable for leachate collection, particularly for closed landfills where drainage conditions should be fairly steady. Where drainage conditions are more variable, such as in the cover drainage system, the lateral drainage rate is underestimated when the saturated depth is building and overestimated when the depth is falling. Overall, this assumption causes the maximum depth to be slightly overestimated and the maximum drainage rate to be slightly underestimated. The long-term effect on the magnitude of the water balance components should be small. As with leakage or percolation through liners, the average saturated depth is computed from the gravity water and moisture retention properties of the drain layer and other layers when the drain layer is saturated. The program assumes that horizontal and vertical saturated hydraulic conductivity to be of similar magnitude and that the horizontal value is specified for lateral drainage layer.

Subsurface inflow is assumed to occur at a constant rate and to be uniformly distributed spatially throughout the layer, despite entering the side. This assumption causes a delay in its appearance in the leachate collection and more rapid achievement of steady-state moisture conditions. This limitation can be minimized by dividing the landfill into sections where inflow occurs and sections without inflow.

Leachate recirculation is assumed to be uniformly distributed throughout the layer by a manifold or distribution system. Leachate collected on one day for recirculation is distributed steadily throughout the following day.

5.2 LIMITS OF APPLICATION

The model can simulate water routing through or storage in up to twenty layers of soil, waste, geosynthetics or other materials for a period of 1 to 100 years. As many as five liner systems, either barrier soil, geomembrane or composite liners, can be used. The model has limits on the order that layers can be arranged in the landfill profile. Each layer must be described as being one of four operational types: vertical percolation, lateral drainage, barrier soil liner or geomembrane liner. The model does not permit a vertical percolation layer to be placed directly below a lateral drainage layer. A barrier soil liner may not be placed directly below another barrier soil liner. A geomembrane liner may not be placed directly below another geomembrane liner. Three or more liners, barrier soil or geomembrane, cannot be placed adjacent to each other. The top layer may not be a barrier soil or geomembrane liner. If a liner is not placed directly below the lowest lateral drainage layer, the lateral drainage layers in the lowest subprofile are treated by the model as vertical percolation layers. If a geomembrane liner is specified as the bottom layer, the soil or material above the liner is assumed to be the controlling soil layer. No other restrictions are placed on the order of the layers.

The lateral drainage equation was developed and tested for the expected range of hazardous waste landfill design specifications. The ranges examined for slope and maximum drainage length of the drainage layer were 0 or 30 percent and 25 to 2000 feet; however, the formulation of the equations indicates that the range of the slope could be extended readily to 50 percent and the length could be extended indefinitely.

Several relations must exist between the moisture retention properties of a material. The porosity, field capacity and wilting point can theoretically range from 0 to 1 in units of volume per volume, but the porosity must be greater than the field capacity, and the field capacity must be greater than the wilting point. The general relation between soil texture class and moisture retention properties is shown in Figure 2.

The initial soil moisture content cannot be greater than the porosity or less than the wilting point. If the initial moisture contents are initialized by the program, the moisture contents are set near the steady-state values. However, the moisture contents of layers below the top liner system or cover system are specified too high for arid and semi-arid locations and too low for very wet locations, particularly when thick profiles are being modeled.

Values for the maximum leaf area index may range from 0 for bare ground to 5.0 for an excellent stand of grass. Greater leaf area indices may be used but have little impact on the results. Detailed recommendations for leaf area indices and evaporative depths are given in the program. For numerical stability, the minimum evaporative zone depth should be at least 3 inches.

The program computes the evaporation coefficient for the cover soils based on their soil properties. The default values for the evaporation coefficient are based on experimental results reported by Ritchie (1972) and others. The model imposes upper and lower limits of 5.50 and 3.30 for the evaporation coefficient so as not to exceed the range of experimental data.

The program performs water balance analysis for a minimum period of one year. All simulations start on the January 1 and end on December 31. The condition of the landfill, soil properties, thicknesses, geomembrane hole density, maximum level of vegetation, etc., are assumed to be constant throughout the simulation period. The program cannot simulate the actual filling operation of an active landfill. Active landfills are modeled a year at a time, adding a yearly lift of material and updating the initial moisture of each layer for each year of simulation.

NORWEST
CORPORATION

ATTACHMENT 2
METEOROLOGICAL SUMMARY FOR USW STATION BY HATCH

Table 1.2 – Meteorological Summary for the Primary Reference station: Upper Sand Wash RAWS.

Meteorological Summary for Upper Sand Wash RAWS Station June 1995 - June 2010													
Meteorological Quantity	Annual/ Average	Monthly Averages											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Mean Wind Speed (m/s)	2.2	1.6	1.7	2.3	2.9	2.8	2.9	2.5	2.4	2.3	2.3	1.7	1.5
Average Mean Wind Speed (mph)	4.9	3.5	3.8	5.2	6.5	6.2	6.4	5.7	5.3	5.2	5.0	3.7	3.4
Average Mean Wind Direction (° True North)	216.4	216.3	219.5	223.5	217.8	233.1	222.6	215.1	203.3	207.3	210.7	212.3	215.1
Maximum Wind Gust (m/s)	30.4	22.8	24.14	38.84	37.1	32.19	39.17	36.61	36.66	42.89	35.76	39.79	35.76
Maximum Wind Gust (mph)	68.1	51.0	54.0	86.9	83.0	72.0	87.6	81.9	82.0	95.9	80.0	89.0	80.0
Average Temperature (° C)	8.8	-3.8	-1.7	3.4	7.7	13.6	18.8	23.3	21.1	15.8	8.8	1.9	-4.1
Average Temperature (° F)	47.8	25.2	29.0	38.2	45.9	56.4	65.9	73.9	70.0	60.4	47.9	35.5	24.6
Maximum Average Air Temperature (° C)	25.0	15.6	17.8	25.0	27.8	35.0	37.8	38.9	36.7	33.9	29.4	21.7	16.7
Maximum Average Air Temperature (° F)	76.9	60.0	64.0	77.0	82.0	95.0	100.0	102.0	98.0	93.0	85.0	71.0	62.0
Minimum Average Air Temperature (°C)	-9.3	-25.6	-21.7	-21.1	-13.9	-6.7	-3.9	5.0	2.8	-4.4	-10.6	-20.0	-26.7
Minimum Average Air Temperature (° F)	15.3	-14.0	-7.0	-6.0	7.0	20.0	25.0	41.0	37.0	24.0	13.0	-4.0	-16.0
Average Relative Humidity (%)	47.4	65.2	63.6	50.6	44.0	37.5	31.4	30.9	38.5	42.3	45.9	55.7	64.1
Minimum Average Relative Humidity (%)	11.1	21.87	20.4	10.6	7.13	6.53	4.81	4.87	7.47	7.07	8.47	15.53	19.8
Total Precipitation (mm)	225.8	7.7	9.4	15.1	22.0	16.4	21.1	18.5	31.8	41.6	27.4	9.9	6.5
Total Precipitation (Inches)	8.9	0.3	0.4	0.6	0.9	0.6	0.8	0.7	1.3	1.6	1.1	0.4	0.3

Note: Highlighted sections show absolute maximum or minimums for quantities of interest. For the full reference station data set see Appendix 1. The General Site Conditions Sheet is provided in Appendix 2.

APPENDIX I

ADDITIONAL EPS INFORMATION

Confidential Business Information

(Provided under separate cover)

APPENDIX J

MONITORING WELL FIELD EVALUATION, 2014

TOMCO HOLLIDAY BLOCK

REPORT OF INTERMEDIATE DEPTH WELL AQUIFER STRESS TESTS MW-01, MW-02, MW-03

OCTOBER 22–NOVEMBER 15, 2014

Prepared for:

TomCo Energy PLC
50 Jermyn Street
London SW1Y
United Kingdom

December 2014

Prepared by:

LOWHAM WALSH LLC
Engineering & Environmental Services

EXECUTIVE SUMMARY

The Oil Mining Company (TomCo) oil shale mining test project is located in the Uintah Basin, Utah, approximately 30 road miles south of Bonanza, Utah. TomCo holds a 1,186-acre oil shale lease located on land owned by the State of Utah School and Institutional Trust Lands Administration. TomCo plans to simultaneously mine oil shale and create an Early Production System retort capsule for extracting oil at this site. The proposed technology uses heat to extract kerogen from oil shale as gases and liquids. As part of the extraction process, the shale will be encapsulated and left in place, and the disturbance area will be reclaimed, with no impact on surface or groundwater resources expected.

To support the submission of a Groundwater Discharge Permit required by the State of Utah to develop the project, three monitoring wells were installed in October 2013 to a depth of 200 feet below ground surface. A fourth well was installed to 1,100 feet below ground surface, approximately 400 feet below the limits of mining. Because this report focuses on potential water resources within and near the mining horizon, this deep well is not the subject of this report so is not discussed further here. As part of the required data collection effort, aquifer stress testing was proposed for the three 200-foot wells to provide hydrogeologic data regarding the nature and extent groundwater resources at depths of up to 200 feet beneath the site. Testing included pump-drawdown tests followed by a recovery period of up to 8 days. Data collected included discharge and drawdown data, cumulative volumes pumped, water level recovery rates, and hydraulic properties estimation. These data are summarized in the TomCo Ground Water Discharge Permit Application, Section 9.

Water level measurements obtained 12 days after initial development activities were completed in each well are presented in Table 1. These water levels are compared to measurements made during October 2014, approximately one year later. As shown in Table 1, each well registered some amount of water level change since October 2013, probably reflecting the process of the well coming into equilibrium with the ambient head of the screened interval. The October 2014 water levels are therefore considered the best available representation of ambient conditions for the water-bearing zone in contact with the screen in each well.

Table 1. Water Level Measurements, 2013 versus 2014.

Monitoring Well	Depth to water, October 2013 (ft bgs)[1]	Depth to water, October 2014 (ft bgs)	Water Level Change (feet)
MW-01	175.3	173.69	+1.61
MW-02	180.3	181.85	-1.55
MW-03	180.7	190.03	-9.33

Key:
ft bgs = feet below ground surface
Note:
1. Water levels measured on 10/22/2103, 12 days after initial development was completed in each well.

The lack of significant head in each well suggests that substantial water bearing zones are not present beneath the TomCo project site. This conclusion is also supported by the diminished capacity of each well to transmit appreciable amounts of groundwater when pumped at low rates (generally 0.1 to 0.34 gallons per minute). Specific capacities ranged from a low of 0.02 gallons per minute per foot (gpm/ft) to a high of 0.05 gpm/ft, which reflects the efficiency of the well and suggests that the well screens are in contact with material of low permeability, or are affected by well skin.

An evaluation of the data included the use of analytic models to estimate values for transmissivity, which ranged from 6×10^{-3} square feet per day to 6×10^{-2} square feet per day, and assumed unconfined conditions. By the assumption that the wetted screen length represented the aquifer thickness, estimates of hydraulic conductivities ranged from a low of 2×10^{-4} feet per day to a high of 7×10^{-3} feet per day. These values are consistent with published values representative of silt, clayey sand, or silty sand.

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
DWQ	Utah Division of Water Quality
ft btoc	feet below top of casing
ft/min	feet per minute
gpm	gallons per minute
gpm/ft	gallons per minute per foot
GWDPA	Ground Water Discharge Permit Application
psi	pounds per square inch
r_c	well effective radius
s_w	well skin factor
TomCo	`The Oil Mining Company, Inc.

1 INTRODUCTION

Hydrogeological data are required for the purposes of developing a Groundwater Discharge Permit (GDP) submitted to the State of Utah. Three, two-inch diameter wells were completed at The Oil Mining Company's (TomCo's) Holliday Block lease to a depth of 200 ft. below ground surface (bgs) in October 2013. Well construction data are tabulated in Table 2.

Table 2. Summary of Well Construction Parameters.

Well ID	Borehole Depth (ft bgs)	Screen Interval (ft bgs)	Bore-hole Diam. (inches)	Inner Casing Diam. (inches)	Volume per lineal feet (gal/ft)	Outer Casing Stickup (ft ags)	Inner Casing Stickup (ft ags)	Water Level Oct 2013 (ft btoc)[1]	Water Level Oct 2014 (ft btoc)
MW-01	200	148–198	6.25	2	0.163	2.26	1.71	177.01	175.4
MW-02	200	148–198	6.25	2	0.163	2.13	1.85	182.15	183.7
MW-03	200	117.3–197.3	6.25	2	0.163	2.08	1.87	182.57	191.9

Key:
Diam. = diameter
ft ags = feet above ground surface
ft bgs = feet below ground surface
ft btoc = feet below top of casing
gal/ft = gallons per foot
Note:
1. Water levels measured 12 days after initial well development.

Water samples from the wells were collected and analyzed for a variety of parameters, and packer tests were performed. Data results were incorporated into the GWDPA that TomCo submitted to the Utah Division of Water Quality (DWQ) in January 2014. After reviewing the GWDPA, the DWQ requested that additional data be collected from the three intermediate wells to further characterize well drawdown and recharge in the proposed mining horizon.

In response to the DWQ's comments, TomCo's subcontractor, Lowham Walsh, conducted three single well aquifer stress tests. These tests were conducted as simple pump and recovery tests with the objective of estimating:

1. Total volume pumped (volume)
2. Well drawdown (length, feet)
3. Sustainable pump rate(s) (volume/time)
4. Rate of recovery (residual drawdown vs. time)

If possible, hydraulic properties, well efficiency, and aquifer drawdown will also be estimated. The workplan for these tests was predicated upon the ability of each well to sustain a constant pump rate at a quasi-stable value of drawdown. In practice, however, identification of sustainable pump rates was complicated by the depth to water and the ability of the equipment to sustain constant rates at such depths. Therefore, each well was pumped at whatever rate the pump could sustain for as long as measurable drawdown was available or until the pump could not overcome the pressure differential at some increased value of drawdown.

2 GENERAL TEST PROCEDURE

Each well was instrumented and tested over a two-day period, which included pump and transducer installation, overnight trend measurement, and pumping followed by at least a week of recovery. Table 3 summarizes pertinent dates, times, durations, and selected data associated with each test.

Table 3. Summary of Instrumentation Times, Test durations, Drawdown, and Recovery.

Well ID	Pump Installed	Test Start	Duration of Pumping (minutes)	Maximum Drawdown (feet)	Volume Pumped (gallons)	Recovery Duration (days)	Residual Drawdown (feet)
MW-02	1400 on 10/22/14	0930 on 10/23/14	78.24	11.42	6.8	8.1	9.24
MW-03	1530 on 10/22/14	1252 on 10/23/14	8.1	7.41	3.14	8	1.16
MW-01	1100 on 11/6/14	1105 on 11/7/2014	33.0	10.7	5.76	7.9	0.82

Three 1.75-inch diameter Geotech GeoSub™ stainless steel submersible pumps were specified for the testing in the monitoring wells (Figure 1). In this model, the pump rate is determined by a relative power setting (0 to 255) controlled by an electronic controller at land surface. The pump controller has a built-in overcurrent prevention circuit that prevents the pump from damage from settings corresponding to an overly high rate for the pressure head the pump must overcome to lift water to land surface. The controller indicates when max power has been reached and prevents the user from increasing the output further. This proved to be problematic in selecting an appropriate initial rate without the overcurrent protection cutting power to the pump as each pump behaved differently due to initial water level, depth of placement, and individual idiosyncrasies associated with each pump.

The pump curve for this pump model is presented in Figure 2. Inspection of the pump curve indicates that at the depths deployed, this pump model was near, but not at, its limitations.

The transducer model selected for testing was an In-Situ Troll 700^{TM}, with a 30 pounds per square inch (psi) (69-foot) rating, which records pressure in psi, temperature in Celsius, and either depth below water level, or depth to water from a measurement point. In all cases, the transducer was programmed to record depth to water below the top of the 2-inch PVC casing.

Figure 1. Geotech Geosub™ Submersible Pump and Controller.

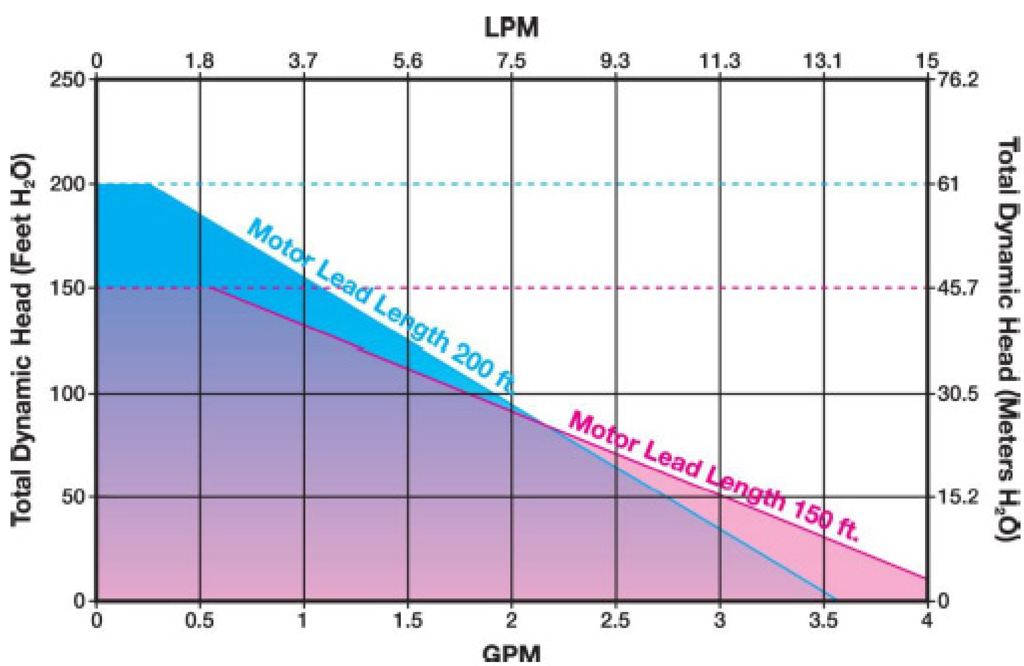


Figure 2. Geotech Geosub Pump Performance Chart.

Both the inner and outer casing stickup was measured in feet above ground surface (ags) to determine the desired pump placement and reference the transducer to depth to water below the top of the inner 2-inch casing.

Depth to water was determined manually upon arriving at the site using an In-Situ Rugged 200™ electronic water level tape, referenced to the top of the 2-inch PVC well casing. Once depth to water was determined, the height of the static water column was calculated by subtracting the depth to water bgs from the total depth of the well bgs.

The target depth for the bottom of the Geotech GeoSub™ stainless steel submersible pump was approximately equal to the bottom of the screen. This depth was determined by measuring out the appropriate length of discharge tubing and connecting one end of the tubing to the pump. The length of the pump from its bottom at the water intake point to the discharge tubing connection point was approximately 1.1 feet, which was taken into consideration when referencing the pump to top of casing. The pump was then lowered into the well, taping off the discharge tubing to the pump support cable every 10 feet or so. This was followed by the installation of the transducer, which was lowered into the well until positive pressure was registered in the log. This level was recorded, and the transducer was then further lowered until it contacted the pump or hung up on the pump-tubing coupling. The transducer was then pulled up several inches until its weight indicated that it was suspended in the well.

After the instrumentation was installed in each well, the water level increased per the displaced volume of water. A volume of displacement was calculated for each item placed in the well by determining the depth of placement, the radius of each item, and length of each item. A total volume in gallons was calculated, and the corresponding increase in water level was determined by dividing this volume by the volume per foot for 2-inch casing (0.163 gallons per foot).

The transducer was set up to log overnight to record water level trend, with an offset measured manually at the time the logging began. At the time pumping began the next day, water level change was judged to be stable enough to being testing, but in each case, there was several tenths of a foot of water of undissipated head left in the well at the time the pumping began. Just before pumping began, a new manual water level was obtained and used to set a new offset for depth to water as input into the transducer logging software. The pump was then set to an initial power setting and started.

At the time the pump initialization phase was completed and the pumping began, the transducer log was started simultaneously with a stopwatch to record splits for discharge measurements. Discharge was calculated between time splits measured for 1 gallon of water captured in a graduated bucket. This resulted in average discharge values for the time split rather than instantaneous discharge measurements, which could have only been achieved through the use of a high precision low-flow meter, which was not available. Because it was known from observation that discharge decreased over time, discharge estimates were made and added to the log to augment the average discharge measurements during the data reduction to better fit the analytical models used in curve-fitting procedure.

3 ANALYTICAL PROCEDURE

The general procedure for analysis of pumping and recovery data for all wells is described below. Exceptions to the procedure are discussed in the sections covering the results from the individual wells.

1. The data obtained during tested were downloaded from the transducer and imported into the Aqtesolv™ for hydrologic properties estimation.
2. The analytical model was selected based on the conceptual model that the screen interval was in contact with a water bearing zone under unconfined conditions. The model developed by Moench (1997) was selected based on its ability to consider well-bore storage and delayed gravity response.
3. As suggested by Duffield (2007), the data were first analyzed by the Papadopulos-Cooper (1967) method to acquire an initial estimate of transmissivity and evaluate well-bore storage by adjusting the effective casing radius value and performing a visual curve-fit.
4. Intermediate estimates of discharge rates were input into the software to augment the average discharge rates obtained from the bucket volume-stopwatch measurements. These rates were adjusted until the drawdown curve was approximated near the beginning of the test during the time at which insufficient pump rates were selected. Automatic curve matching was then employed using the Moench (1997) model to obtained an estimate of transmissivity.
5. A radial flow plot was then prepared to further evaluate the effect of radial flow (infinite-acting aquifer), well-bore storage, and the influence of a boundary condition such as recharge, leakage, or no-flow.
6. A derivative analysis was conducted to evaluate radial flow and infinite-acting aquifer conditions.

7. Recovery data were analyzed by preparing semi-log charts of residual drawdown (s') versus the ratio of time since pumping began (t) and time since pumping ceased (t'). A portion of the resulting curve was selected and fitted with a straight line. The residual drawdown corresponding to one log cycle was then determined and used the following equation to compute transmissivity:

$$T = \frac{2.303 * Q}{4\pi * \Delta s'}$$

8. Hydraulic conductivity was estimated by dividing the transmissivity by the length of the wetted well screen, which yields a generalized value because the true thickness of the water-bearing zone is unknown and because the likelihood of partial penetration cannot be reliably evaluated.

9. Estimates of the storage coefficient cannot be reliably obtained from single well tests due to the inability to determine effective radius and therefore are not reported herein.

The data collection and analytical results from each well are discussed in greater detail below.

MW-02 Test Summary

Data collected before and during the instrumentation process in MW-02 are presented in Table 4.

Table 4. MW-02 Test Parameters.

Water Level at Start (ft btoc)[1]	Height of Static Water Column (feet)[2]	Length of Wetted Screen (feet)	Pump Bottom (ft bgs)	Transducer Depth Below Water Level (feet)[3]	Volume Displaced by Downhole Equipment (gallons)	Undissipated Head at Time of Test Start (feet)[4]
183.4	18.45	16.45	198	11.85	1.71	0.3

Key:
ft btoc = feet below top of casing
ft bgs = feet below ground surface
Notes:
1. Water level shown is manually measured depth to water immediately before starting pump. The static water level measured the previous day before the well was instrumented was 183.7 ft btoc.
2. Referenced to total depth of well (200 ft bgs).
3. Value calculated from pressure measurement read immediately preceding the start of pumping.
4. This value represents the remaining increase in water level since the time the well was instrumented on 10/22/2014.

After lowering the pump to the prescribed depth and securing the suspension cable to the outer casing, the pump was powered up at approximately 9:30 AM on October 23, 2014. The initial pump power setting was left at the default of 100, which proved too low. After 10 minutes at this power setting, no water was observed at land surface and the power setting was then increased to 125. After another 10 minutes passed, the power setting was increased to 150.

This setting was maintained for 5 additional minutes, with no water produced to ground surface. The pump power setting was then again increased to values of 175, 200, and 225 at 5-minute increments, with no water observed at ground surface

After 5 minutes at a power setting of 225, the pump's power was increased to the maximum value of 255. Water appeared at ground surface about 40 seconds later, enabling discharge measurements to be made. A summary of pump settings and average discharge measurements made per gallon pumped is presented in Table 5.

As shown in Table 5, at about 75.5 minutes after pumping began, the pressure began to increase, signifying that the water level in the well was beginning to increase. This was due to the pump operating at the edge of its capability, as it could no longer pump water at a rate to continue drawdown. At this point, the transducer registered 0.122 psi, corresponding to a depth to water of 194.98 feet below the top of the casing (ft btoc), indicating about 0.28 feet of water was present above the transducer, close to dewatering the transducer sensor. Air was noticed in the discharge tubing shortly thereafter at about 77.5 minutes, and the test was terminated at 78.23 minutes.

The maximum observed drawdown from the transducer record of the pumping period was 11.59 feet.

Table 5. MW-02 Pump Setting and Discharge Measurements

Time Since Pumping Began (minutes)	Pump Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)	Comment
0	100	NA	NA	NA	NA	No water
10	125	NA	NA	NA	NA	No water, pump rate increase.
20	150	NA	NA	NA	NA	No water, pump rate increase.
25	175	NA	NA	NA	NA	No water, pump rate increase.
30	200	NA	NA	NA	NA	No water, pump rate increase.
35	225	NA	NA	NA	NA	No water, pump rate increase.
40.16	255	NA	NA	NA	NA	No water, pump rate increase.
40.8	255	40:58	44:13	3.25	0.31	Grey, silty; hydrocarbon odor.
44.1	255	44:13	48:19	4.1	0.25	Same
48.2	255	48.19	53:25	5.1	0.2	Same
60.23	255	60:23	70:19	9.93	0.1	Water clearing.
75.24	255	NA	NA	NA	NA	Down-hole water level up.

Table 5. MW-02 Pump Setting and Discharge Measurements

Time Since Pumping Began (minutes)	Pump Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)	Comment
77.23	255	NA	NA	NA	NA	Air in tubing. No flow.
78.24	0	NA	NA	NA	0	Pump shut down.

Key:
gpm = gallons per minute
mm:ss = minutes:seconds
NA = not applicable
Notes:
1. Average rate for the entire time of pumping 0.09 gpm considering the total volume pumped over the entire duration from pump start to absence of flow (77.5). This includes the volume of the discharge tubing, which filled to top if casing in the first minute of pumping (1.05 gallons). If the duration of pumping is assumed to be equal to when the pumping setting was set to the maximum value to when flow stopped (37.1 minutes), average discharge is 0.18 gpm.
2. A small amount of water may have been drawn into the tubing while pump failed to flow water.

The recovery period for MW-02 began 78.23 minutes after pumping initially began. Note that the water level increased by 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing. The recovery period was observed for approximately one hour, during which periodic water level measurements were obtained as a check on the transducer. The wellhead was then secured with all the down-hole equipment intact and with the transducer continuing to log the recovering water level as programmed.

The MW-02 site was revisited after eight days and the logging terminated followed by removal of the test equipment. A chart of drawdown in MW-02 computed for the period of record starting from when pumping began until the transducer was removed from the well is presented in Figure 3.

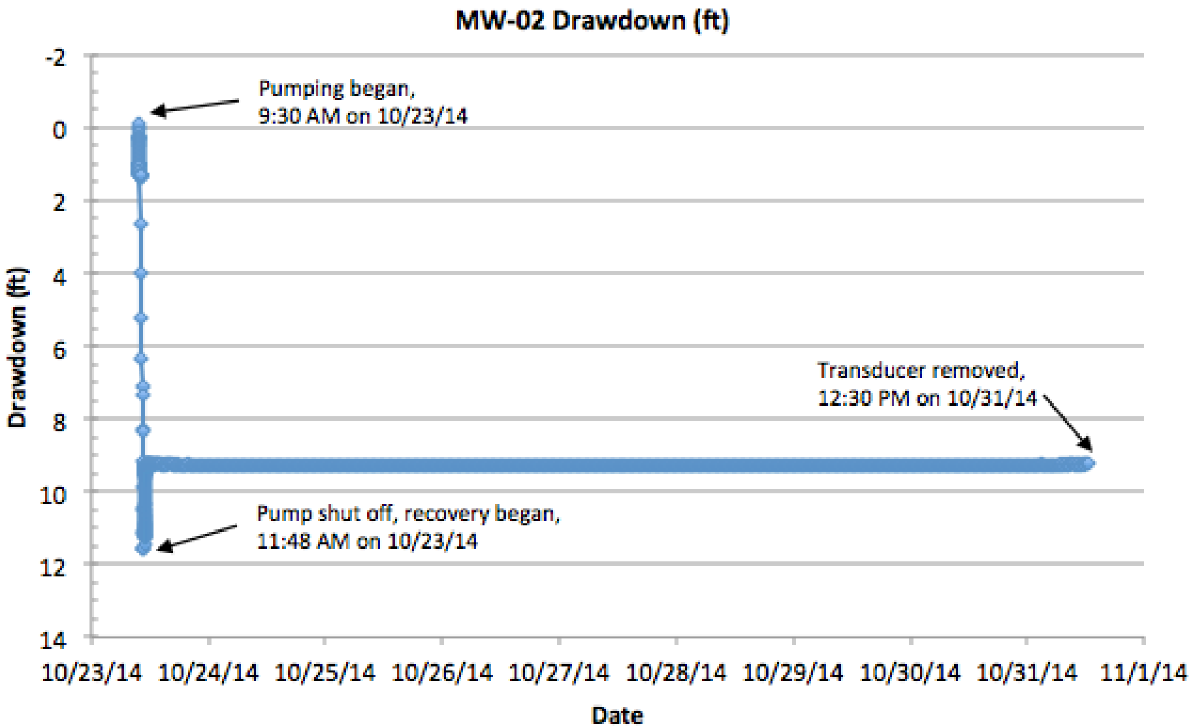


Figure 3. MW-02 Drawdown Computed for Pumping and Recovery Period of Record.

Figure 4 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery. This figure shows the water level response to the 40-minute period of insufficient pump rates and the corresponding rise in water temperature as the operation of the pump heated the stagnant water column. After flow is achieved at approximately 40.8 minutes, the water level begins to drop at a rate of about 0.6 feet per minute (ft/min). The down-hole water temperature then decreases as groundwater at ambient temperatures is drawn into the well screen. As the pump nears its capacity to lift, the water temperature begins to increase again as less water is drawn into the well.

Note that the calculation of duration of pumping is somewhat subjective. If the total time since the pump was turned on until the pump was shut off were assumed, the duration would be approximately 78.24 minutes. If the total time since the pump was turned on until no flow was observed at top of casing were assumed, the duration would be approximately 77.23 minutes. If the total time since the pump was set to 255 to the time no flow was observed at top of casing were assumed, the total time would be calculated as 37.07 minutes, with an average rate of drawdown of approximately 0.3 ft/min.

Two analyses were performed on data obtained from the MW-02 pump and recovery testing. The results from the testing conducted in MW-02 are summarized in Table 6 and depicted in Figure 5 (pumping) and Figure 6 (recovery).

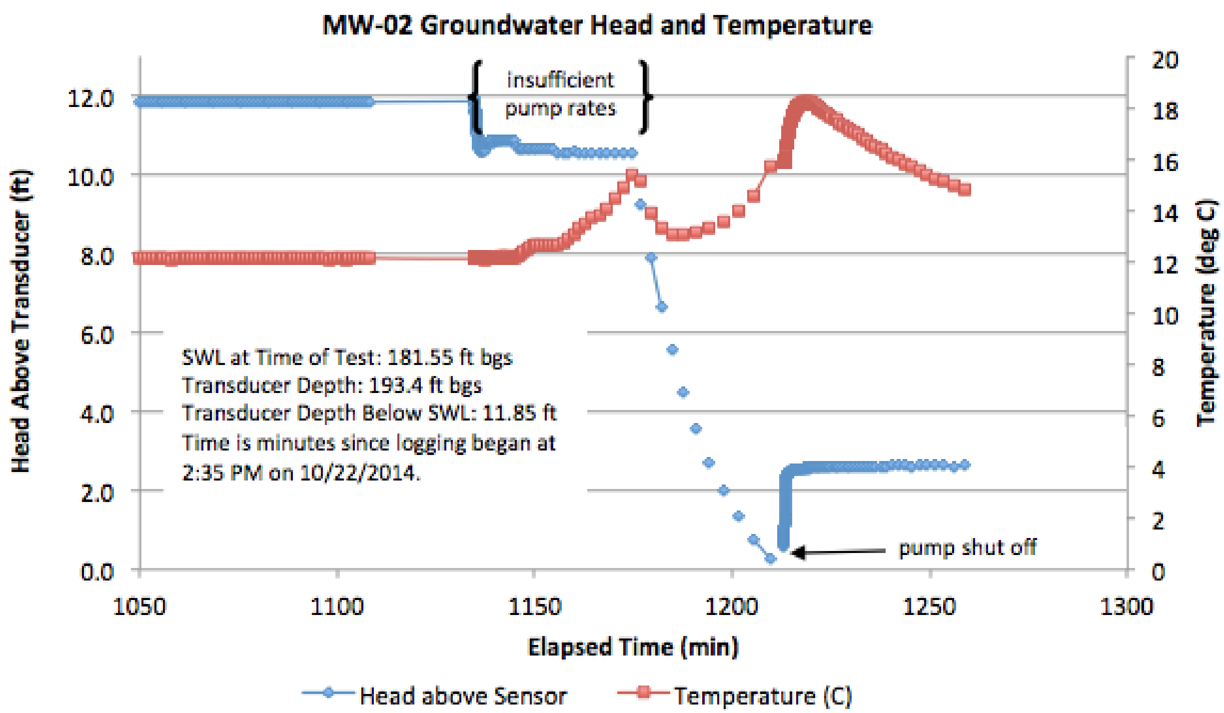


Figure 4. MW-02 Drawdown and Initial Recovery with Groundwater Temperature.

Table 6. Summary of Results from MW-02.

Analysis	Discharge Rate (gpm)	Volume Pumped (gallons)	Duration of Test Period	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	Variable	6.8	77.2 minutes	11.59	1E-01	7E-04
Theis Recovery[1]	0.09	--	8.1 days	2.35	1.2	7E-02
Theis Recovery[3]	0.18	--	8.1 days	2.35	2.6	2E-01

Key:
ft/day = feet per day
ft^2/day = square feet per day
gpm = gallons per minute

Notes:

1. Average discharge rate of 0.09 gpm is calculated by assuming the duration is represented by the time pumping initially started to when water stopped flowing at top of casing (77.5 minutes), and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.05 gallons).
2. Average discharge rate 0.18 gpm is calculated by assuming the duration is represented by the time at which the pump setting was set to the to the maximum value of 255 to when water stopped flowing at top of casing (37 minutes), and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.05 gallons).

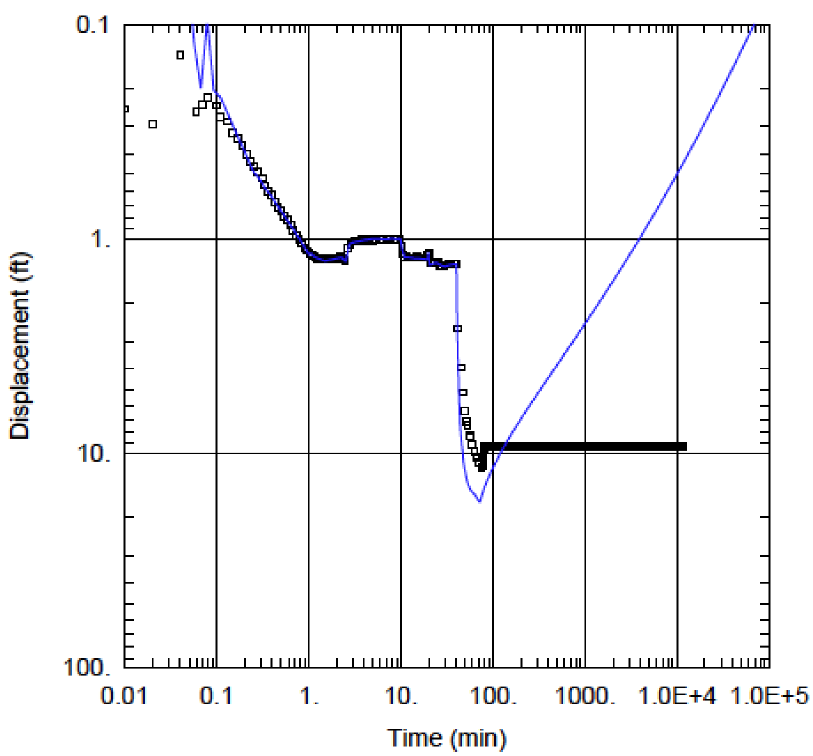


Figure 5. Aqtesolv Plot of Moench (1997) Curve-fit to MW-02 Time-Drawdown Data.

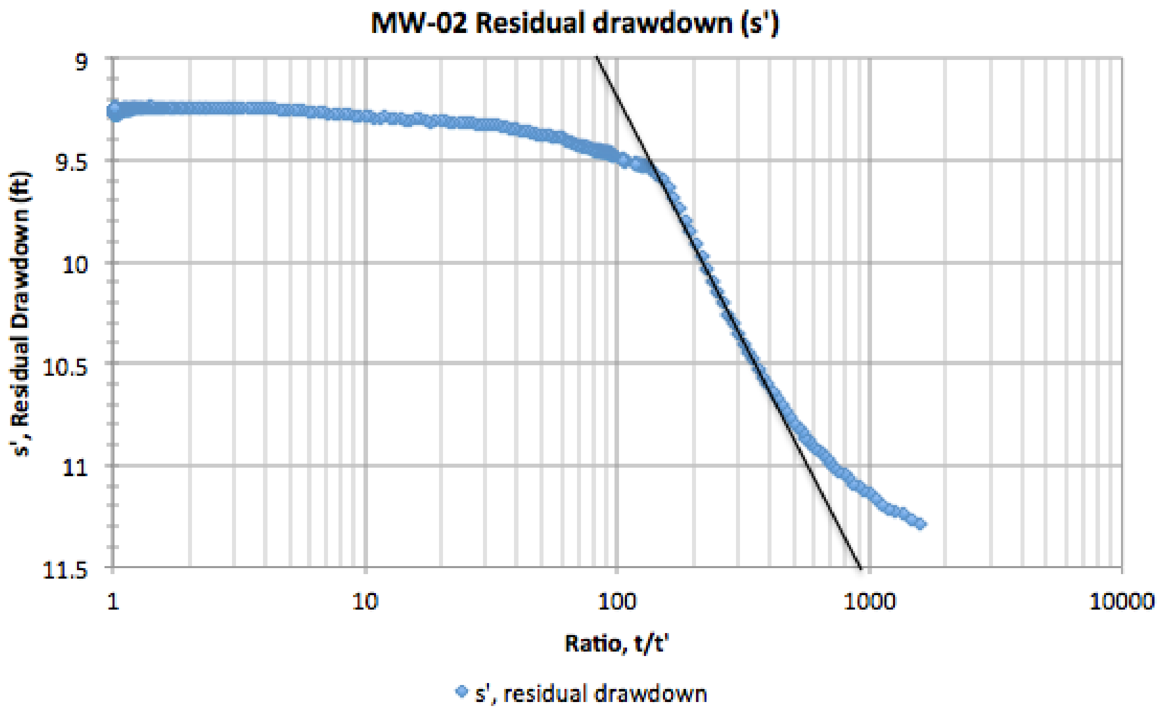


Figure 6. Theis (1935) Recovery Analysis of MW-02 Residual Drawdown Versus Ratio of t/t'.

The pumping period was analyzed by the method of Moench (1997) as implemented by the Aqtesolv™ well hydraulics analytical software program (Duffield 2007). Aqtesolv™ plots for all well tests are presented in Appendix B. The duration of pumping assumed was 77.5 minute, as explained above, which reflects the total time the pump was on until no flow was observed at ground surface. Estimated intermediate pump rates were entered into Aqtesolv™ to account for the 40 initial minutes of pumping with no flow at top of casing and to account for decreasing rates as lowered head decreased pump performance.

The recovery period was analyzed by the residual drawdown method derived from the Theis (1935) non-equilibrium equation as presented by Driscoll (1986). The recovery response analysis was complicated by the non-linear response of the recovery and possibly by water draining back down the discharge tubing at the cessation of pumping. The selection of the portion of the recovery curve to analyze is therefore somewhat subjective, but is generally taken as an independent check on the results calculated from the pumping period (Driscoll 1986), and is especially valuable when a constant discharge rate could not be maintained during the pumping period.

The duration of pumping is not relevant to the recovery analysis, but figures into the calculation of the average rate for input into the equation. Two values for average rate were calculated. One was based on the total volume pumped from the well divided by the total time of pumping until no flow, yielding an average rate of 0.09 gallons per minute (gpm) for the pumping period.

The second value was calculated assuming a total pumping duration represented by the time at which the pump setting was set to the maximum value of 255 to when water stopped flowing at the top of the casing (37 minutes), yielding an average rate of 0.18 gpm.

The values of transmissivity obtained from the Theis recovery analysis are several orders of magnitude higher than the Moench analysis conducted in Aqtesolv™. It is also clear that the values are affected by the average discharge rate selected for input into the recovery analysis equation, with larger values of average discharge yielding higher values of transmissivity. Because of the subjectivity involved in selecting the appropriate portion of the curve to analyze, and the range in average discharge values, the transmissivity estimate obtained from the recovery analysis should receive much less weight. The value of 1.2 square feet per day (ft^2/day) (Table 6) should be regarded as the absolute upper end for transmissivity, and the estimate obtained from Aqtesolv as a more appropriate value.

MW-03 Test Summary

Data collected before and during the instrumentation process in MW-03 are presented in Table 7.

The pump was powered up at approximately 12:52 PM on October 23, 2014. Based on the experience with the pump performance in the previous well test, the initial pump setting was set to 255 in an attempt to bring water to the surface as soon as possible. This setting resulted in an overcurrent shutdown almost immediately after the pump started.

The setting was then decreased to 235 and a restart was attempted with the same overcurrent result. At 12:56 PM, the setting was changed to 225 and reattempted, which resulted in a successful pump start. Water appeared at ground surface one minute later, enabling discharge measurements to be made.

Table 7. MW-03 Test Parameters.

Water Level at Start (ft btoc)[1]	Height of Static Water Column (feet)	Length of Wetted Screen (feet)	Pump Bottom (ft bgs)	Transducer Depth Below Water Level (feet)[3]	Volume Displaced by Downhole Equipment (gallons)	Undissipated Head at Time of Test Start (feet)[4]
191.53	10.34	7.64	198.62	7.65	1.32	0.37

Key:
ft bgs = feet below ground surface
ft btoc = feet below top of casing
Notes:
1. Water level shown is manually measured depth to water immediately before starting pump. The static water level measured the previous day before the well was instrumented was 191.9 ft btoc.
2. Referenced to total depth of well (200 ft bgs).
3. Value calculated from pressure measurement read immediately preceding the start of pumping.
4. This value represents the remaining increase in water level since the time the well was instrumented on 10/22/2014.

A summary of pump settings and average discharge measurements made per gallon pumped is presented in Table 8. The water level in the well decreased fairly rapidly, at an average rate of approximately 0.9 ft/min. At approximately 7:56 minutes into pumping, the transducer reading indicated that the transducer was about to dewater (0.09 psi), and the pump was shut down seconds later. Maximum observed drawdown was 7.41 feet.

The recovery period for MW-03 began 8.1 minutes after pumping began. Similar to the early case in MW-02, the water level increased by about 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing.

Table 8. MW-03 Pump Setting and Discharge Measurements

Time Since Pumping Began (minutes)	Pump Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[1]	Comment
-4	255	NA	NA	NA	NA	Overcurrent shutdown[2]
-2	235	NA	NA	NA	NA	Overcurrent shutdown[2]
0	225	NA	NA	NA	NA	Pump started
1.02	225	1:01	4:04	3.05	0.33	Grey, silty hydrocarbon odor
4.07	225	4:04	7:02	2.97	0.34	Alternating clear and dark
7.56	225	NA	NA	NA	NA	0.091 psi
8.1	255	NA	NA	NA	NA	Pump off

Key:
gpm = gallons per minute
mm:ss = minutes:seconds
NA = not applicable
psi = pounds per square inch

Notes:
1. Average rate for the entire time of pumping 0.39 gpm considering the total volume pumped, including the volume of the discharge tubing, which filled to top if casing in the first minute of pumping (1.1 gallons).
2. A small amount of water may have been drawn into the tubing and subsequently released each time the pump was started and stopped due to current overload.

The recovery period was observed for approximately one hour before securing the wellhead with the down-hole equipment intact and the transducer continuing to log the recovering water level. The MW-03 site was revisited after eight days, and the logging terminated followed by removal of the test equipment. Figure 7 presents a chart of drawdown in MW-03 computed for the period of record starting from when pumping began until the transducer was removed from the well.

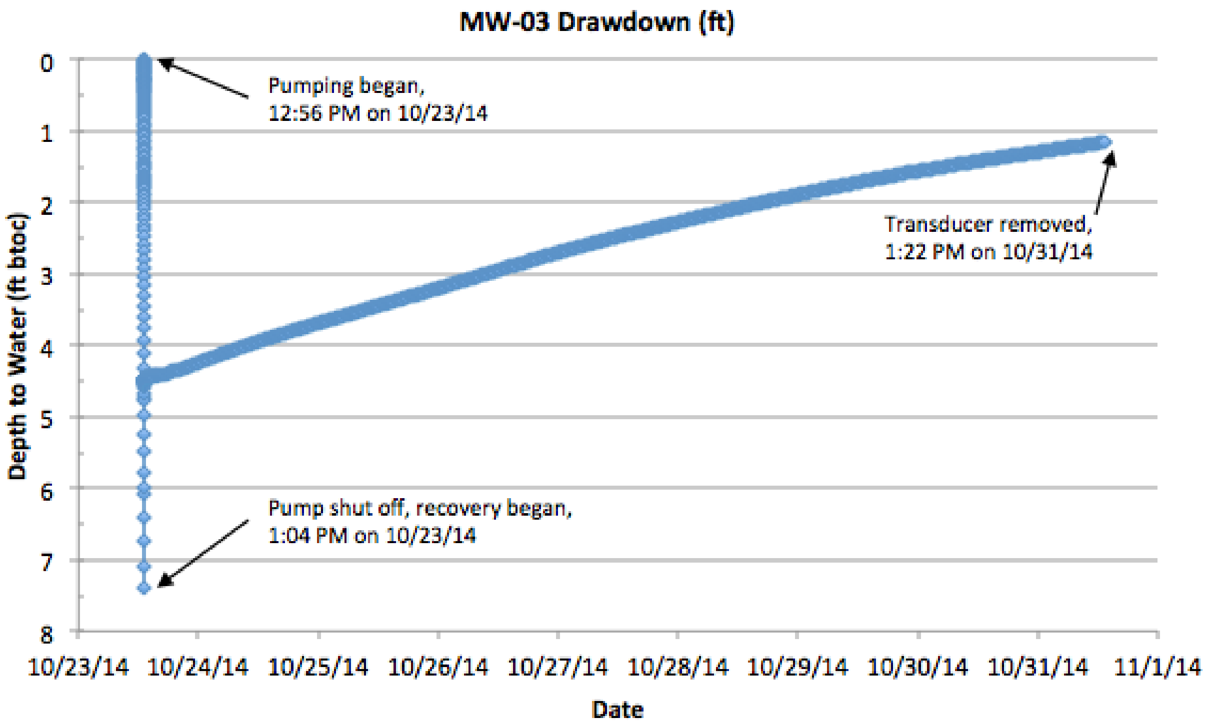


Figure 7. MW-03 Drawdown Computed for Pumping and Recovery Period of Record.

Figure 8 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery in MW-03. Inspection of Figure 8 reveals a steady drop in water level in response to a fairly constant pump rate over a short period of time. A small temperature increase is noted, likely due to the initial attempts at pumping that resulted in overcurrent condition. After flow is achieved, the temperature drops slightly as groundwater at ambient temperatures is drawn into the well screen.

As the pumping in MW-03 began to nearly dewater the transducer, the pump was shut down. The water temperature was observed to rise markedly due to the small amount of water left in the well available to adsorb heat from the pump. At some point during recovery, the temperature drops as groundwater at ambient temperature enters the well.

The data obtained from the pumping period in MW-03 were analyzed by the method of Moench (1997) as implemented in Aqtesolv™. Aqtesolv™ plots for all well tests are presented in Appendix B.

The results from the testing conducted in MW-03 are summarized in Table 9. The results of the Moench (1997) analysis of the pumping phase data are depicted in Figure 9.

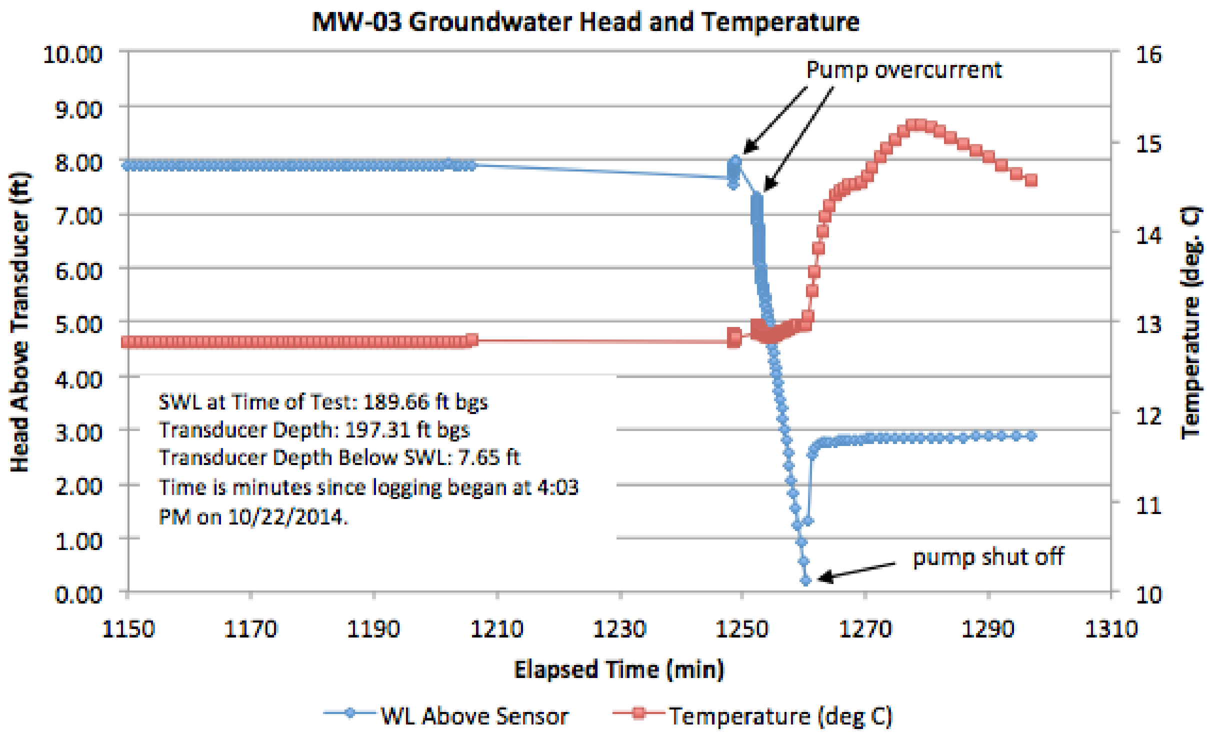


Figure 8. MW-03 Drawdown and Initial Recovery with Groundwater Temperature.

Table 9. Summary of Results from MW-03.

Analysis	Discharge Rate (gpm)[1]	Volume Pumped (gallons)	Duration of Test Period	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	0.39	3.14	8.1 minutes	7.41	6E-02	7E-03
Theis Recovery	0.39	--	8 days	6.25	4.3	0.52

Key:
ft/day = feet per day
ft^2/day = square feet per day
gpm = gallons per minute
Notes:
1. Average rate for the entire time of pumping is 0.39 gpm calculated from time pumping started to when water stopped flowing, and considering the calculated volume of the discharge tubing that filled with water before water appeared at land surface (1.1 gal).

Significant in Figure 9 is the unusual flexure of the recovery portion of curve, signifying an increasing rate of recovery at large times. When the assumptions of theory are met, the rate of recovery is initially quick and decays exponentially with time, with the concave portion of the curve directed downwards on a log-log plot. This is the opposite of the behavior typically observed in infinite-acting isotropic and homogeneous aquifers with radial flow towards the well.

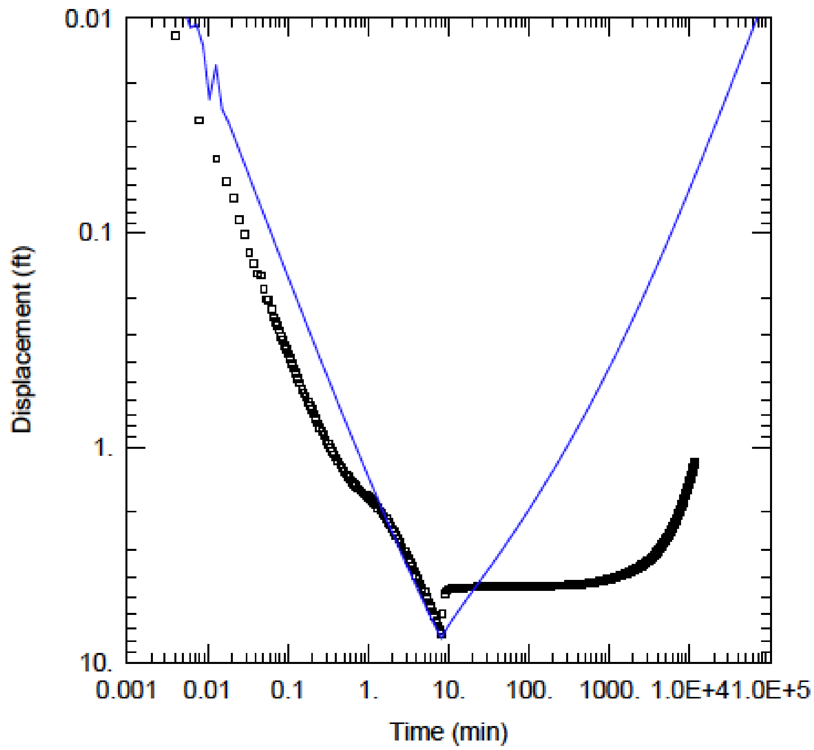


Figure 9. Aqtesolv Plot of Moench (1997) Curve-fit to MW-03 Time-Drawdown Data.

An attempt was made to analyze the recovery period data by the Driscoll (1986) implementation of the Theis (1935) residual drawdown method (Figure 10). As shown on Figure 10, the recovery response analysis was complicated by the unusual recovery curve, indicating that the recovery response at small ratios of t/t' did not fit the assumptions of the analytical model. Furthermore, there was little insight as to which part of the curve to fit. Assuming that the latter part of the curve at large values of t/t' was the beginning of the appropriate segment for analysis, values for transmissivity and hydraulic conductivity were estimated. The values shown in Table 9 for recovery appear large when compared to the results from MW-03 pumping phase and both recovery and pumping phase results from MW-02.

Similar to the case of MW-02, it is believed that the MW-03 recovery values represent an overestimate, and the pumping phase data, corrected for casing storage within the Moench (1997) analytical model, yields a more reliable estimate of transmissivity. The explanation for the inaccuracy of the recovery value is that at small ratios of t/t', the computed value was essentially unity for a significant portion of that the MW-03 recovery period. The plausible explanation for the cause of this is the short duration of pumping (due to the lack of usable drawdown), possibly in concert with low permeability material in contact with the MW-03 well screen. As a result, a significant percentage of the water yield was likely derived from casing storage, which will produce an overestimate of transmissivity. The derivative analysis and the radial flow plot for MW-03 (Figure 11) also suggest this to be the case.

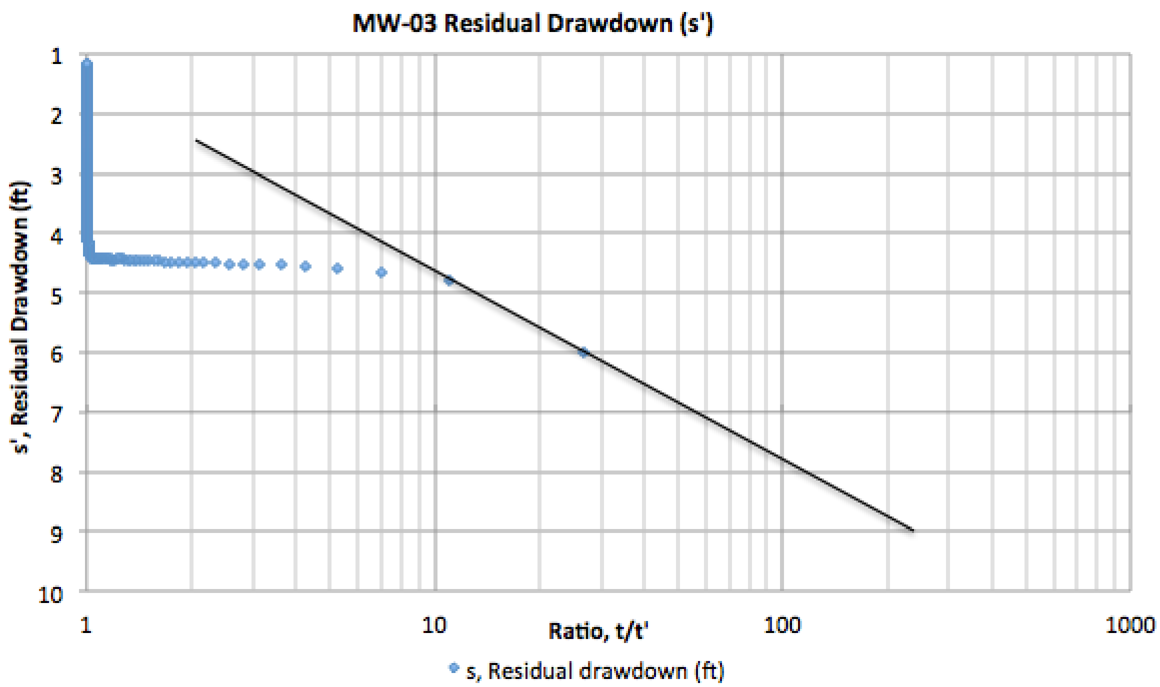


Figure 10. Theis (1935) Recovery Analysis of MW-03 Residual Drawdown Versus Ratio of t/t'.

On the log-log radial flow plot shown in Figure 11, early-time data exhibiting a unit slope are indicative of wellbore storage (Duffield 2007). This plot suggests that for a short time, the aquifer began to behave as if it was yielding water by radial flow, but shortly later resumed characteristics of wellbore storage for the duration of the pumping test.

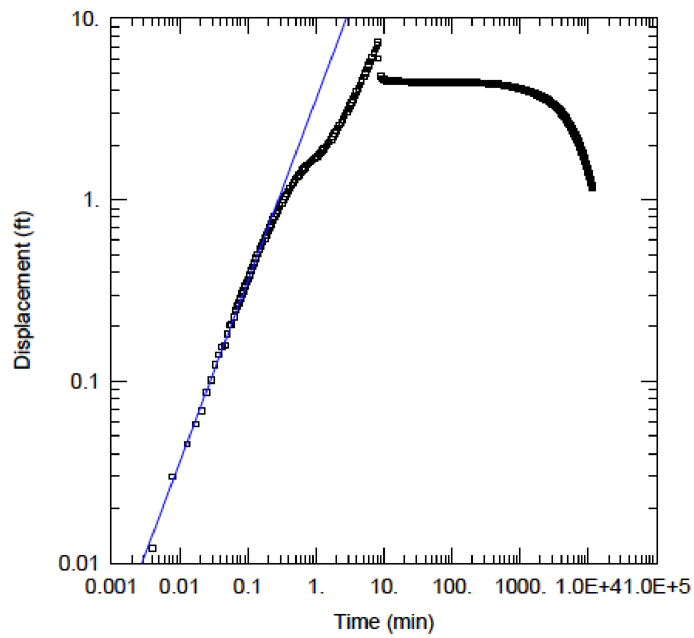


Figure 11 Radial Flow Plot for MW-03 Indicating Significant Casing Storage Effects.

A cursory derivative analysis was also performed. The fact that the derivative never approaches a constant with time (not shown, see Appendix B3) is additional evidence that radial flow was not a dominant source of water to the well.

MW-01 Test Summary

Two tests were attempted in MW-01 on November 7, 2014. Data collected before and during the instrumentation process in MW-01 are presented in Table 10.

Table 10. MW-01 Test Parameters.

Water Level at Start (ft btoc)[1]	Height of Static Water Column (feet)[2]	Length of Wetted Screen (feet)	Pump Bottom (ft bgs)	Transducer Depth Below Water Level (ft)[3]	Volume Displaced by Downhole Equipment (gallons)	Undissipated Head at Time of Test Start (feet)[4]
175.17	26.54	25.54	197.89	20.17	2.18	0.22

Key:
ft bgs = feet below ground surface
ft btoc = feet below top of casing
Notes:
1. Water level shown is manually measured depth to water immediately before starting pump. The static water level measured the previous day before the well was instrumented was 175.41 ft btoc.
2. Referenced to total depth of well (200 ft bgs).
3. Value calculated from pressure measurement read immediately preceding the start of pumping.
4. This value represents the remaining increase in water level since the time the well was instrumented on 11/6/2014.

The first test, which began at approximately 9:19 AM on November 7, 2014, was aborted due to poor pump performance. After unsuccessful attempts to increase the power setting to a value that would discharge water at ground surface, the first test was terminated approximately 23 minutes after starting.

Based on experience in the previous well tests, the initial pump setting was set to 225 in an attempt to bring water to the surface as soon as possible without over-powering the pump. This setting resulted in an overcurrent shutdown almost immediately after the pump started. The setting was decreased to 200 and a restart was successful, commencing pumping at 9:21 AM. At 1.63 minutes later, the pump power setting was successfully changed to 225. Another attempt was made at 3 minutes, but the controller indicated that 225 was the maximum possible setting at this time. At 11.05 minutes, the power setting was successfully increased to 231. Water appeared at ground surface at 13.67 minutes after pumping began but did not flow past the top of the outer casing. At 16.5 minutes, the water level rose an additional 5 to 6 inches but still but did not flow past the top of the outer casing. At 17:75 minutes, the level in the discharge tubing began falling, and then rose again at 18:5 minutes. At 22 minutes, it was decided to remove the extension cord out of the power loop to the generator to eliminate that as a possible source of line loss. The pump was momentarily stopped and restarted without a change in performance. At 23:25 minutes, it was decided to abort the test and change the pump to a backup unit in an effort to flow water at ground surface.

A summary of pump settings and associated observations for the aborted test is presented in Table 11.

Table 11. MW-01 Pump Setting and Discharge Measurements (Attempt 1)

Time After Pumping Began (minutes)	Pumping Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[1]	Comment
-2	225	NA	NA	NA	NA	Overcurrent shutdown.[2]
0	200					Pump started.
1.63	225	NA	NA	NA	NA	Power increase successful.
3	225	NA	NA	NA	NA	Power change attempted.
8:67	225	NA	NA	NA	NA	Manual W.L. 176.98 ft btoc.
11.05	231	NA	NA	NA	NA	Power increase successful.

Table 11. MW-01 Pump Setting and Discharge Measurements (Attempt 1)

Time After Pumping Began (minutes)	Pumping Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement End (mm:ss)	Duration (minutes)	Calculated Average Discharge (gpm)[1]	Comment
13:67	231	NA	NA	NA	NA	Water at top of casing. Water slightly discolored to clear.
16.5	231	NA	NA	NA	NA	Water in tube rising, water clear.
17.75	231	NA	NA	NA	NA	Water in tube falling.
18.5	231	NA	NA	NA	NA	Water in tube rising.
22	231	NA	NA	NA	NA	Pump shut down and restarted to remove extension cord.
23.25	0	NA	NA	NA	NA	Test aborted, pump shut down.
60	--	--	--	--	--	New pump reinstalled to same depth. WL 175.27 ft btoc.
72.5	--	--	--	--	--	New log begun for trend.[3]
75	--	--	--	--	--	WL 175.2 ft btoc.
101	--	--	--	--	--	WL 175.2 ft btoc.

Key:
ft botc = feet below top of casing
gpm = gallons per minute
mm:ss = minutes:seconds
NA = not applicable

Notes:
1. No water produced past top of casing.
2. A small amount of water may have been drawn into the tubing and subsequently released each when the pump was started and stopped due to current overload.
3. Logging for trend was commenced to determine when the water level was stable after the removal and replacement of all down-hole equipment to same depths.

The pump was removed and replaced with an identical model at 10:22 AM on November 7, 2014. The replacement pump was set to the depth identical to the previous installation. A manual water level of 175.27 ft btoc was obtained after the pump was secured. The transducer was reinstalled to a depth below water of approximately 21 feet.

A water level trend transducer log was started to determine when water level change was sufficiently small to begin a new test. At 10:34 AM, a manual measurement indicated that water was 175.2 feet btoc. At 11:00 AM, the same measurement was obtained. At this time, it was decided to proceed with the second test, as water level appeared stable and differed only by 0.03 feet from the value obtained just before the previous test.

At 11:05, the pump for test 2 was successfully started at a power setting of 225. One minute later, the power setting was increased to 240. At 1.33 minutes after pumping started, flowing water appeared at top of casing and discharge measurements commenced. At 31 minutes after pumping began, flow could no longer be maintained at land surface. At 31.5 minutes, the pump power setting was successfully changed to the maximum setting with no change in flow at land surface. At 33.4 minutes after pumping began, the pump was shut down, and the recovery period for MW-01 began. Maximum observed drawdown for the pumping period was 10.7 feet.

A summary of pump settings and average discharge measurements made per gallon pumped is presented in Table 12.

Table 12. MW-01 Pump Setting and Discharge Measurements (Attempt 2)

Time Since Pumping Began (minutes)	Pumping Setting	Discharge Measurement Start (mm:ss)	Discharge Measurement Start (mm:ss)	Duration (minutes)	Calculated Average discharge (gpm)[1]	Comment
0	225	NA	NA	NA	NA	Pump started.
1	240	NA	NA	NA	NA	Power increase successful.
1.33	240	1:20	5:30	4.17	0.24	Water flowing at top of casing light grey with suspended fines. 1 gallon pumped.
5.5	240	5:30	10:00	4.5	0.22	Total 2 gallons pumped.
10.33	240	10:20	17:31	7.18	0.14	Total 3 gallons pumped.
17.52	240	17:31	27:00	9.48	0.11	Total 4 gallons pumped.
25:33	247	NA	NA	NA	NA	Power increase successful.
27	247	27:00	31:00	4	0.19	0.75 gallons produced in this time interval. Cumulative total 4.75 gallons pumped.
31	247	NA	NA	NA	NA	Water stopped flowing.
31.5	255	NA	NA	NA	NA	Power increase successful. No flow.
33.4	0	NA	NA	NA	NA	Pump shut down.

Key and Notes to Table 12
<u>Key:</u>
gpm = gallons per minute
mm:ss = minutes:seconds
NA = not applicable
<u>Notes:</u>
1. Average rate for the entire time of pumping 0.19 gpm, calculated from time pumping started to when water stopped flowing, and considering the volume of the discharge tubing (1.01 gallons).

Similar to what was observed in the other wells, the water level increased by about 2 feet in the first 30 seconds, indicating that some water may have drained back into the well from the tubing.

The recovery period was observed for approximately one hour before securing the well with the down-hole equipment intact and the transducer continuing to log the recovering water level. The MW-01 site was revisited after 7.9 days and the logging terminated followed by removal of the test equipment. A chart of drawdown in MW-01 computed for the period of record starting from when pumping began until the transducer was removed from the well is presented in Figure 12.

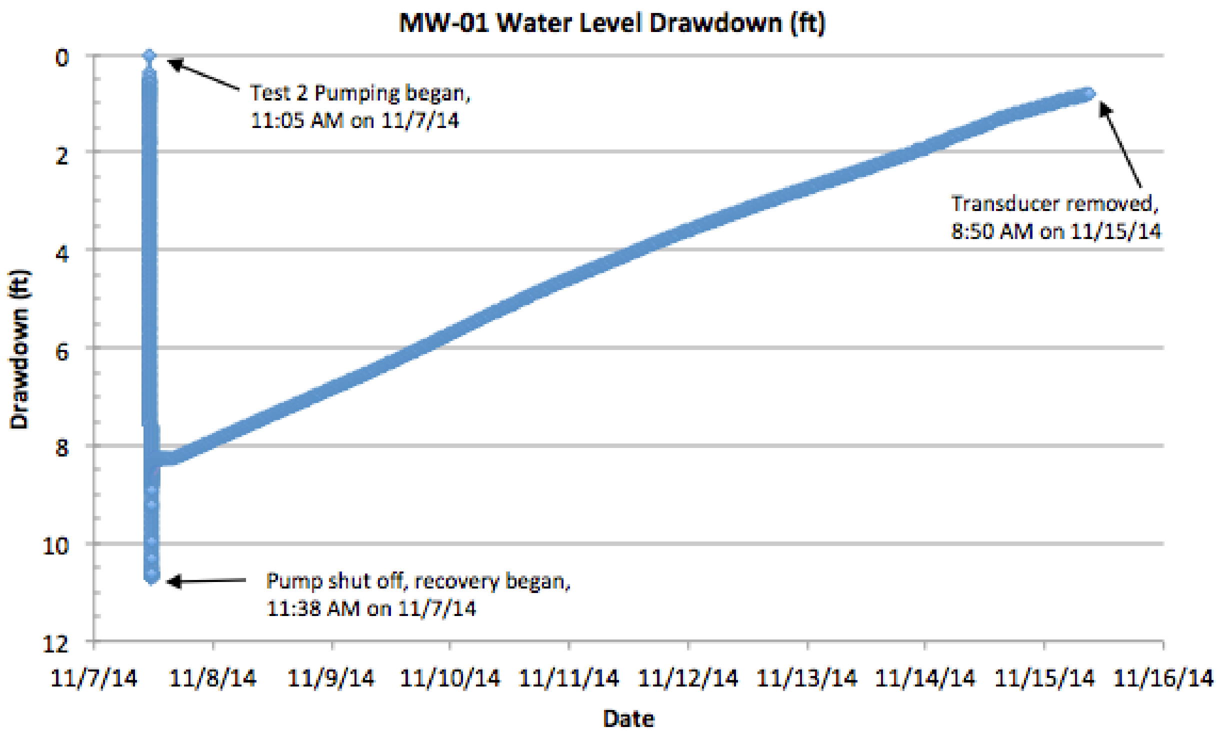


Figure 12. MW-01 Drawdown Computed for Pumping and Recovery Period of Record.

Figure 13 presents a chart of water level above the transducer sensor and water temperature for the pump period and initial recovery in MW-01. Inspection of Figure 13 reveals a standard water level response indicative of water contributed from the water bearing zone with a minimal amount of influence from casing storage A flexure is apparent at about 60 minutes (about 25 minutes after pumping began), which reflects the increase in pump rate when the power setting was increased to 247.

The groundwater temperature response in MW-01 was somewhat different than the other wells. In the case of MW-01, the temperature displayed a relatively significant decrease in temperature as groundwater at ambient temperatures was initially drawn into the well screen. Only when drawdown decreased the amount of water in the well, and the decrease in pumping rate slowed the intake of groundwater into the screen, did the temperature begin to increase. After the cessation of pumping, the temperature spiked, reflecting the heat transferred to the relatively static column of water left in the well.

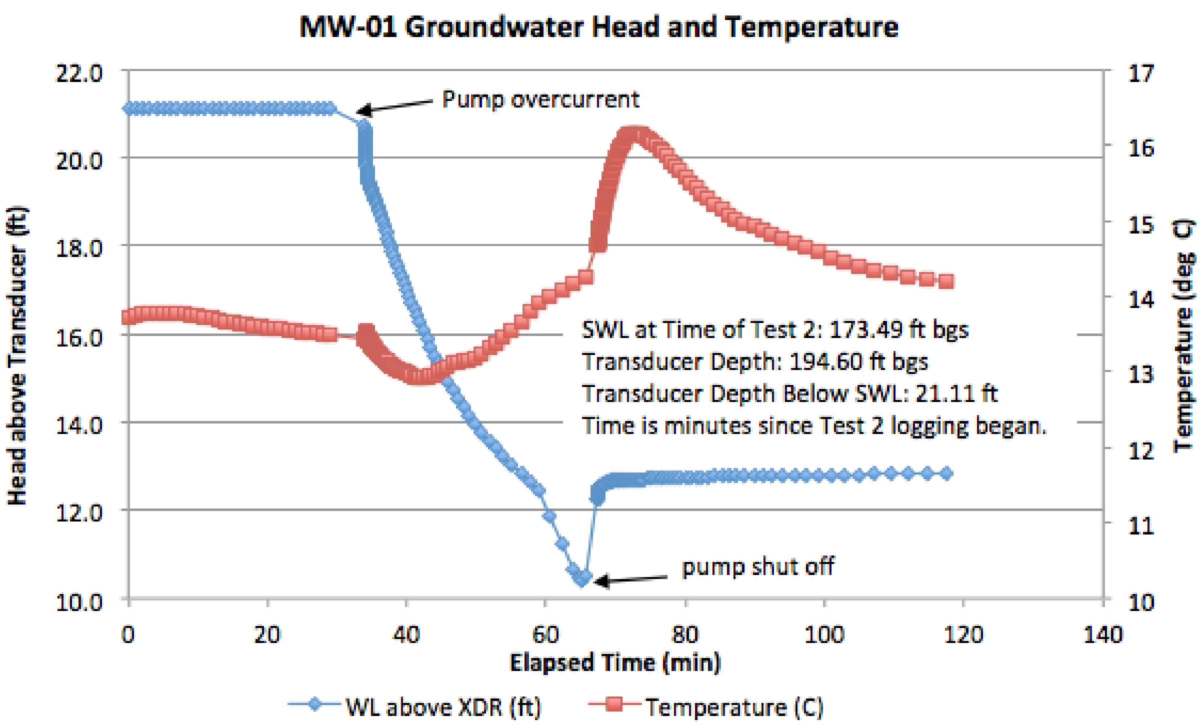


Figure 13. MW-01 Drawdown and Initial Recovery with Groundwater Temperature.

A summary of results from the testing conducted in MW-01 is presented in Table 13**.** The data obtained from the pumping period in MW-01 were analyzed by the method of Moench (1997) as implemented by the Aqtesolv^{TM} well hydraulics analytical software program (Duffield 2007). Aqtesolv^{TM} plots for all analyses performed for the MW-01 testing are presented in Appendix B1.

Table 13. Summary of Results from MW-01.

Analysis	Discharge rate (gpm)[1]	Volume Pumped (gallon)	Duration of Test Period[2]	Maximum Drawdown or Recovery (feet)	Estimated Transmissivity (ft^2/day)	Estimated Hydraulic Conductivity (ft/day)
Moench	Variable	5.76	31 minutes	10.7	6E-03	2E-04
Theis Recovery	0.19	--	7.9 days	9.88	37	1.5

Key:
ft/day = feet per day
ft^2/day = square feet per day
gpm = gallons per minute

Notes
1. Average rate for the entire time of pumping is 0.19 gpm calculated from time pumping started to when water stopped flowing, and considering the volume of the discharge tubing filled with water before water appeared at land surface (1.01 gallons).
2. Pump was shut off after 33 minutes, but water stopped flowing at 31 minutes.

The results of the Moench (1997) analysis of the pumping phase data are depicted in Figure 14. Some difficulty was experienced in the curve-fitting process due to apparent fluctuations in the rate of drawdown during the pumping phase of the test.

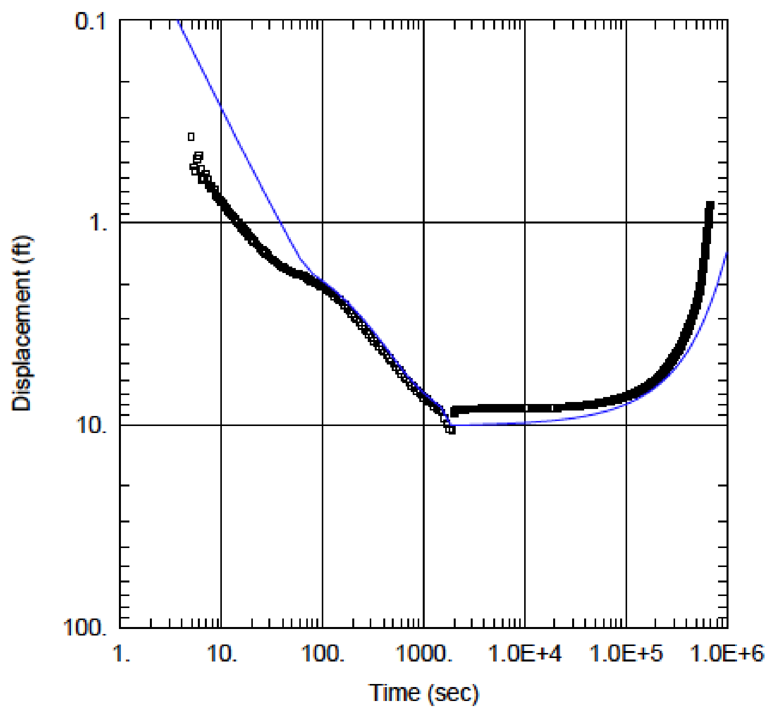


Figure 14. Aqtesolv Plot of Moench (1997) Curve-fit to MW-01 Time-Drawdown Data.

In an effort to set the pump to its maximum rate, the pump power setting was increased three times: at 1 minute, at 25.3 minutes, and at 31.5 minutes, approximately 30 seconds after water stopped flowing at the surface. Though the pump was set to the maximum possible power setting at 31.5 minutes, water did not resume flowing.

A case could be made that the slight flexure at 1 minute resulted from the increase in pump rate at that time. However, there is seemingly no explanation based on pump rate that could account for other changes in the drawdown curve.

In order to rule out pump rates as the cause, intermediate rates were added into the Aqtesolv™ input file. Intermediate rates that decreased with time were estimated at quasi-regular time intervals. Care was taken to ensure that the volumes produced in those time intervals matched the production measured by bucket and stopwatch for the corresponding timeframe. This resulted in a somewhat closer fit, but still not close enough for the solution to converge.

Other possible explanations are boundary conditions that result in leakage, recharge, no flow, or reduced flow. Such boundary conditions could be a leaky aquitard, recharge from a large fracture or fault, or a pinching water-bearing zone such as that often displayed by lens-shaped sand bodies.

Finally, following guidance in the Aqtesolv™ Documentation (Duffield 2007), parameter tweaking was employed iteratively, focusing mainly on well effective radius (r_c) and well skin factor (s_w). These adjustments proved successful in fitting MW-01 mid-to-late time data, initially employing automatic curve matching for the preliminary fit, followed by a slight adjustments in s_w and r_c for the final fit.

Early time data were not well-fit, presumably due to casing storage effects, which were evaluated with the radial flow plot and derivative analysis. Early-time data with unit slope on a radial flow plot with log-log axes is characteristic of wellbore storage, whereupon inspection of the radial flow plot presented in Figure 15 confirms that well-bore storage was a minor but contributing factor.

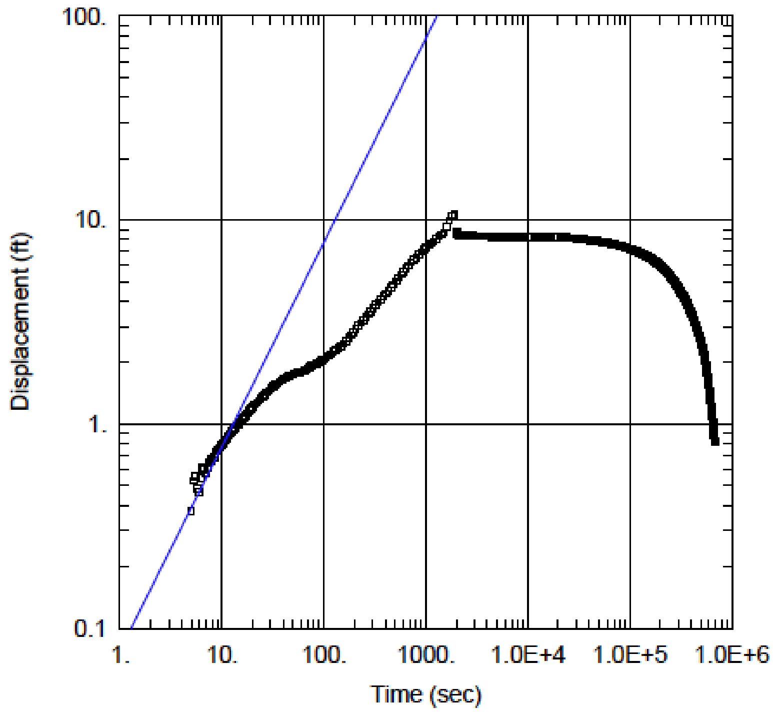


Figure 15. Radial Flow Plot for MW-01 Illustrating Well-Bore Storage at Early Times.

The derivative analysis confirmed this conclusion, with a pronounced peak in the derivative (red colored data) that is characteristic of well-bore storage (Figure 16). At intermediate to late time, the derivative approaches a constant value when the aquifer is infinite-acting (i.e., radial flow is occurring). Unfortunately, the pump was not able to sustain discharge soon after that point; thus, further data supporting radial flow after this time this were not available. At the end of the test, the derivative approaches zero, suggesting the influence of recharge or leakage (e.g., pump rate falling to zero, allowing recharge to enter the well).

An attempt was made to analyze the recovery period data by the residual drawdown method derived from the Theis (1935) non-equilibrium equation as presented by Driscoll (1986). The first issue in evaluating the recovery response was to correct for spikes discovered in the down-hole pressure measurement record. Upon arriving at the MW-01 site on November 15, 2014, it was evident that vandals had cut the tape securing both the pump and the transducer cables to the outer casing.

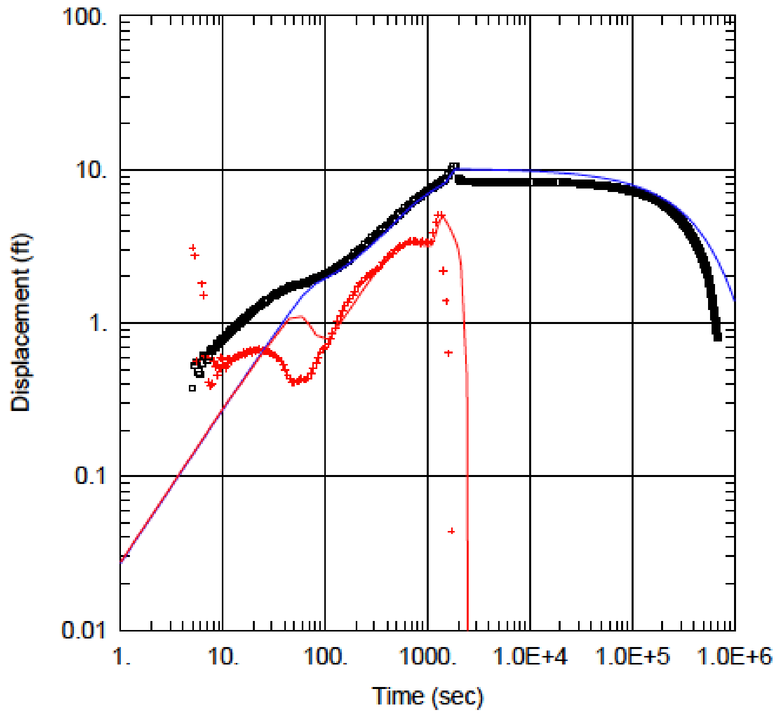


Figure 16. MW-01 Derivative Analysis Indicating Well-Bore Storage and Incipient Radial Flow.

After unlocking and opening the cover on the outer well casing, it appeared that the transducer had moved downwards by some amount. The pump, however, did not appear to have slipped downwards by much, if at all. When the well was initially secured on November 7, 2014, the excess pumping tubing was coiled up and pressed down in the annular space between the inner and outer well casing. Apparently, when the tape securing the pump cable was cut, the coiled end of discharge tubing had hung up inside the casing, preventing the pump from slipping down into the bottom of the well. The lack of movement was confirmed by the tape mark that indexed the pump suspension cable to the top of the outside casing.

According to the transducer log, the time at which the transducer movement first occurred was approximately 6:34 PM on November 13, 2014 (Figure 17). The vandalism probably occurred at that time, or possibly sometime earlier.

In any case, the damage to the transducer mounting allowed the transducer to slip downwards, resulting in an apparent instantaneous change in water level of 0.97 feet upwards. At approximately 11:19 PM, another abrupt change of 0.13 feet was detected, due to further slippage of the transducer. Finally, at 2:34 AM on November 14, 2014, one additional water level change of 0.064 feet was observed. These changes were easily corrected for and have no bearing on the results. The chart of MW-01 drawdown presented in Figure 12 and the MW-01 hydrograph presented in Appendix D show the water level record corrected for these changes.

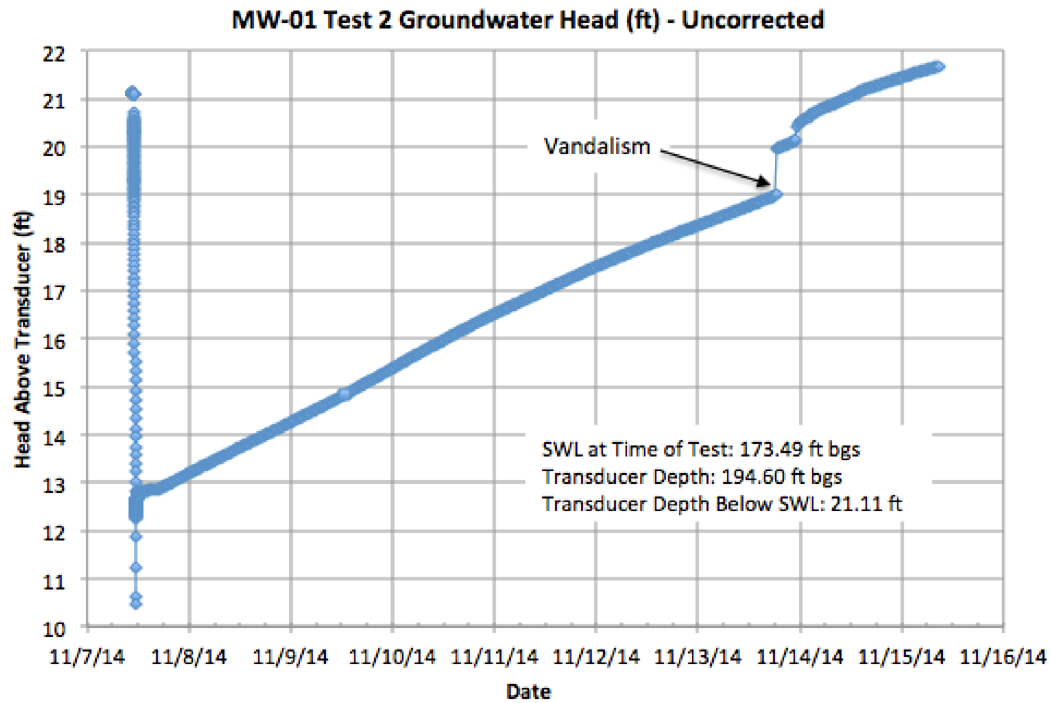


Figure 17. MW-01 Drawdown and Recovery Showing Abrupt change in Water Level Due to Vandalism of Cable Suspension Mount Point.

Once the corrections were made to the water level record, the recovery response was analyzed by the Driscoll (1986) implementation of the Theis (1935) residual drawdown method. As shown in Figure 18, the response was such that a linear fit was achieved to the semi-log plot of the data, allowing the estimation of transmissivity to be made directly from the regression equation. However, the estimated value of transmissivity from this analytical method was an order of magnitude larger (37 ft^2/day) than the results of the same analysis conducted for the other wells.

In comparison to the recovery analysis conducted in the other wells, there is less uncertainty in the computation of the average discharge rate for MW-01, which was assumed to be equal to the total volume pumped from the well divided by the time of pumping. With respect to the other two wells, there was subjectivity in the selection of the duration of pumping because of the issues surrounding achieving an initial sustainable pump rate in those wells. Note that the recovery-based transmissivity results from MW-02 (Table 6) and MW-03 (Table 9) compare somewhat closely to MW-01 when using the same method for calculating the pumping duration and when considering the subjectivity involved in that and the assumptions required for the Theis (1935) method.

In any case, other contributing factors to the larger values of transmissivity calculated for all the wells by the Theis (1935) recovery method likely include the conventions required by the method, which assume confined conditions, radial flow, an infinite-acting aquifer, and the neglection of casing storage and aquitard leakage.

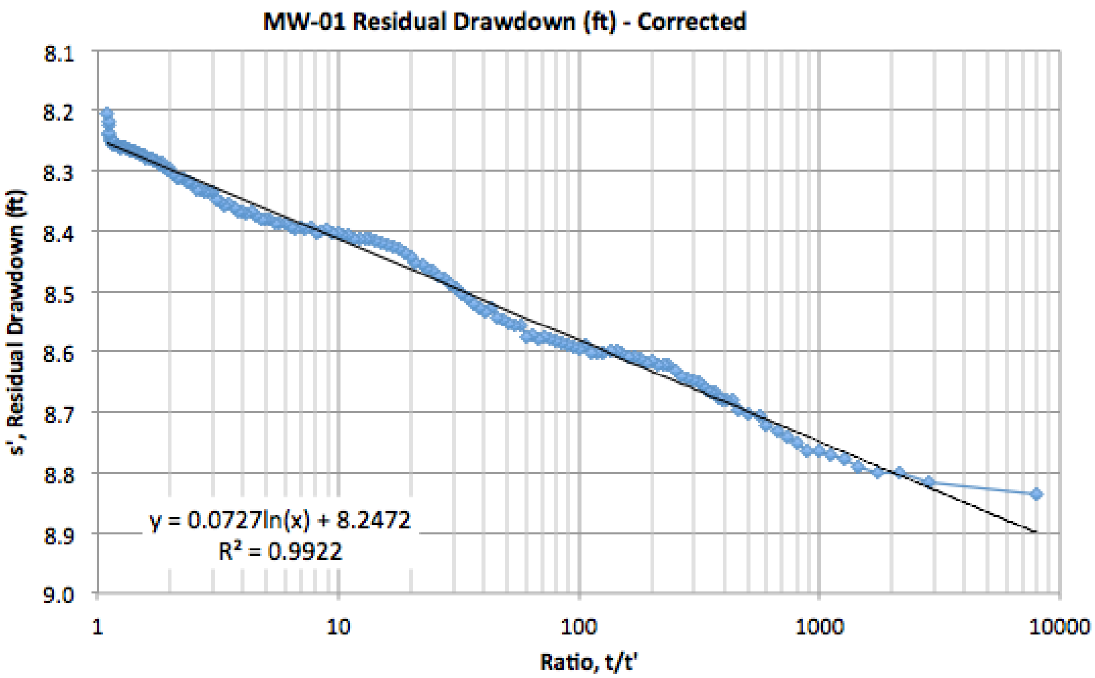


Figure 18. Theis (1935) Recovery Analysis of MW-01 Residual Drawdown Versus Ratio of t/t'.

Due to the limitation if the Theis (1935) under the hydrogeologic conditions at the TomCo site, the estimate of transmissivity for MW-01 provided through the use of the Moench (1997) analysis (Table 13) should be considered the best available estimate.

4 CONCLUSIONS

Aquifer stress testing was conducted to provide hydrogeologic data regarding the nature and extent of groundwater resources at depths of up to 200 feet beneath the TomCo site. Testing included pump-drawdown tests followed by a recovery period of up to eight days. Data collected included discharge and drawdown data, cumulative volumes pumped, water level recovery rates, and hydraulic properties estimates.

Measured depths to water obtained in October 2013 and a year later in October 2014, maximum water level drawdown during pumping, cumulative gallons pumped and best engineering estimates of hydraulic properties are presented in Table 14.

Table 14. Summary of TomCo Monitoring Well Test Observations.

WELL ID	October 2013 DTW (ft bgs)	October 2014 DTW (ft bgs)	Water Level Decrease (feet)	Maximum Drawdown (feet)	Volume Pumped (gallons)	BEE[1] Specific Capacity (gpm/ft)	BEE T (ft^2/day)	BEE K (ft/day)
MW-01	175.3	173.69	+1.61	10.7	5.76	0.02	6E-03	2E-04
MW-02	180.3	181.85	-1.55	11.42	6.85	0.02	1E-02	7E-04
MW-03	180.7	190.03	-9.33	7.41	3.14	0.05	6E-02	7E-03

Key:
BEE = best engineering estimate
ft bgs = feet below ground surface
ft/day = feet per day
ft^2/day = square feet per day
gpm/ft = gallons per minute per foot
K = Hydraulic Conductivity
T = Transmissivity
Notes:
1) In all cases, value obtained from the Moench (1997) analysis.

The lack of significant head in each well suggests that substantial water bearing zones are not present beneath the TomCo site. This conclusion is also supported by the diminished capacity of each well to transmit appreciable amounts of groundwater when pumped at low rates (generally 0.34 to 0.1 gpm). Specific capacities ranged from a low of 0.02 gpm/ft to a high of 0.05 gpm/ft, which reflects the efficiency of the well and suggests that the well screens are in contact with material of low permeability, and may also be affected by well skin.

An evaluation of the data included the use of analytic models to estimate values for transmissivity, for which best estimates ranged from $6x10^{-3}$ ft^2/day to $6x10^{-2}$ ft^2/day, assuming unconfined conditions under the Moench (1997) model. Estimates of transmissivity obtained using the Theis (1935) residual recovery method as described by Driscoll (1986) were up to several orders of magnitude larger, underscoring the limitations of that method under non-confined conditions, casing storage effects, and boundary influences, resulting in non-infinite acting aquifer conditions, and non-radial flow.

By the assumption that the wetted screen length represented the thickness of the zone thought to have potential to bear water, estimates of hydraulic conductivities ranged from a low of

$2x10^{-4}$ ft/day to a high of $7x10^{-3}$ ft/day. These values are consistent with published values representative of silt, clayey sand, or silty sand (Halford and Kuniansky 2002; Fetter 1994).

The testing and analysis presented herein indicates that while minor water-bearing zones may be present in the sub-surface in the vicinity of the TomCo project site, these by definition cannot be classified as aquifers due to the low yield, and apparent limited lateral and vertical extent of the water-bearing zones in contact with the screened intervals of TomCo MW-01. MW-02. And MW-03.

5 REFERENCES CITED

Driscoll, F.G., 1986. Groundwater and Wells (2nd ed.), Johnson Filtration Systems, Inc., St. Paul, Minnesota, pp. 252-257.

Duffield, G.M., 2007. AQTESOLV for Windows Version 4.5 User's Guide, HydroSOLVE, Inc., Reston, VA.

Fetter, C.W., 1994. Applied Hydrogeology (3rd Edition), Prentice-Hall, Inc., Upper Saddle River, New Jersey, pg 98.

Halford, K.J. and Kuniansky, E.L., 2002. Documentation of Spreadsheets for the Analysis of Aquifer-Test and Slug-Test Data, U.S. Geological Survey Open-File Report, 02-197, 51 p.

Moench, A.F., 1997. Flow to a well of finite diameter in a homogeneous, anisotropic water-table aquifer, Water Resources Research, vol. 33, no. 6, pp. 1397-1407.

Papadopulos, I.S. and H.H. Cooper, 1967. Drawdown in a well of large diameter, Water Resources Research, vol. 3, no. 1, pp. 241-244.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

APPENDIX A: WELL CONSTRUCTION AND LITHOLOGIC LOGS

Appendix A
Lithological Logs

MW-01, MW-02, MW-03, MW-04
Installed September 19th to October 9th, 2013
The Oil Mining Company, Inc.
Uintah County, Utah

Legend

Sandstone

Grainstone

Siltstone

Mudstone

Marlstone

Shale

Oil shale

Mahogany Zone

Volcanic tuff

Borehole / Well Completion Log

Client The Oil Mining Company
Project Holliday Block Groundwater Study
Well ID MW-01 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

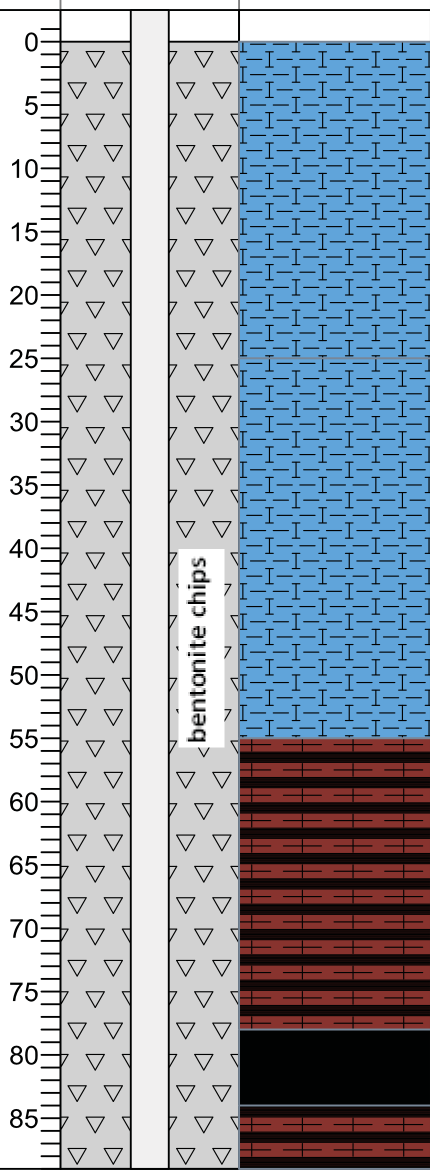
Drilling

Drilling Contractor	Himes Drilling			Northing	4405433.9
Drilled by	Sam Homedew	Completion Date	10/09/2013	Easting	654547.7
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6092.0
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	200'	TOC Elev. (ft)	6094.5
Drilling Method	Rotary	Borehole Dia. (in)	6.25"	Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 134.1'		
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	DTW (ft. btoc)	150.5 10/1/2013
Casing Joints	Threaded / Flush	Filter Interval	140.4' - 200'		* DTW measured after well development
Casing Dia. (in)	2"	Seal Material	Bentonite pellets	Notes:	
Screen Type	Sch. 80 PVC	Seal Interval	134.'1 - 140.4'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	148' - 198'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13		

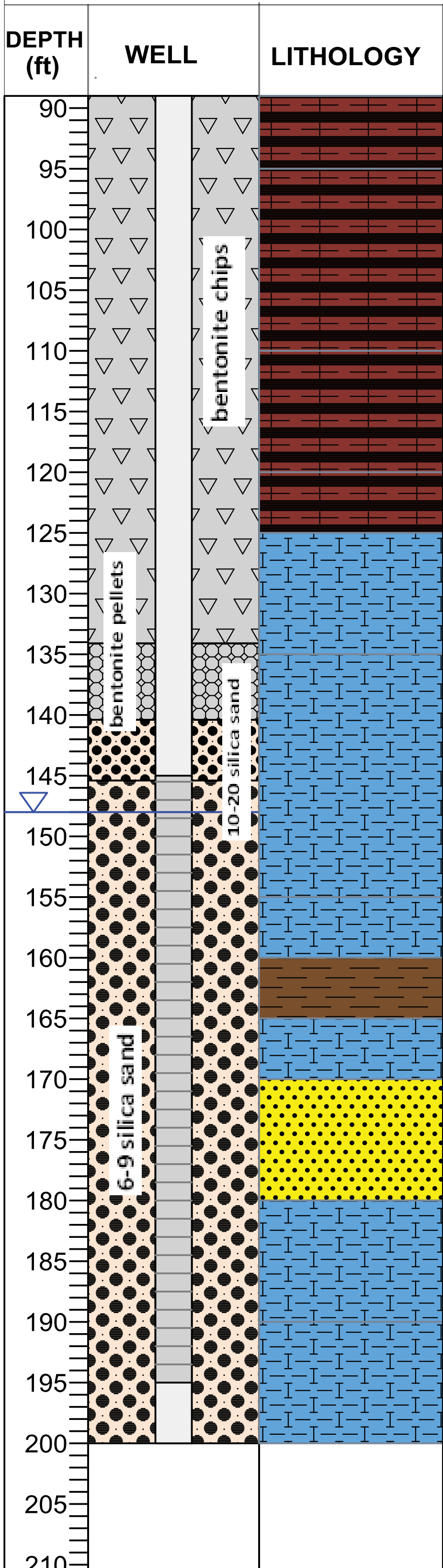
DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS
0 – 25			Brown to gray marlstone.	
25 – 55			Gray to black flakey, marlstone.	A Groove, 40 - 55 feet.
55 – 78			Dark brown to black shale with strong petroleum odor. Visible moisture on sample return, dust ceased at 70 feet. Very damp at 75 feet.	Mahogany Zone, 55 - 125 feet.
78 – 84			Dark brown to black oil shale.	Mahogany Bed.
84 –			Dark brown to black shale with petroleum odor. <2gpm water at 80 foot drill string reset, per driller.	



Borehole / Well Completion Log

Client: The Oil Mining Company
Project: Holliday Block Groundwater Study
Well ID: MW-01
Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists



LITHOLOGICAL DESCRIPTION	REMARKS
Dark brown to black shale with petroleum odor. <2gpm water at 80 foot drill string reset, per driller.	
Dark brown to black shale with occasional light brown to light gray claystone, medium petroleum odor.	
Brown shale to marlstone with medium petroleum odor.	
Brown to gray shale to marlstone with reducing petroleum odor and very fine chips.	Possible Curly Tuff.
Gray to brown marlstone, very fine chips.	B Groove, 125 - 135 feet.
Gray to light brown marlstone with dark brown to black fine sandstone.	
Gray to brown marlstone.	
Gray shale to marlstone with thin flaky chips	
Gray to black marlstone with gray sandstone. Mild petroleum odor.	
Black to gray very fine sandstone.	
Coarse gray marlstone with occasional fine sand.	
Gray marlstone to shale.	

Borehole / Well Completion Log

Client The Oil Mining Company

Project Holliday Block Groundwater Study

Well ID MW-02 **Project No.** LO-000080-0003-10TTO

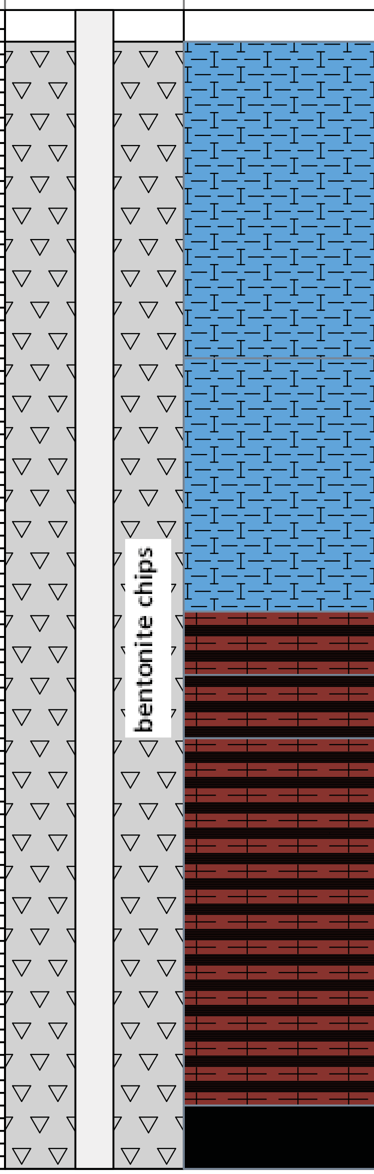
ecology and environment, inc.
Global Environmental Specialists

Drilling

Drilling Contractor	Himes Drilling			Northing	4403964.9
Drilled by	Sam Homedew	Completion Date	10/08/2013	Easting	654602.0
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6232.0
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	200'	TOC Elev. (ft)	6234.5
Drilling Method	Rotary	Borehole Dia. (in)	6.25"	Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 127.4'	
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	DTW (ft. btoc) 115.3 10/1/2013
Casing Joints	Threaded / Flush	Filter Interval	134.5' - 200'	* DTW measured after well development
Casing Dia. (in)	2"	Seal Material	Bentonite pellets	Notes:
Screen Type	Sch. 80 PVC	Seal Interval	127.4' - 134.5'	
Slot Size (in)	0.0	Surface Seal	Cement pad	
Screen Interval	148' - 198'	Development	Surge, air lift on 10/9/13	
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13	



DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS
0			Gray marlstone.	
25			Gray to brown marlstone.	A Groove, 25-45 feet.
45			Dark gray to dark brown shale with strong petroleum odor. Visible moisture with sample return.	Mahogany Zone, 45 - 120 feet.
52			Dark gray to dark brown shale with strong petroleum odor.	
57			Dark gray to dark brown oil shale with strong petroleum odor. Pushed 1-2 gpm water at 60 foot pipe reset per driller.	
85			Light brown to light gray shale with very strong petroleum odor.	Mahogany Bed.

Borehole / Well Completion Log

Client The Oil Mining Company

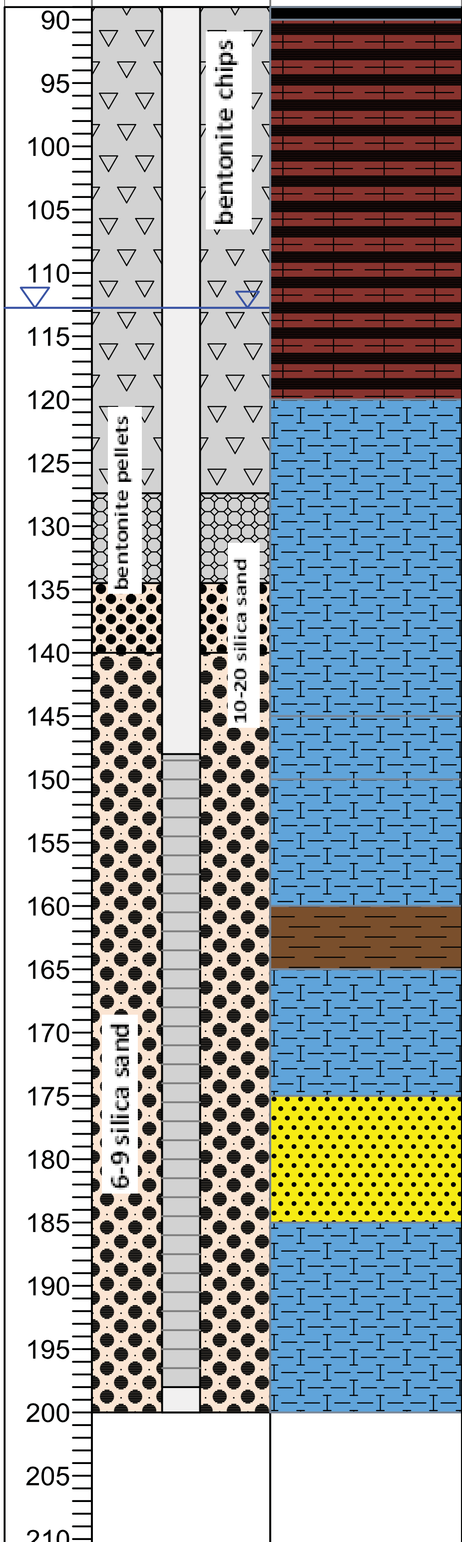
Project Holliday Block Groundwater Study

Well ID MW-02

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



Light brown to light gray shale with very strong petroleum odor.

Light brown to light gray shale with petroleum odor.

Gray marlstone.

Gray to light brown marlstone.

Gray to light brown marlstone with occasional buff to yellowish brown tuff.

Gray to brown marlstone to shale.

Gray to black marlstone.

Black to gray very fine sandstone to very coarse marlstone

Gray marlstone.

REMARKS: B Groove, 120 - 130 feet.

Borehole / Well Completion Log

Client The Oil Mining Company

Project Holliday Block Groundwater Study

Well ID MW-03 **Project No.** LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

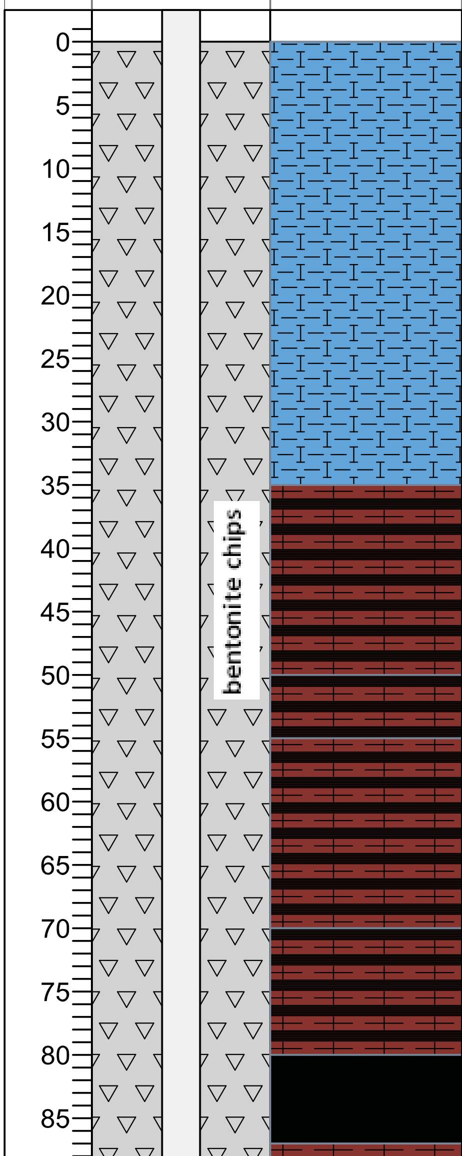
Drilling

Drilling Contractor	Himes Drilling			Northing	4405418.3
Drilled by	Sam Homedew	Completion Date	10/09/2013`	Easting	655179.6
Logged By	J.J. Brown	Drilling Fluid	Air and foam	Surface Elev. (ft)	6132.4
Drill Rig	Truck-mounted Portadrill TKT	Borehole Depth	200'	TOC Elev. (ft)	6134.9
Drilling Method	Rotary	Borehole Dia. (in)	6.25"	Stick-up/down	2.5

Well

Well Depth (bgs)	200'	Backfill Interval	0' - 110.8'		
Casing Type	Sch. 80 PVC	Filter Material	6-9 Colorado Silica Sand	DTW (ft. btoc)	129.4 10/1/2013
Casing Joints	Threaded / Flush	Filter Interval	117.3' - 199.3'		* DTW measured after well development
Casing Dia. (in)	2"	Seal Material	Bentonite pellets	Notes:	
Screen Type	Sch. 80 PVC	Seal Interval	102.6' - 110.8'		
Slot Size (in)	0.0	Surface Seal	Cement pad		
Screen Interval	117.3' - 197.3'	Development	Surge, air lift on 10/9/13		
Backfill Material	Bentonite chips		Surge, air lift, pump on 10/22/13		

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS
0			Gray marlstone, large chip size.	
17				A Groove, 17 - 35 feet.
35			Gray to dark brown shale with mild petroleum odor and platy chips.	Mahogany Zone, 35 - 120 feet.
50			Dark brown shale with mild petroleum odor.	
55			Dark brown friable oil shale with strong petroleum odor.	
70			Brown to gray friable oil shale with strong petroleum odor.	
80			Gray to brown shale with persistent strong petroleum odor and very fine flaky chips.	Mahogany Bed.



Borehole / Well Completion Log

Client: The Oil Mining Company

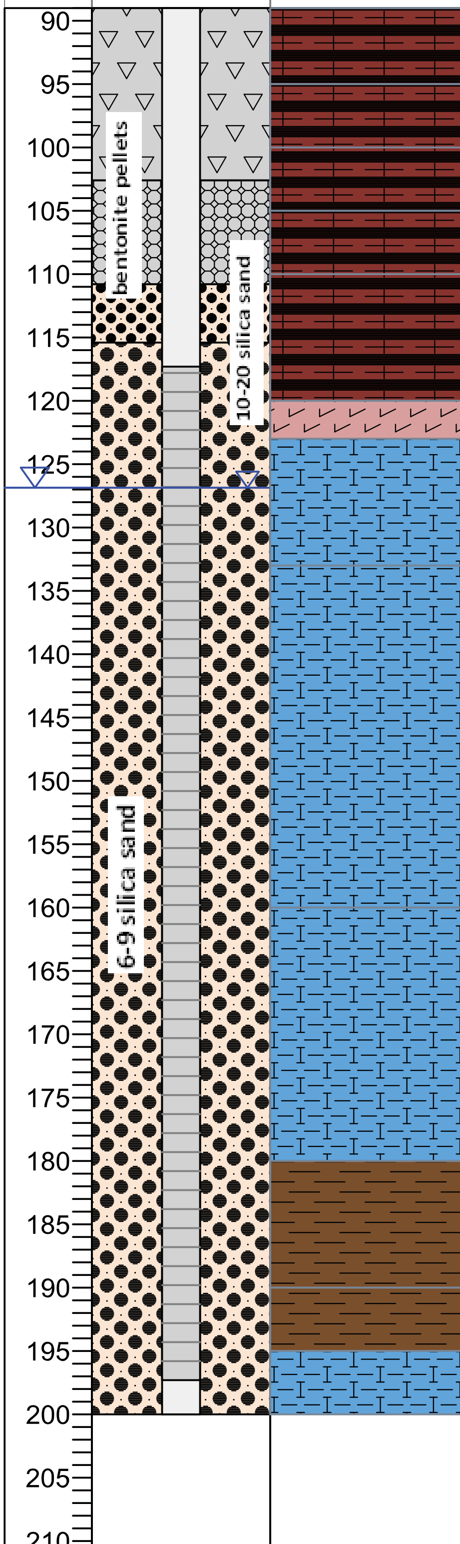
Project: Holliday Block Groundwater Study

Well ID: MW-03

Project No. LO-000080-0003-10TTO

ecology and environment, inc.
Global Environmental Specialists

DEPTH (ft)	WELL	LITHOLOGY	LITHOLOGICAL DESCRIPTION	REMARKS



Light gray to dark brown marlstone and shale with odor and chips as above.

Gray to dark brown marlstone and shale with odor and chips as above.

Gray to dark brown shale with odor and chips as above.

Gray to dark brown marlstone and shale with odor and chips as above.

Gray to dark brown shale with odor as above.

Buff colored tuff.

Dark gray coarse marlstone, very fine chips, poor strength.

Dark gray weak coarse marlstone with trace very fine sandstone. Tangy odor. Coarse silt and very fine pulverized sand in cuttings with low plasticity.

Gray to brown marlstone and shale.

Dark gray to brown shale.

Light gray shale with light gray to white marlstone with low competency.

Gray marlstone.

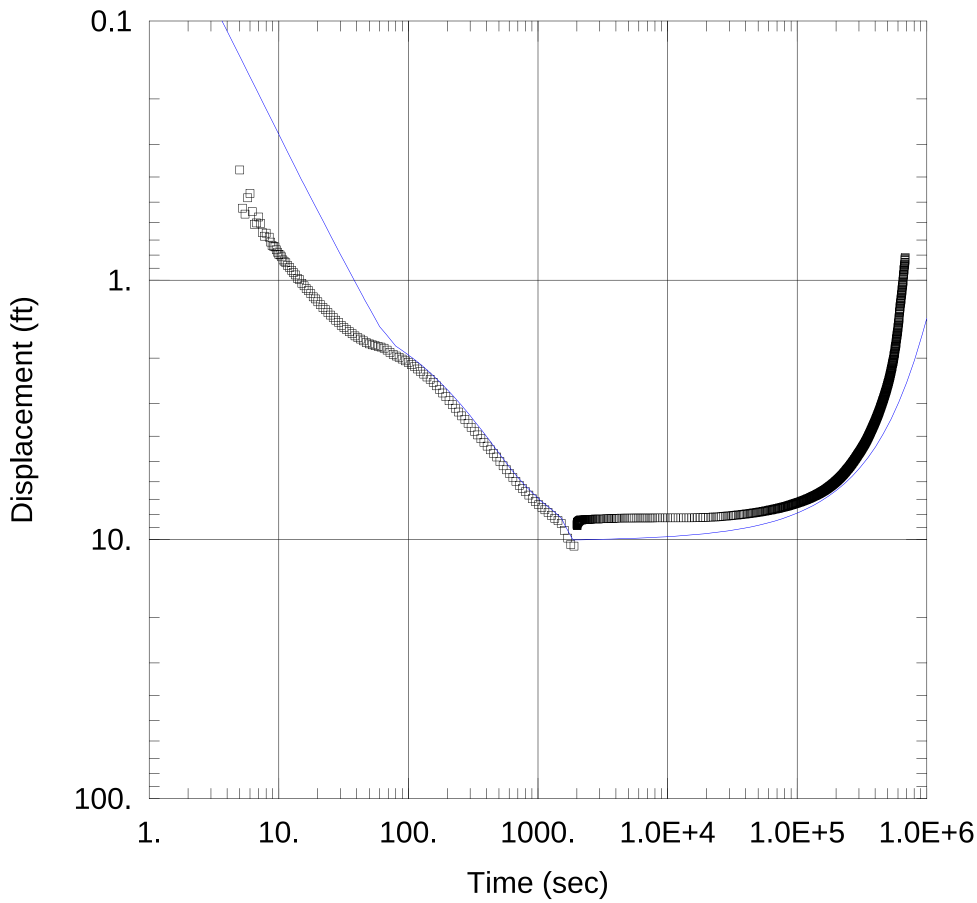
REMARKS:

Wavy Tuff, 120 - 123 feet.

B Groove, 123 - 133 feet.

APPENDIX B: AQTESOLV PLOTS

Appendix B1: MW-01



MW-01 PUMP AND RECOVERY

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-01 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:08:33

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-01
Test Date: 11/7/2014

AQUIFER DATA

Saturated Thickness: 24.54 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-01	0	0

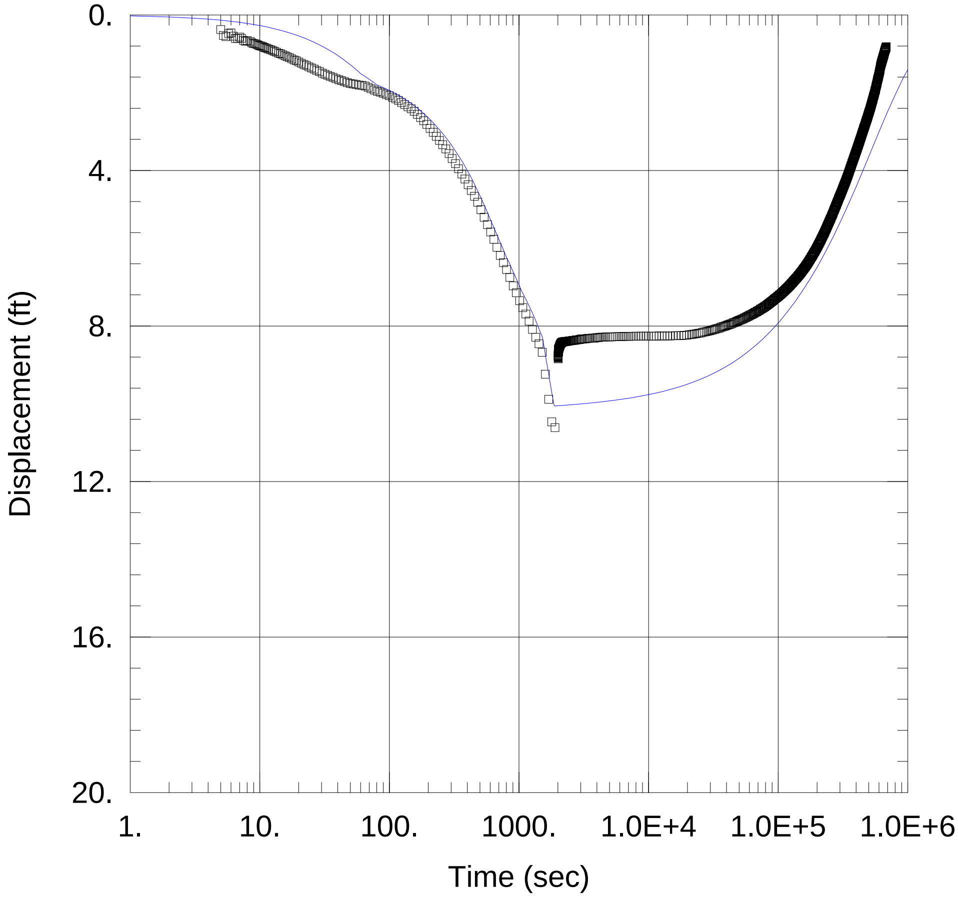
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-01	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.005655 ft^2/day
S = 5.002E-5
Sy = 0.1306
ß = 8.173E-5
Sw = -1.655
r(w) = 0.2218 ft
r(c) = 0.1589 ft
alpha = 1.249E-8 sec^{-1}



MW-01 PUMP AND RECOVERY

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-01 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:07:32

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-01
Test Date: 11/7/2014

AQUIFER DATA

Saturated Thickness: 24.54 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-01	0	0

Observation Wells

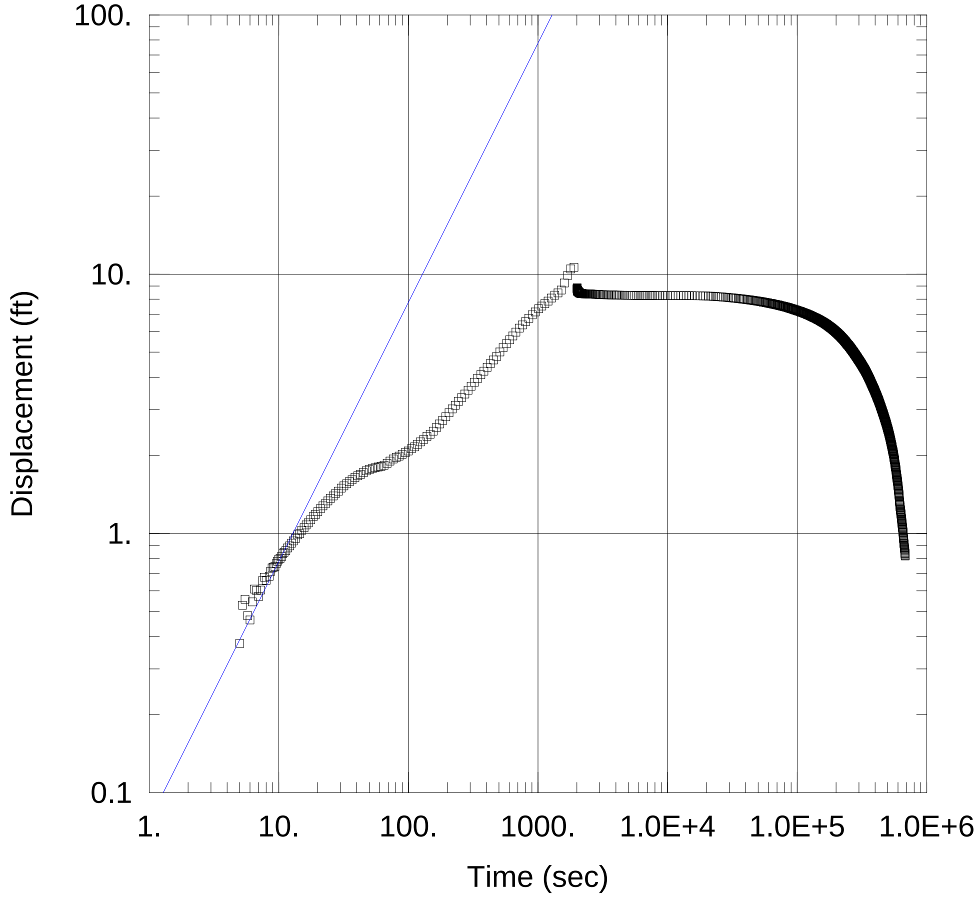
Well Name	X (ft)	Y (ft)
□ MW-01	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.005655 ft^2/day
Sy = 0.1306
Sw = -1.655
r(c) = 0.1589 ft

S = 5.002E-5
ß = 8.173E-5
r(w) = 0.2218 ft
alpha = 1.249E-8 sec^{-1}



MW-01 PUMP AND RECOVERY

Data Set: C:\...\MW-01 Moench (unconfined) Radial Flow log-log.aqt
Date: 11/17/14 Time: 17:58:55

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-01
Test Date: 11/7/2014

AQUIFER DATA

Saturated Thickness: 24.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-01	0	0

Observation Wells

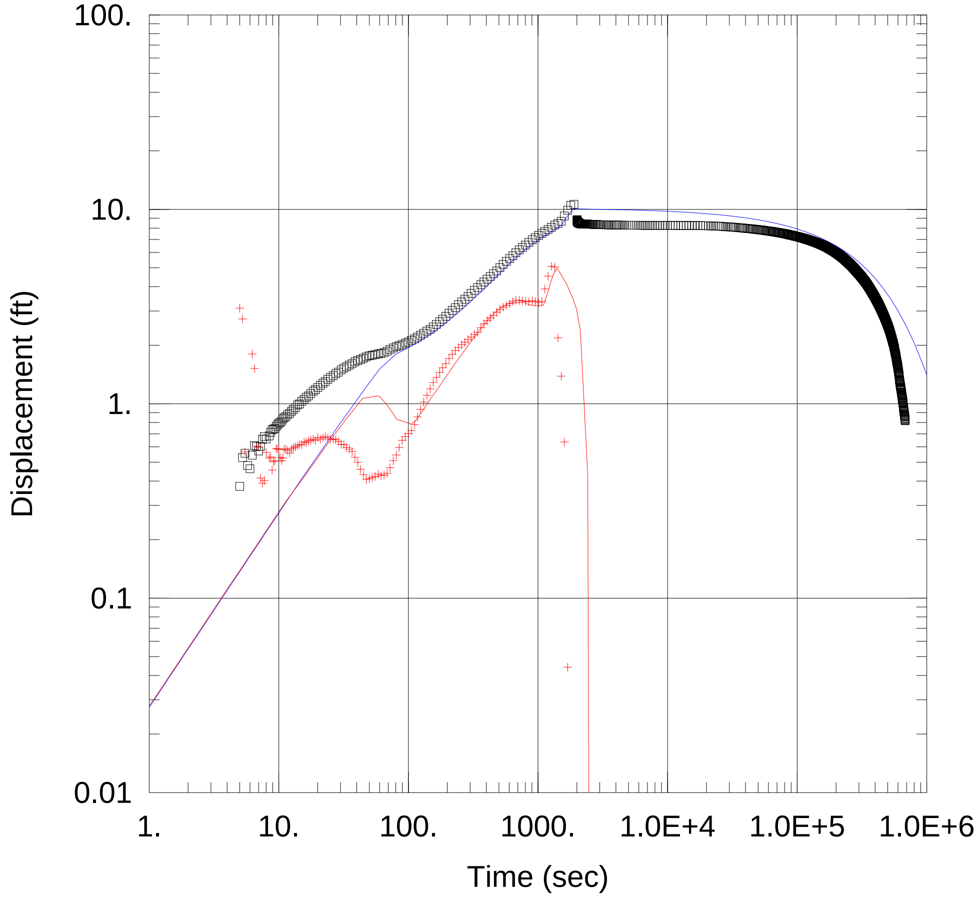
Well Name	X (ft)	Y (ft)
□ MW-01	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.005655 ft^2/day
Sy = 0.1306
Sw = -1.655
r(c) = 0.1589 ft

S = 5.002E-5
ß = 8.173E-5
r(w) = 0.2218 ft
alpha = 1.249E-8 sec^{-1}



MW-01 PUMP AND RECOVERY

Data Set: C:\...\MW-01 Moench (unconfined) Derivitive Analysis.aqt
Date: 11/17/14 Time: 18:02:16

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-01
Test Date: 11/7/2014

AQUIFER DATA

Saturated Thickness: 24.54 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-01	0	0

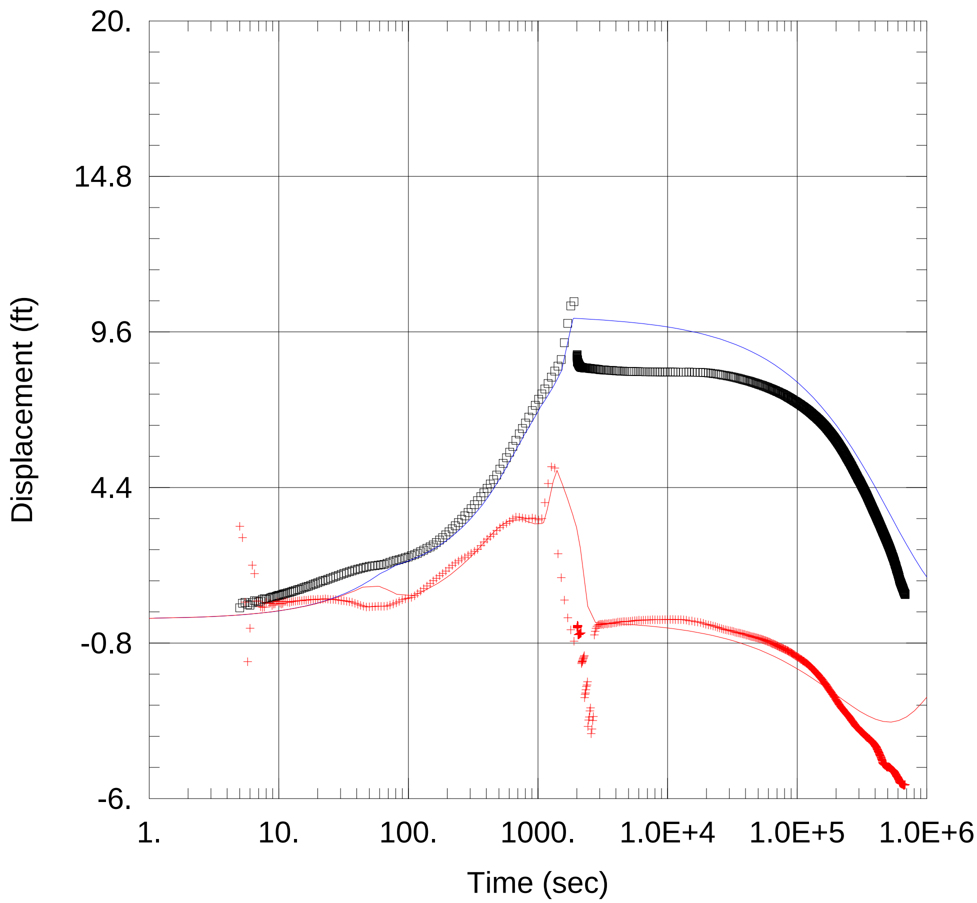
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-01	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.005655 ft^2/day
S = 5.002E-5
Sy = 0.1306
ß = 8.173E-5
Sw = -1.655
r(w) = 0.2218 ft
r(c) = 0.1589 ft
alpha = 1.249E-8 sec^{-1}



MW-01 PUMP AND RECOVERY

Data Set: C:\...\MW-01 Moench (unconfined) Derivitive Analysis.aqt
Date: 11/17/14 Time: 18:04:13

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-01
Test Date: 11/7/2014

AQUIFER DATA

Saturated Thickness: 24.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-01	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-01	0	0

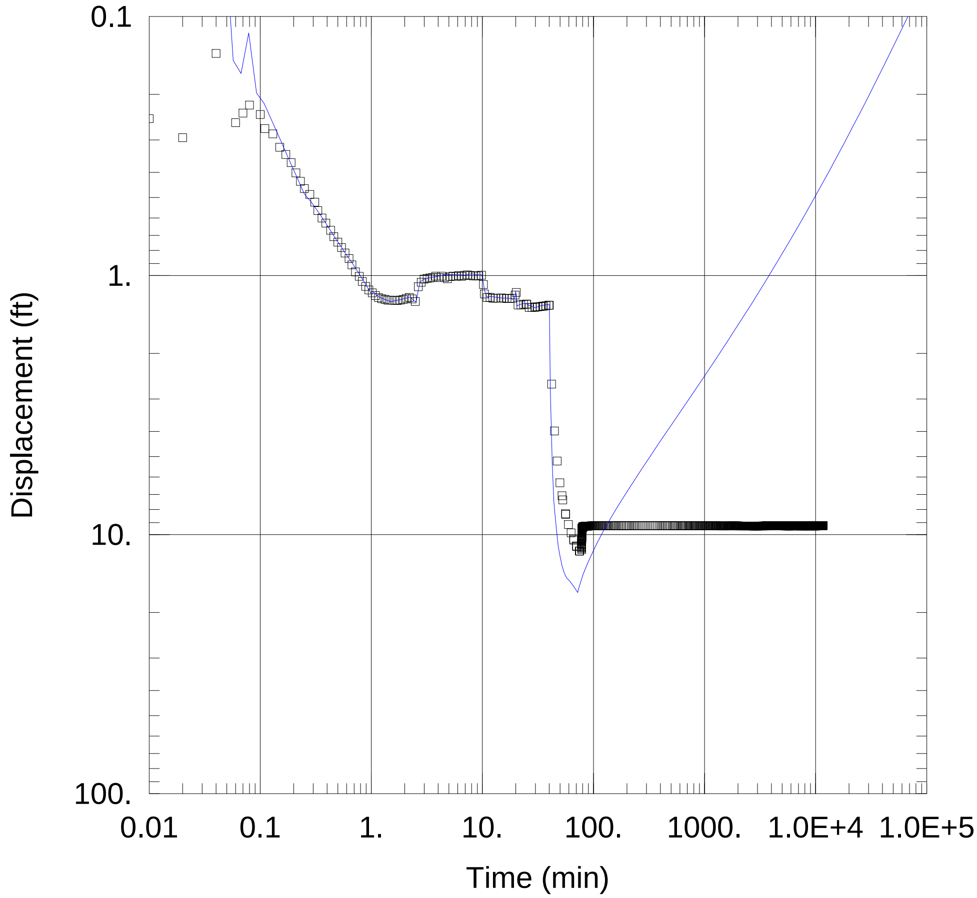
SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.005655 ft^2/day
Sy = 0.1306
Sw = -1.655
r(c) = 0.1589 ft

S = 5.002E-5
ß = 8.173E-5
r(w) = 0.2218 ft
alpha = 1.249E-8 sec^{-1}

Appendix B2: MW-02



MW-02 PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-02 Moench (unconfined) ver4.aqt
Date: 11/12/14 Time: 13:24:52

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-02
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 16.45 ft Anisotropy Ratio (Kz/Kr): 2.438

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-02	0	0

Observation Wells

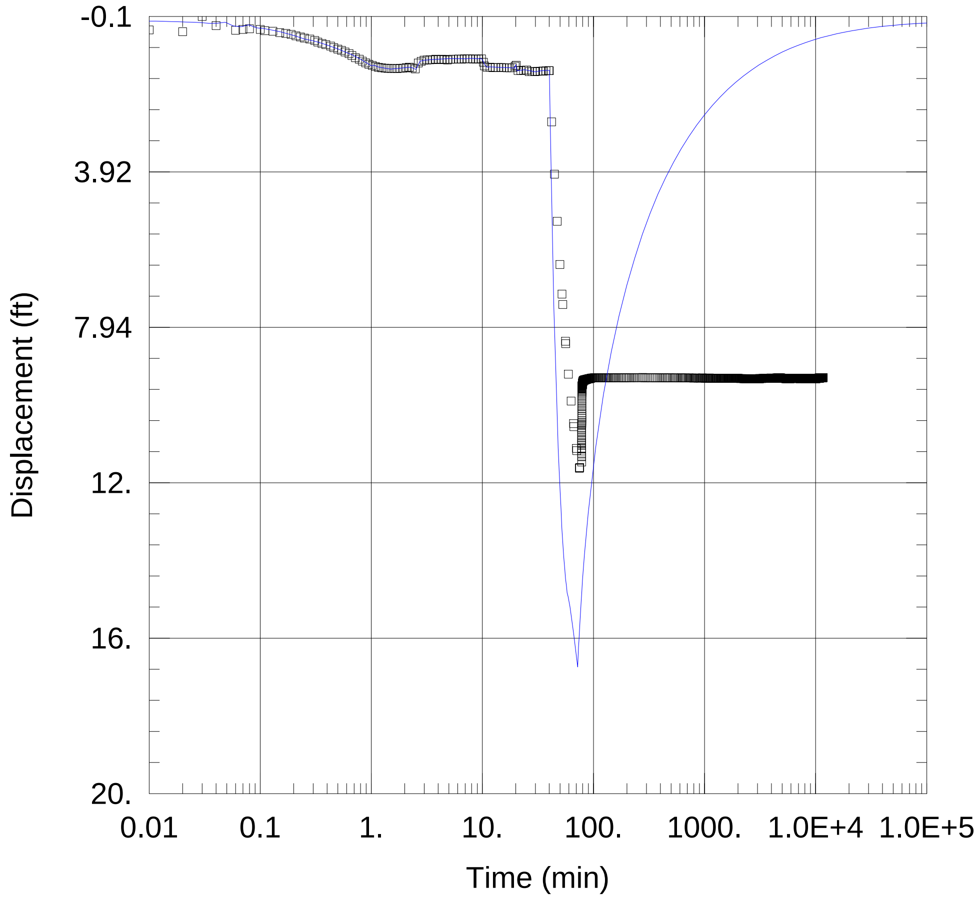
Well Name	X (ft)	Y (ft)
□ MW-02	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.01091 ft^2/day
Sy = 0.00121
Sw = 0.
r(c) = 0.0833 ft

S = 1.
ß = 0.000609
r(w) = 0.26 ft
alpha = 2.719E+9 min^{-1}



MW-02 PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-02 Moench (unconfined) ver4.aqt
Date: 11/12/14 Time: 13:25:21

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-02
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 16.45 ft
Anisotropy Ratio (Kz/Kr): 2.438

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-02	0	0

Observation Wells

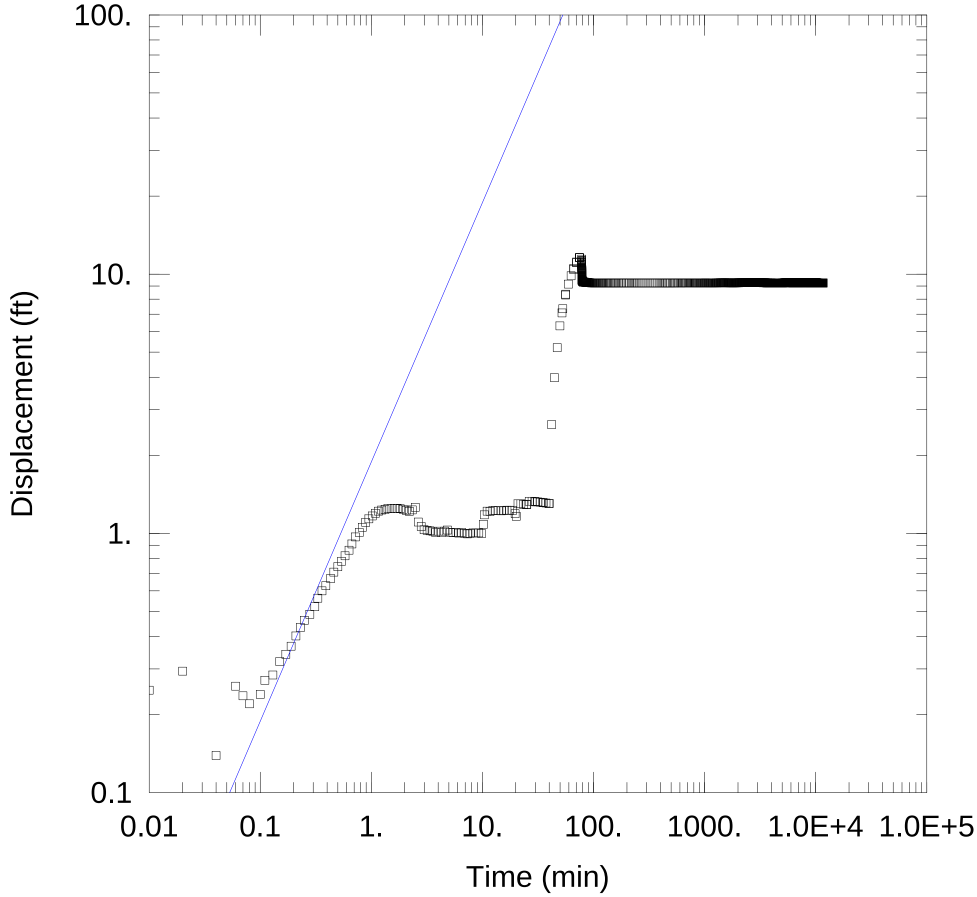
Well Name	X (ft)	Y (ft)
□ MW-02	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.01091 ft^2/day
Sy = 0.00121
Sw = 0.
r(c) = 0.0833 ft

S = 1.
ß = 0.000609
r(w) = 0.26 ft
alpha = 2.719E+9 min^{-1}



MW-02 PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-02 Moench (unconfined) ver4.aqt
Date: 11/12/14 Time: 13:29:10

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-02
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 16.45 ft
Anisotropy Ratio (Kz/Kr): 2.438

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-02	0	0

Observation Wells

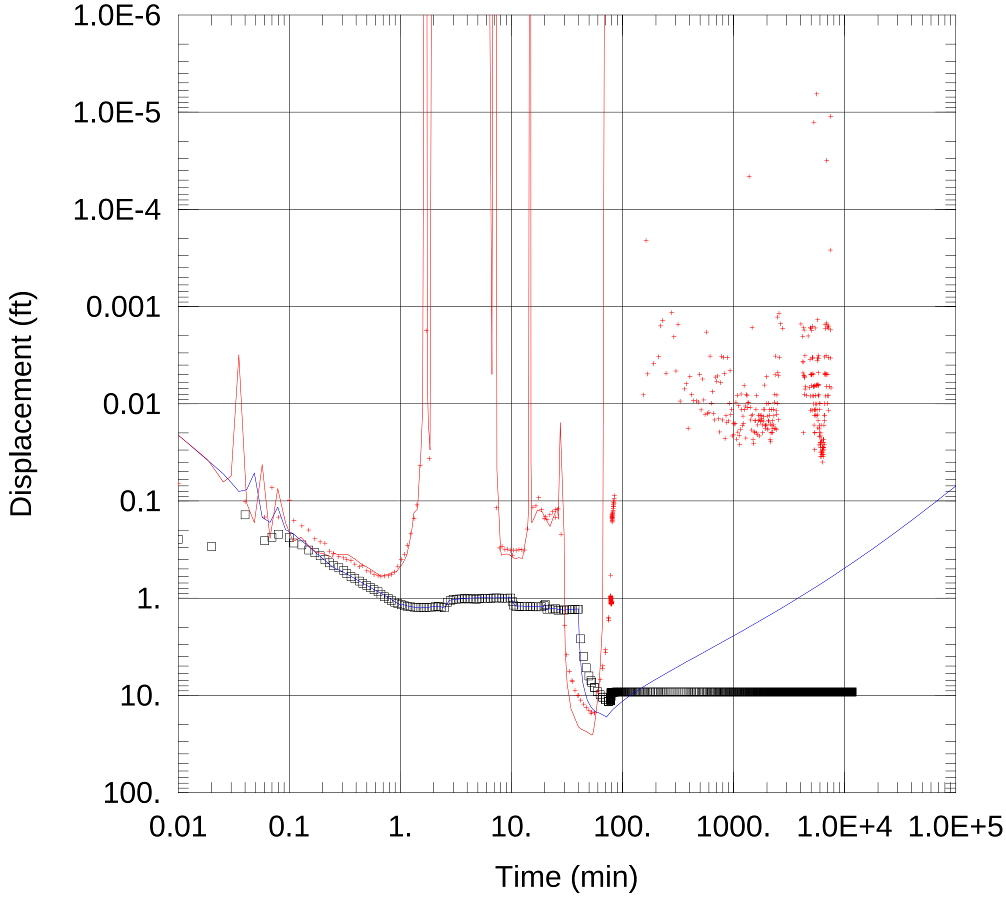
Well Name	X (ft)	Y (ft)
□ MW-02	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.01091 ft^2/day
Sy = 0.00121
Sw = 0.
r(c) = 0.0833 ft

S = 1.
ß = 0.000609
r(w) = 0.26 ft
alpha = 2.719E+9 min^{-1}



MW-02 PUMP & RECOVERY TEST

Data Set: C:\...\MW-02 Moench (unconfined) ver4 Derivitive Analysis.aqt
Date: 11/12/14 Time: 13:32:57

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-02
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 16.45 ft
Anisotropy Ratio (Kz/Kr): 2.438

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-02	0	0

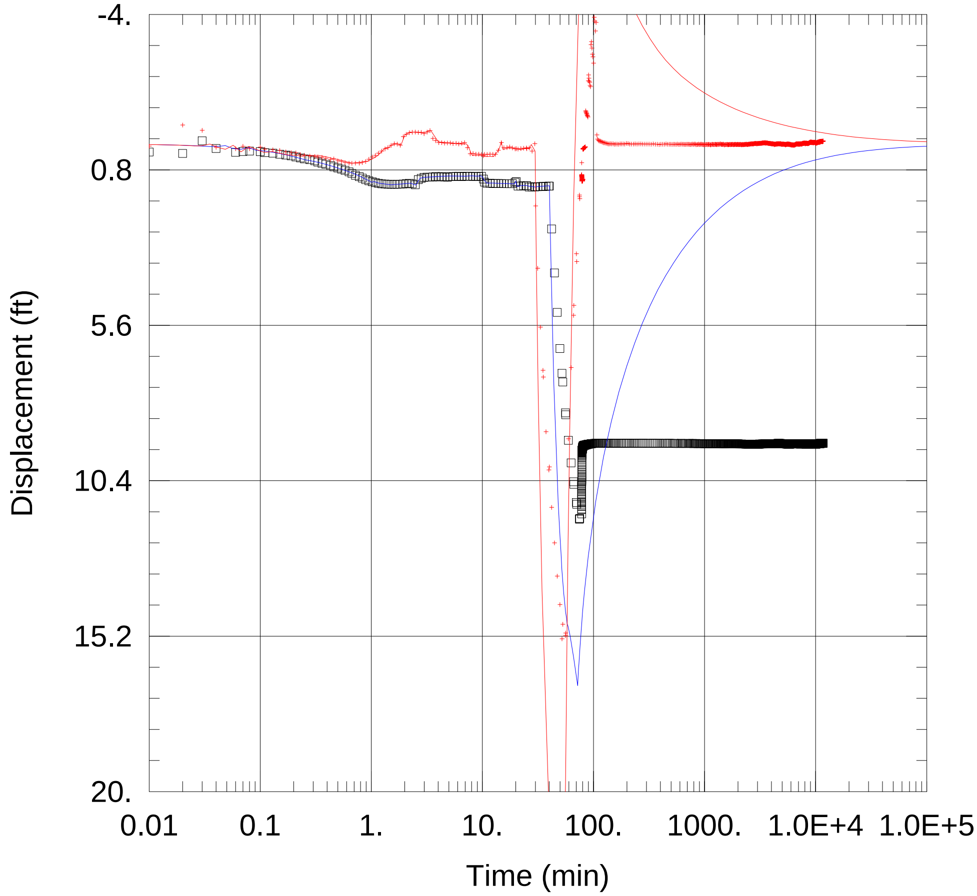
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-02	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.01091 ft^2/day
S = 1.
Sy = 0.00121
ß = 0.000609
Sw = 0.
$r(w)$ = 0.26 ft
$r(c)$ = 0.0833 ft
alpha = 2.719E+9 min^{-1}



MW-02 PUMP & RECOVERY TEST

Data Set: C:\...\MW-02 Moench (unconfined) ver4 Derivitive Analysis.aqt
Date: 11/12/14 Time: 13:33:21

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-02
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 16.45 ft   Anisotropy Ratio (Kz/Kr): 2.438

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-02	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-02	0	0

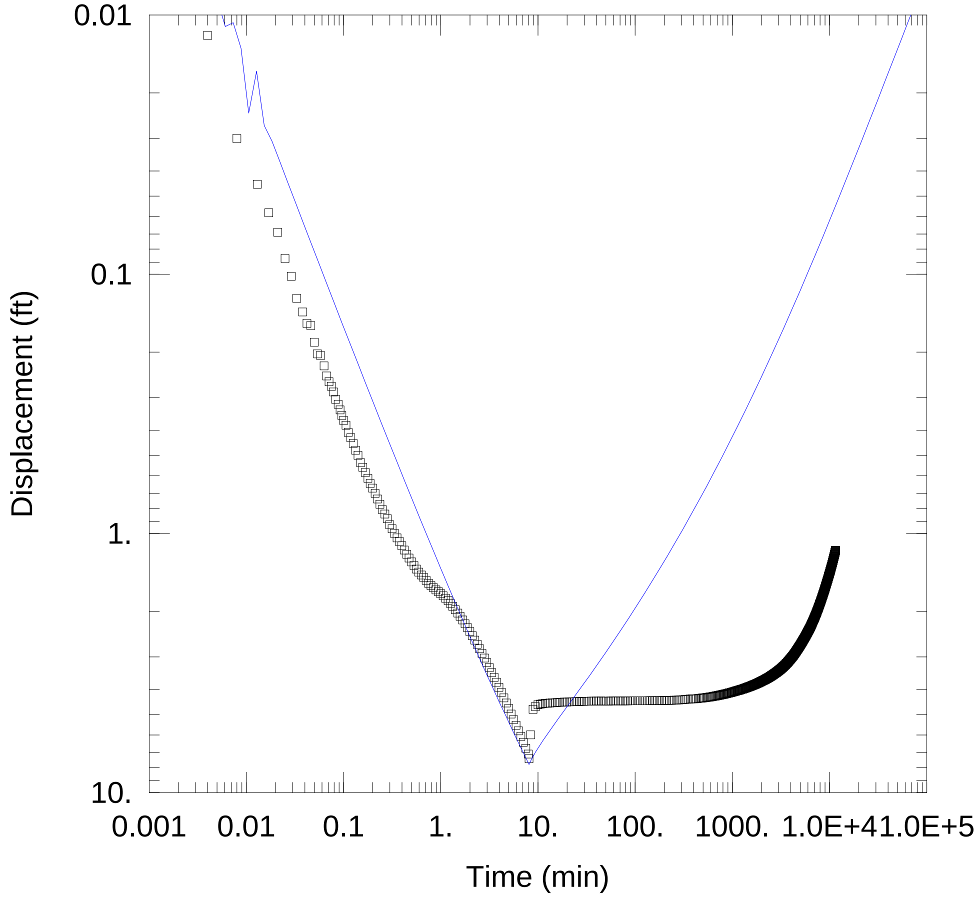
SOLUTION

Aquifer Model: Unconfined   Solution Method: Moench

T = 0.01091 ft^2/day
Sy = 0.00121
Sw = 0.
r(c) = 0.0833 ft

S = 1.
ß = 0.000609
r(w) = 0.26 ft
alpha = 2.719E+9 min^{-1}

Appendix B3: MW-03



MW-03 WELL PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-03 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:17:51

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-03
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 7.64 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-03	0	0

Observation Wells

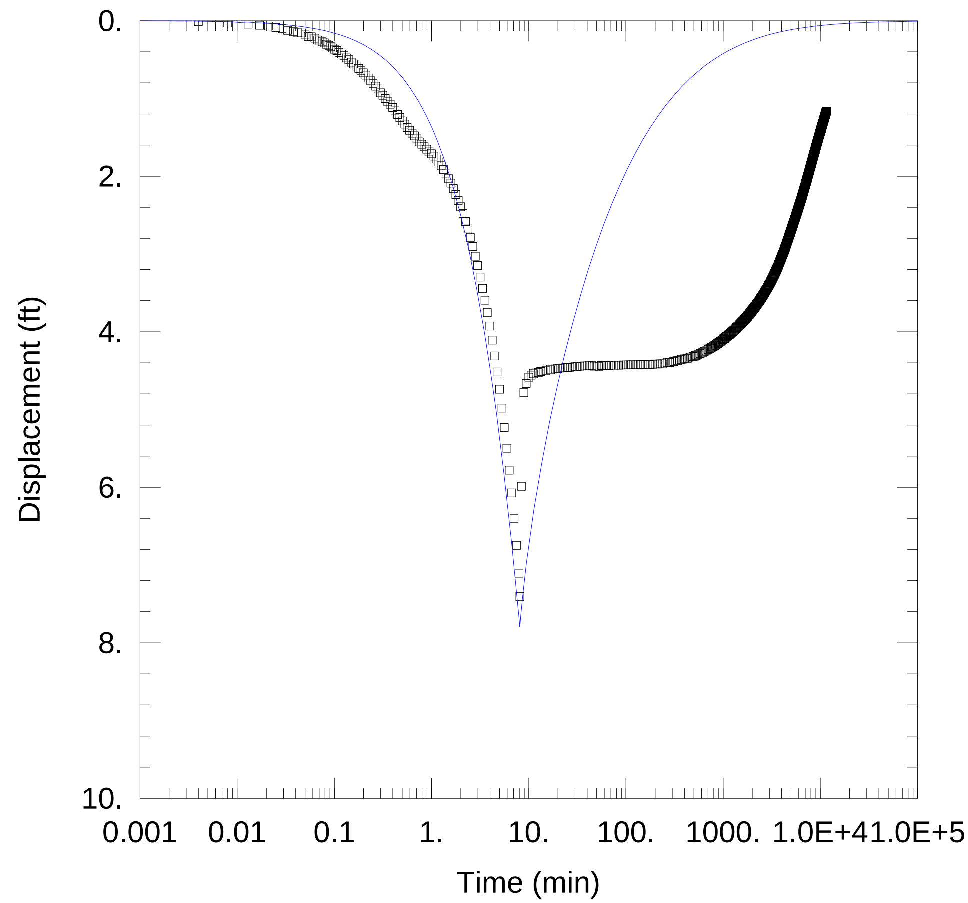
Well Name	X (ft)	Y (ft)
□ MW-03	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.06091 ft^2/day
Sy = 0.5
Sw = -0.075
r(c) = 0.1025 ft

S = 0.7937
ß = 0.001167
r(w) = 0.261 ft
alpha = 1.0E+30 min^{-1}



MW-03 WELL PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-03 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:16:29

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-03
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 7.64 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-03	0	0

Observation Wells

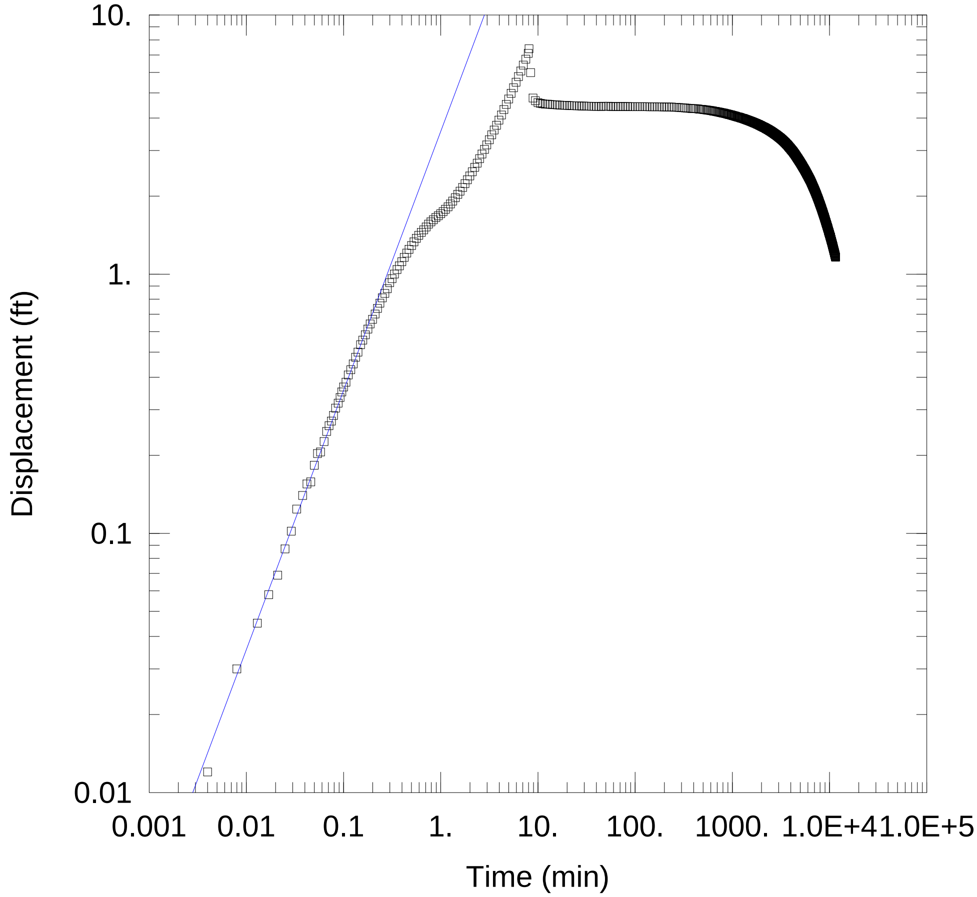
Well Name	X (ft)	Y (ft)
□ MW-03	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.06091 ft^2/day
Sy = 0.5
Sw = -0.075
r(c) = 0.1025 ft

S = 0.7937
ß = 0.001167
r(w) = 0.261 ft
alpha = 1.0E+30 min^{-1}



MW-03 WELL PUMP & RECOVERY TEST

Data Set: C:\...\MW-03 Moench (unconfined) Radial Flow log-log.aqt
Date: 11/17/14 Time: 19:28:30

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-03
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 7.64 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-03	0	0

Observation Wells

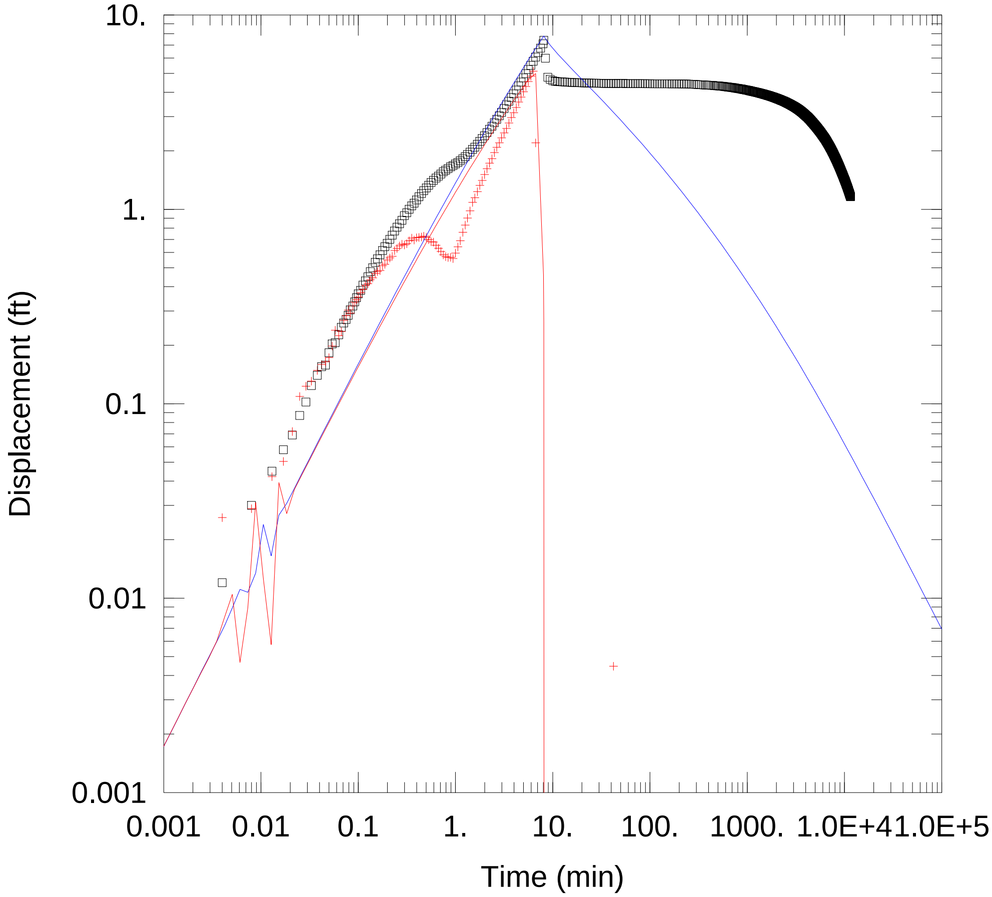
Well Name	X (ft)	Y (ft)
□ MW-03	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.06091 ft^2/day
Sy = 0.5
Sw = -0.075
r(c) = 0.1025 ft

S = 0.7937
ß = 0.001167
r(w) = 0.261 ft
alpha = 1.0E+30 min^{-1}



MW-03 WELL PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-03 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:20:55

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-03
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 7.64 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-03	0	0

Observation Wells

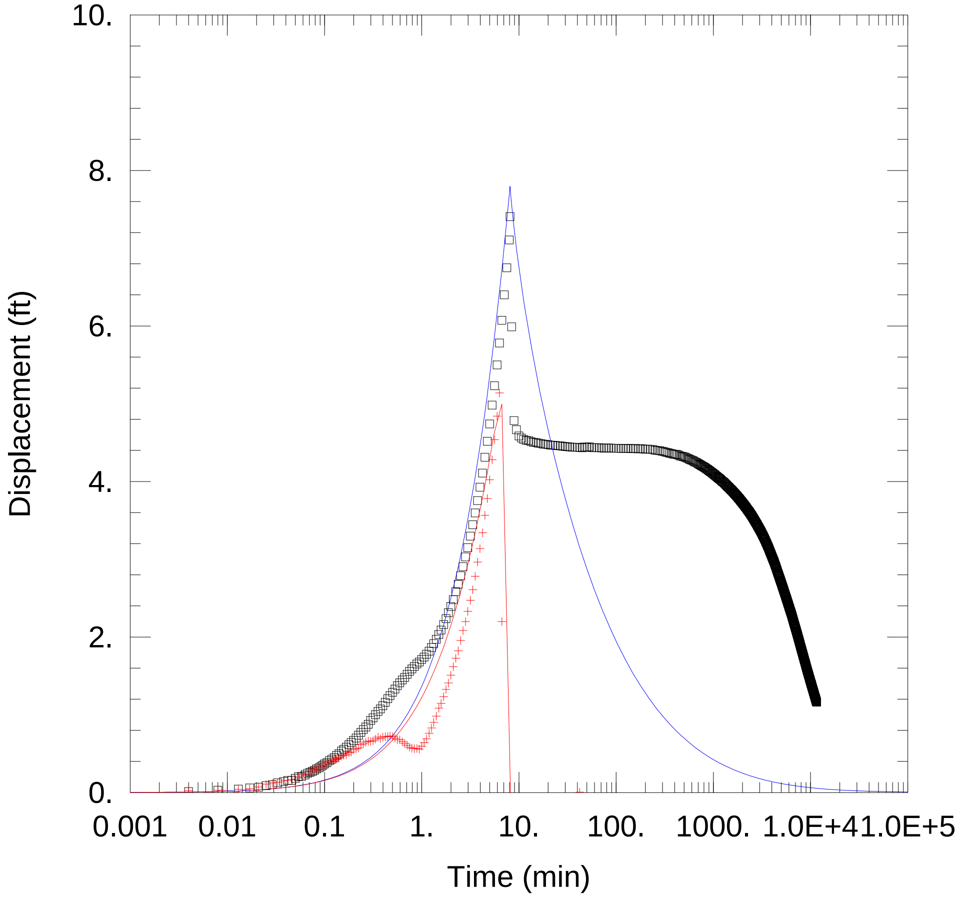
Well Name	X (ft)	Y (ft)
□ MW-03	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.06091 ft^2/day
Sy = 0.5
Sw = -0.075
r(c) = 0.1025 ft

S = 0.7937
ß = 0.001167
r(w) = 0.261 ft
alpha = 1.0E+30 min^{-1}



MW-03 WELL PUMP & RECOVERY TEST

Data Set: C:\Users\Jon Kaminsky\Documents\Personal\MW-03 Moench (unconfined).aqt
Date: 11/17/14 Time: 18:21:27

PROJECT INFORMATION

Company: Mesa Hydro-Logic
Client: TOMCo
Project: WO 15-1
Location: Holliday Block
Test Well: MW-03
Test Date: 10/22/2014

AQUIFER DATA

Saturated Thickness: 7.64 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-03	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-03	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 0.06091 ft^2/day
Sy = 0.5
Sw = -0.075
r(c) = 0.1025 ft

S = 0.7937
ß = 0.001167
r(w) = 0.261 ft
alpha = 1.0E+30 min^{-1}

APPENDIX C: PHOTOGRAPHS

Figure C- 1. View of Aquifer Test Setup at MW-01.

Figure C- 2. Close-up View of Pump Controller (right) and Electronic Water Level Measuring Tape (left) at MW-01.

Figure C- 3. View of Dark Gray Discolored Discharge Water Being Measured with a Graduated Bucket. At MW-01

Figure C- 4. View of Pump and discharge tubing being lowered into MW-02.

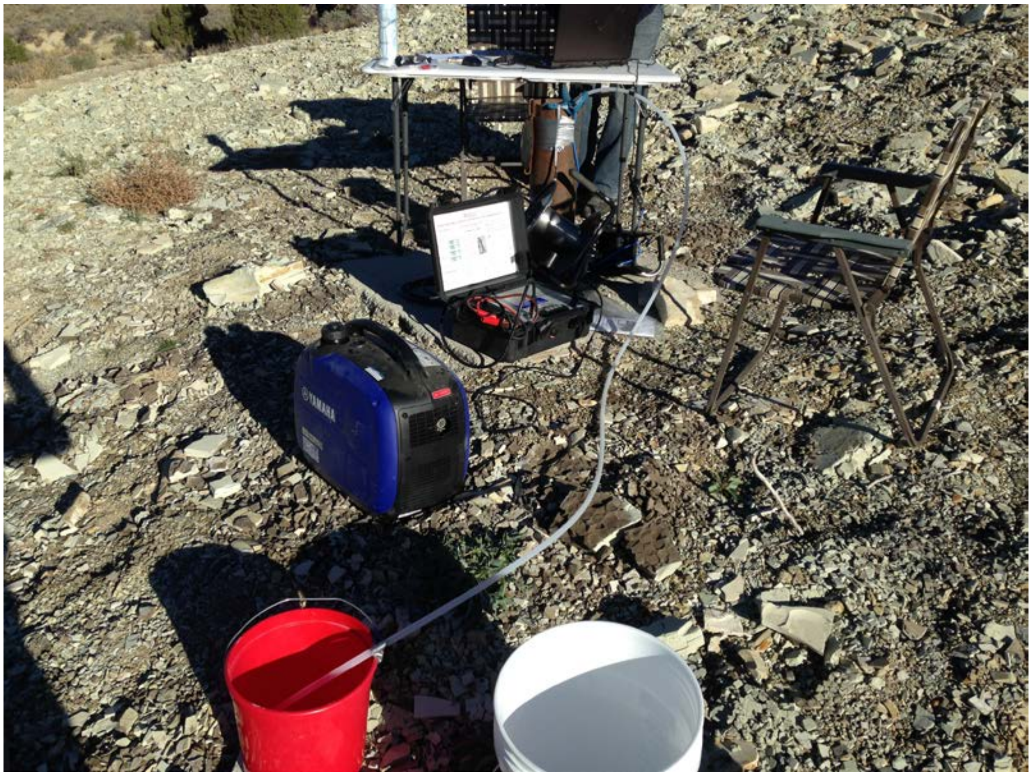


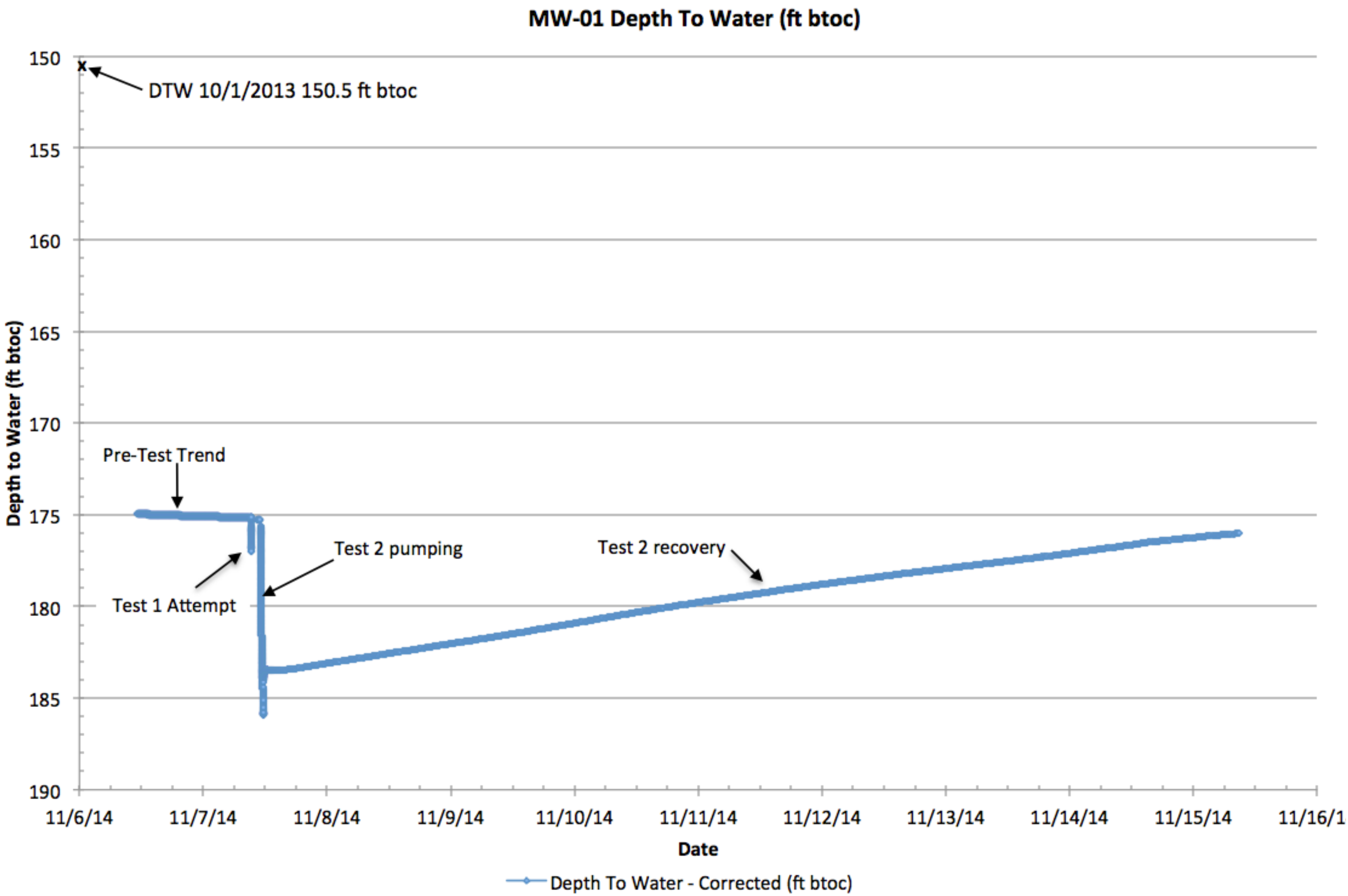
Figure C- 5. Completed Test Setup at MW-02.

Figure C- 6. Obtaining the Initial Depth to Water Level Measurement at MW-03.

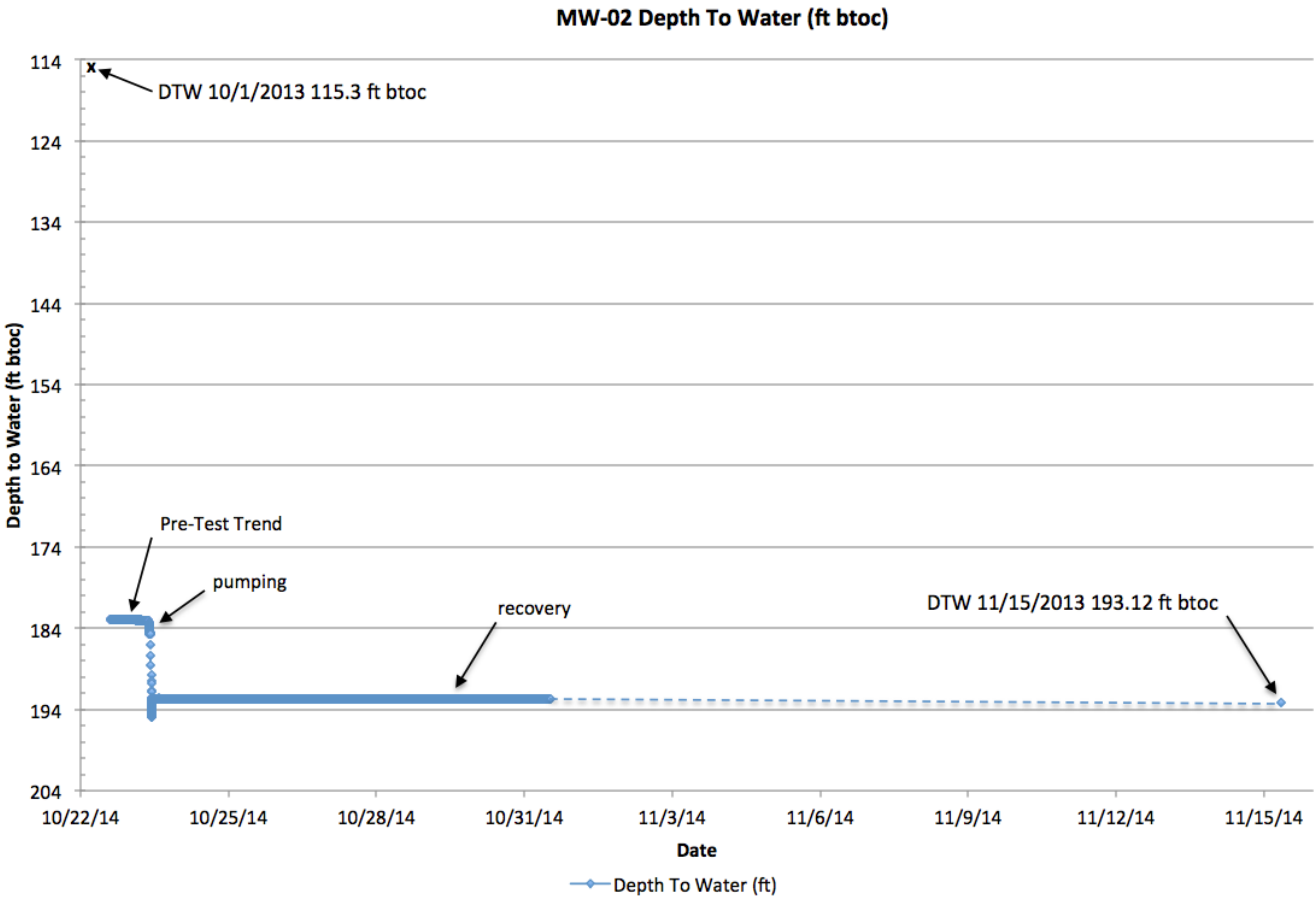
Figure C- 7. Completed Test Setup at MW-03.

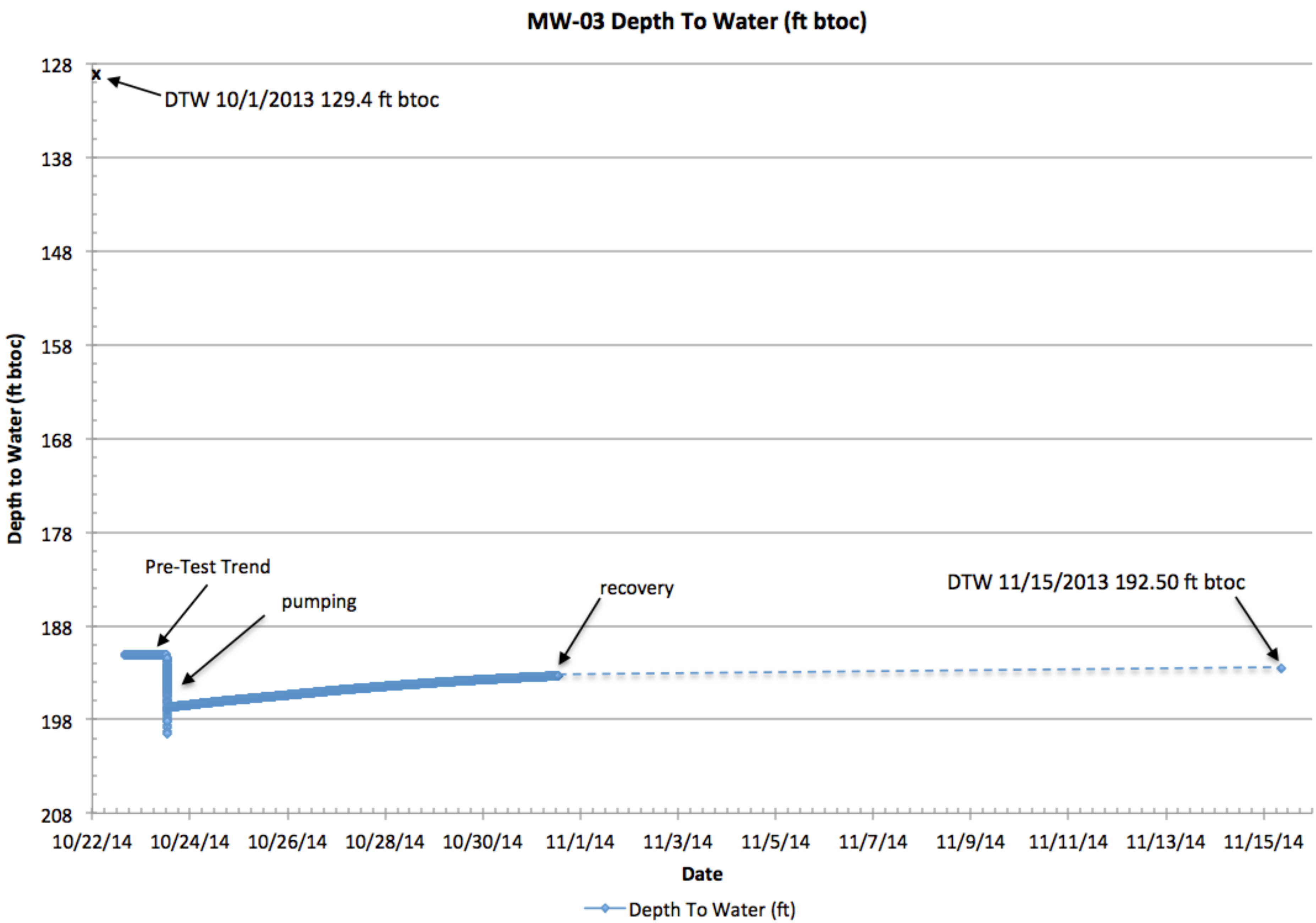
Figure C- 8. View into Graduated Bucket Containing Black Discolored Discharge Water from MW-03.

APPENDIX D: HYDROGRAPHS



MW-01 Depth To Water (ft btoc)
150
155
160
165
170
175
180
185
190
Depth to Water (ft btoc)
DTW 10/1/2013 150.5 ft btoc
Pre-Test Trend
Test 1 Attempt
Test 2 pumping
Test 2 recovery
11/6/14
11/7/14
11/8/14
11/9/14
11/10/14
11/11/14
11/12/14
11/13/14
11/14/14
11/15/14
11/16/1
Date
Depth To Water - Corrected (ft btoc)


MW-02 Depth To Water (ft btoc)
x
DTW 10/1/2013 115.3 ft btoc
Pre-Test Trend
pumping
recovery
DTW 11/15/2013 193.12 ft btoc
114
124
134
144
154
164
174
184
194
204
Depth to Water (ft btoc)
10/22/14
10/25/14
10/28/14
10/31/14
11/3/14
11/6/14
11/9/14
11/12/14
11/15/14
Date
Depth To Water (ft)



MW-03 Depth To Water (ft btoc)
Depth to Water (ft btoc)
128
138
148
158
168
178
188
198
208
DTW 10/1/2013 129.4 ft btoc
Pre-Test Trend
pumping
recovery
DTW 11/15/2013 192.50 ft btoc
10/22/14
10/24/14
10/26/14
10/28/14
10/30/14
11/1/14
11/3/14
11/5/14
11/7/14
11/9/14
11/11/14
11/13/14
11/15/14
Date
Depth To Water (ft)

APPENDIX K

GEOLOGICAL EVALUATION OF TOMCO AND RED LEAF PROPERTIES

GEOLOGICAL COMPARISON OF THE TOMCO SITE WITH RED LEAF SITE

Prepared for:

TomCo Energy PLC
50 Jermyn Street
London SW1Y
United Kingdom

December 2014

Prepared by:

LOWHAM WALSH LLC
Engineering & Environmental Services

EXECUTIVE SUMMARY

The Oil Mining Company, Inc. (TomCo) proposes to develop an oil shale mine and production project in Uintah County, Utah in Township 12 South, Range 24 East. As part of the permitting process, TomCo submitted a Ground Water Discharge Permit (GWDP) application to the Utah Division of Water Quality (DWQ) in February 2014.

After reviewing this GWDP application, the DWQ requested that TomCo provide information on the geochemical characteristics of spent oil shale so this information could be considered during the DWQ's preparation of a GWDP.

The DWQ specifically requested that TomCo conduct Synthetic Precipitation Leaching Procedure (SPLP) tests on spent shale—the material that would remain on site after ore processing was complete. The purpose of SPLP analysis is to determine if specific leachable contaminants are present in spent oil shale. Results from such testing can then be used to determine potential for contaminant release from spent shale waste and to assess possible impacts on groundwater quality.

The SPLP test must be conducted on material representative of site-specific materials. In the case of TomCo's project, the subject material is spent oil shale ore. However, because TomCo's project is in the development phase, no mining or processing of ore has been conducted; thus, there has not yet been an opportunity to provide representative spent shale waste rock material. TomCo has proposed to utilize SPLP results from similar material from the nearby Red Leaf Oil Shale Mining Project (Red Leaf) site if it can be demonstrated that the geologic site conditions at the Red Leaf site are sufficiently similar to TomCo to act as a surrogate data set for waste rock characteristics

This report provides a comparison of the geologic characteristics at the TomCo and Red Leaf sites.

Digital data obtained from United States Geological Survey (Johnson et al. 2010) and the Utah Geological Survey (Vanden Berg 2008) from over 630 wells drilled in the study region were reviewed for this report. These data were supplemented with well data obtained directly from the Utah Division of Oil, Gas and Mining Online Oil and Gas Information System. Information available from these sources included collar elevations, formation tops, Fischer assay results, and various geophysical logs. These data were parsed for appropriate location, focusing on the Red Leaf and TomCo sites and the intervening area between the sites.

The analysis demonstrated that the stratigraphy between the sites is remarkably similar and contiguous and that the Fischer analyses obtained for the Mahogany Zone were similar throughout the region studied. The similarity of the Fischer analyses suggest that these data can be extrapolated to the waste ore characteristics based on the hypothesis that spent waste rock of similar lithology, containing similar amounts of hydrocarbon, sharing a common geologic origin, and demonstrated to be contiguous throughout the region studied, should yield similar SPLP results.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
BAS	bentonite amended soil
bgs	below ground surface
DOGM	Utah Division of Oil, Gas and Mining
DWQ	Utah Division of Water Quality
EPS	Early Production System
GPT	gallons per ton
GWDP	Ground Water Discharge Permit
LMO	Large Mining Operation
OOGIS	Online Oil and Gas Information System
RLR	Red Leaf Resources, Inc.
SMO	Small Mining Operation
SPLP	Synthetic Precipitation Leaching Procedure
TomCo	The Oil Mining Company, Inc.

1 INTRODUCTION

The Utah Division of Water Quality (DWQ) requested that The Oil Mining Company, Inc. (TomCo) provide information on the geochemical characteristics of spent oil shale ore that would be produced in a single proposed Early Production System (EPS) capsule, to be located in Uintah County, Utah. This information will assist the DWQ in evaluating the likelihood of the EPS process impacting Utah's groundwater.

The DWQ requested that TomCo conduct Synthetic Precipitation Leaching Procedure (SPLP) testing on spent shale to be used in the EPS capsule. The purpose of SPLP analysis is to determine if leachable contaminants are present in the spent shale. Results from such testing can then be used to determine the potential for contaminant release from spent shale waste and possible impacts to groundwater quality.

Typically, SPLP is conducted via United States Environmental Protection Agency Solid Waste SW-846 Method 1312. Method 1312 is designed to determine the mobility of both organic and inorganic analytes present in liquids, soils, and wastes. The SPLP test simulates leaching, then analyzes leachate, which is defined as any liquid that, in passing through solid matter (in this case, spent shale), extracts solutes, suspended solids, or any other leachable component of the material through which it has passed. The SPLP test is designed to simulate material sitting in or on top of the ground surface exposed to rainfall (with an assumption that the rainfall is slightly acidic), then determine the mobility of both organic and inorganic analytes present in liquids, soils, and waste from the leachate the material produces. SPLP is used to determine the leaching potential of soils, waste, and wastewater caused primarily by rainfall (precipitation).

The SPLP test must be conducted on material representative of site-specific materials. In the case of TomCo's project, the subject material is spent shale. However, because TomCo's project is in the development phase, no mining and processing of ore has been conducted; thus, there has not yet been an opportunity to provide representative spent shale waste rock material. TomCo proposes to utilize SPLP results from similar material from the nearby Red Leaf Oil Shale Mining Project (Red Leaf) site if it can be demonstrated that the geologic site conditions at the Red Leaf site are sufficiently similar to TomCo act as a surrogate data set for waste rock characteristics.

This report compares the site characteristics of the TomCo and Red Leaf sites (**Figure 1**). To accomplish this comparison, digital data obtained from the United States Geological Survey (USGS) (Johnson et al. 2010) and the Utah Geological Survey (Vanden Berg 2008) from over 630 wells drilled in the study region were reviewed. These data were supplemented with well data obtained directly from the Utah Division of Oil, Gas and Mining (DOGM) Online Oil and Gas Information System (OOGIS):

(http://oilgas.ogm.utah.gov/Data_Center/LiveData_Search/main_menu.htm).

Information available from these sources included collar elevations, formation tops, Fischer assay results, and various geophysical logs. These data were parsed for appropriate location, focusing on the Red Leaf and TomCo sites and the intervening area between the sites. The borehole depth data were recalculated against mean sea level and imported into the Surfer gridding and contouring software package (Golden Software 2013) to create surfaces representing the elevation and attitude of key marker beds. This analysis demonstrated that the stratigraphy between the sites is remarkably similar and contiguous and that the Fischer analyses obtained for the Mahogany Zone were similar throughout the region studied.

The results of this analysis show that the lithologies beneath the sites are continuous, have the same formations and origin, are similar in thickness, and contain similar amounts of oil. These similarities suggest that SPLP testing on spent shale at the Red Leaf site would yield similar results to SPLP testing conducted on similar material at the TomCo site.

The similarity of the Fischer analyses suggests that these data can be extrapolated to the spent shale characteristics based on the hypothesis that a similar lithological rock type containing similar amounts of hydrocarbon and sharing a common geologic origin, and demonstrated to be contiguous throughout the region studied, should yield similar SPLP results.

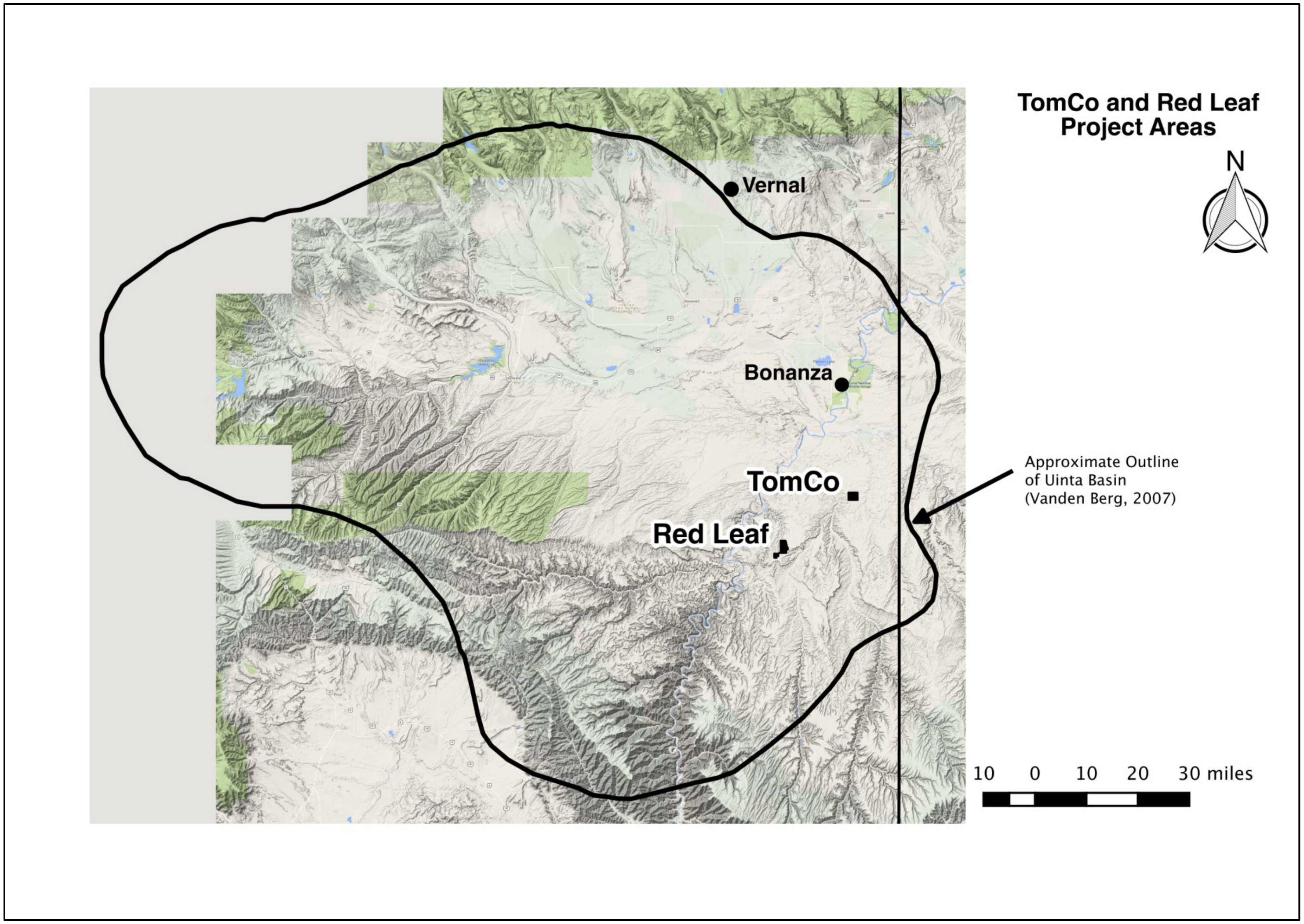


Figure 1. Location Map of the TomCo and Red Leaf Projects with Respect to Uinta Basin.

2 OVERVIEW OF THE PROJECTS

2.1 TomCo Project Background

Initially, TomCo plans to simultaneously mine oil shale and construct a single retort capsule, termed the EPS capsule, for the purpose of extracting oil from the oil shale (TomCo 2014). The project area is located in Uintah County, Utah, in Township 12 South, Range 24 East, and includes the entirety of Section 13 and portions of Sections 11, 12, and 14 (**Error! Reference source not found.**). TomCo has leased approximately 1,186 acres (an area called the "Holliday Block") from the State of Utah School and Institutional Trust Lands Administration as mineral lease ML-49571. The results of the EPS will be used in the design and construction of the commercial capsules.

TomCo has entered into a licensing agreement with Red Leaf Resources, Inc. (RLR) to use their EcoShale™ In-Capsule Technology, a proven method for extracting petroleum from oil shale. The EcoShale™ process involves placing ore in sealed capsules, heating the encapsulated ore, and extracting liquid hydrocarbons via a pipe and tank storage system. TomCo's mine operation is designed to be a zero-discharge facility. There are no point discharges from the operation, and the facility is conservatively designed. The project is designed to contain all product liquids and gases via secondary containment around all tanks and 3-foot-thick clay seals (bentonite amended soils (BAS)) surrounding the capsule.

Equally as important as site geology, the EPS has been designed to minimize infiltration of water into the capsule, reduce the probability of spent shale coming into contact with outside water, and contain the entire retort process within the EPS, thereby substantially reducing the potential for groundwater and other ecological impacts.

As part of the extraction process, the shale will be encapsulated and left in place, and the disturbance area reclaimed. The capsule's design is intended to prevent impacts on groundwater and the surrounding ecosystem by utilizing an impermeable liner of BAS.

TomCo's agreement with RLR allows the company to receive updates to the technologies used at RLR's facility on Seep Ridge Road (the Southwest #1 Project, M/047/0120), located approximately 10.5 miles to the southwest of the TomCo site. RLR has been in continuous operation since 2008 testing capsules of the EcoShale™ In-Capsule Process through its Small Mining Operation (SMO) permit, S/047/0102, and shares results of tests and studies with TomCo.

2.2 Red Leaf Project Background

The Red Leaf project area is located approximately 10 miles south-southwest of the TomCo project area and 60 miles south of Vernal, Utah, in the south-central portion of the Uinta Basin. It includes two state mineral lease tracts (Error! Reference source not found.). RLR, a privately held corporation, developed the EcoShale™ In-Capsule Technology to extract petroleum from oil shale. RLR is attempting to prove the new technology at this location under authority of its

SMO and Large Mine Operation (LMO) permits issued by DOGM. Mining initiated in SE1/4 of Section 30, Township 13 South, Range 23 East with the first test-scale capsule. RLR is currently constructing an EPS capsule at the southwest mine property. This capsule will be approximately 75 percent of the size of the full commercial scale capsule.

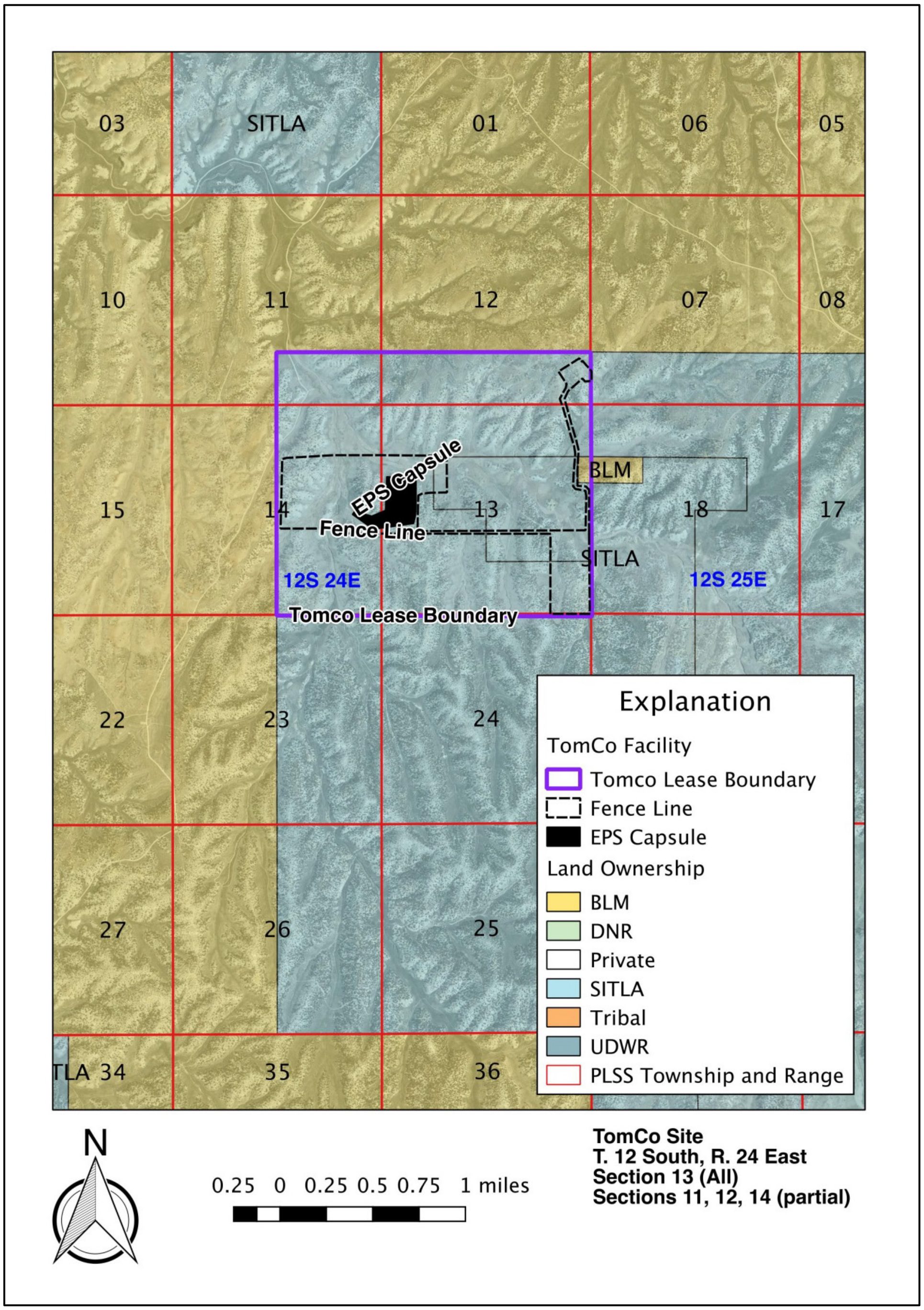


Figure 2. TomCo Project Area Showing Lease Boundary, Selected Proposed Features, and Land Ownership

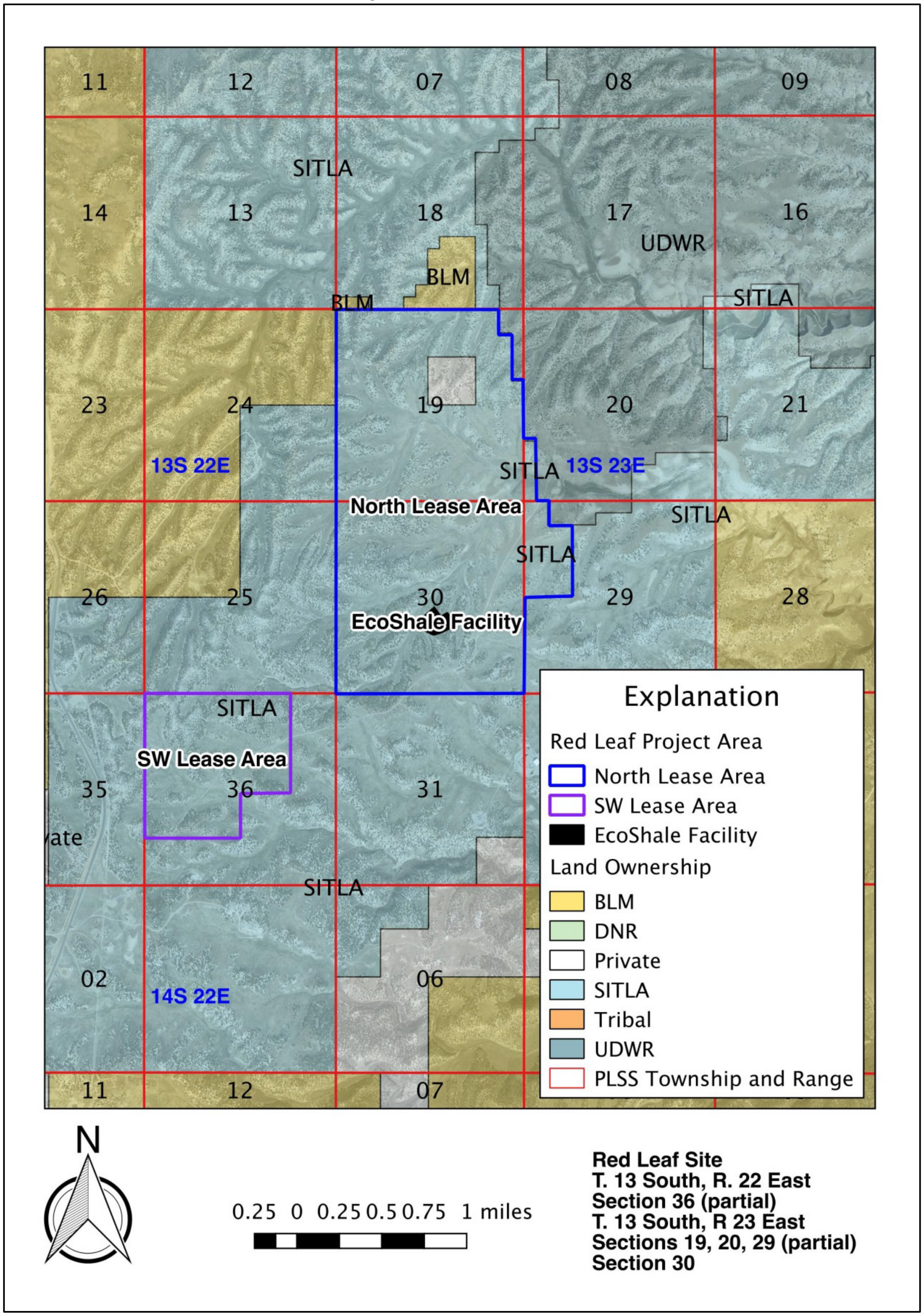


Figure 3. The Red Leaf Project Area Showing Lease Boundaries, Selected Features, and Land Ownership

Based on the findings of EPS capsule tests, RLR plans to proceed with construction of subsequent capsules, progressing east to west and south to north within the current southwest mine project area.

The EPS capsule is constructed with an impermeable wrap of BAS. Inside the BAS layer is a 13-foot thick rind of coarse-sized material or gravel that serves as insulation inside the BAS barrier to conserve heat and protect the BAS from thermal breakdown. A steel liquids-collection pan will be installed within the insulating layer to direct the liberated petroleum liquids to a collection system and to prevent loss of oil to the underlying liner or the environment. The pan will be sloped to direct liquids to a collection trough formed between the slope of the collection pan and the slope of the bulkhead to the north, where pipes will deliver the liquids to a tank system for storage and processing.

Above the pan, approximately 100 feet of ore will be placed in lifts at the same time the side walls, end walls, and insulation layers are built. The mined material is placed in layers with corrugated steel collection pans and heating pipes throughout the capsule. The ore and heating pipes will be incrementally stacked on top of one another. Initially, the capsule will be heated to a temperature approximately the boiling point of water. After steam production diminishes, the heat is increased to a maximum temperature of approximately 725 degrees Fahrenheit when, through pyrolysis, the liquid and gaseous components of kerogen are liberated and collected via the pan/pipe system.

3 REGIONAL GEOLOGY

The TomCo and RLR project areas are located in the Uinta Basin section of the Colorado Plateau physiographic province (Stokes 1986) in Township 12 South 24 East. This physiographic province is also known as the Colorado Plateau's Level III Eco region (Woods et al. 2001). The TomCo and Red Leaf project areas are shown in **Figure 1**.

The Uinta Basin is a structural depression with Eocene fluvial and lacustrine sedimentary rocks exposed at the surface. The project areas are located in the southern part of the basin and are underlain by north-dipping middle Eocene strata. The region is characterized by a dissected plateau with strong relief (Stokes 1986). Elevations in the basin range from under 5,000 feet in the basin center near the Green and White Rivers to above 8,000 feet at the southern basin margins. Incised tributaries of the two rivers flow northward as ephemeral, intermittent, and perennial streams providing the framework for rapid runoff throughout the southern portion of the basin.

The southern Uinta Basin is underlain almost entirely by the Green River Formation. The Green River Formation in the Uinta and Piceance Basins was deposited in Lake Uinta, a large saline lake that formed in early Eocene time when two much smaller freshwater lakes, one in each basin, coalesced across the Douglas Creek arch to form one large lake during a major transgression called the Long Point transgression (Mercier and Johnson 2012). The Douglas Creek arch was an area with relatively low subsidence rates throughout the Paleocene and Eocene, and pre-Long Point Paleocene and lower Eocene rocks thin and largely wedge out on both flanks of the arch.

The Green River Formation has been divided variously into three categories: (1) members based on lithology (Bradley 1931), (2) stages based on the evolution of the lake (Johnson 1985), and (3) rich and lean oil shale zones representing approximately time-stratigraphic intervals of alternating high-organic productivity and low-organic productivity (Trudell et al. 1970; Cashion and Donnell 1972). These divisions will be discussed briefly below.

Four of the members of the Green River Formation—Parachute Creek, Douglas Creek, Garden Gulch, and Evacuation Creek—were originally defined by Bradley (1931), who recognized them in both the Uinta and Piceance Basins, thereby reinforcing the concept that Lake Uinta was a single, unbroken lake spanning the two basins and the intervening Douglas Creek arch throughout much of its history (Mercier and Johnson 2012). The name Evacuation Creek was later abandoned (Cashion and Donnell 1974) because it was determined to be lithologically and stratigraphically equivalent to the upper part of the Parachute Creek Member. In the oil shale section deposited in the offshore areas of the lake, the name Garden Gulch is applied to the illitic oil shale deposited early in the history of Lake Uinta, and the name Parachute Creek is applied to the dolomitic oil shales deposited later. The name Douglas Creek Member is applied to marginal lacustrine rocks along the east and south margins of the Uinta Basin and the west and south margins of the Piceance Basin (Bradley 1931; Cashion 1967).

Trudell and others (1970) correlated individual oil shale beds throughout the central part of the Piceance Basin. Cashion and Donnell (1972) recognized that the entire Parachute Creek and Garden Gulch Members in the Piceance Basin could be subdivided into a sequence of oil-rich zones (R-0 through R-6 zones) and oil-lean zones (L-0 through L-5 zones). The lower zones, from L-0 zone through L-1 zone, are clay-rich and contain little carbonate; they form the Garden Gulch Member. All zones above L-1 zone are dolomitic and form the Parachute Creek Member, which is characterized by the presence of oil shale throughout its thickness. Units above R-6 zone are (in ascending order) B-groove, which is a lean zone; Mahogany zone, the richest oil shale zone in the basin and containing the so-called Mahogany Bed, which can exceed 70 gallons of oil per ton (Vanden Berg 2008), and A-groove, another lean zone.

Though comprehensive cross-sections depicting the correlation between the three classification systems are available (e.g., Johnson 2014; Mercier and Johnson 2012; Johnson 2003; Johnson 1989), it can be difficult to conceptualize the role of the Douglas Creek Member within and between the three frameworks. The Douglas Creek member is considered the first principal aquifer beneath the TomCo and Red Leaf sites, and thus it is helpful to highlight its relationship to the more finely classified stages and zones. For this reason, the Green River Formation members, the stage definitions, and zone definitions are summarized in tabular form (

Table 1). The purpose of this exercise was to not correct or update stratigraphic nomenclature or classification of the region but to attempt to harmonize the several frameworks.

Table 1. Summary of Stratigraphic Nomenclature of the Green River Formation

<table>
<tr><th colspan="4">Generalized Members Definitions[1]</th><th>Stage</th><th>Zone[2]</th><th>Notes</th></tr>
<tr><th>W. Uinta Basin[3]</th><th>C. Uinta Basin[4]</th><th>E. Uinta Basin[5]</th><th>Douglas Creek Arch[6]</th><th></th><th></th><th></th></tr>
<tr><td rowspan="3">GRFU-MLCC</td><td rowspan="8">PCM</td><td rowspan="8">PCM</td><td rowspan="3">~</td><td rowspan="3">5</td><td>B44</td><td>Bed 44 bottom is top of A-Groove</td></tr>
<tr><td>AGR</td><td>Lean zone</td></tr>
<tr><td>MAHZ</td><td>Contains Mahogany Bed</td></tr>
<tr><td rowspan="14">GRFU-LSC</td><td rowspan="14">DCM</td><td rowspan="5">4</td><td>BGR</td><td>Lean zone</td></tr>
<tr><td>R-6</td><td></td></tr>
<tr><td>L-5</td><td></td></tr>
<tr><td>R-5</td><td></td></tr>
<tr><td>L-4</td><td></td></tr>
<tr><td rowspan="5">DCM</td><td rowspan="5">DCM</td><td rowspan="5">3</td><td>R-4</td><td></td></tr>
<tr><td>L-3</td><td></td></tr>
<tr><td>R-3</td><td></td></tr>
<tr><td>L-2</td><td></td></tr>
<tr><td>R-2</td><td></td></tr>
<tr><td rowspan="2">DCM / GGM</td><td rowspan="2">DCM / GGM</td><td rowspan="3">2</td><td>L-1</td><td></td></tr>
<tr><td>R-1</td><td></td></tr>
<tr><td rowspan="2">GGM</td><td rowspan="2">GGM</td><td>L-0</td><td></td></tr>
<tr><td>1</td><td>R-0</td><td></td></tr>
</table>

NOTES

1. Member abbreviations: GRFU Green River Formation undifferentiated; MLCC = Marginal lacustrine clastic and carbonate rock; LSC = Lacustrine shale and carbonate rock; PCM = Parachute Creek Member; DCM = Douglas Creek Member; GGM = Garden Gulch Member
2. Zone abbreviations: B44 Bed 44; AGR A-Groove; MAHZ Mahogany zone; BGR B-Groove.
3. Assumed to be in vicinity of Wells 1 and 2, Plate 1 of Mercier and Johnson (2013).
4. Assumed to be in vicinity of Wells 13 and 14, Plate 1 of Mercier and Johnson (2013).
5. Assumed to be in vicinity of Wells 25 to 27, Plate 1 and U-53, Figure 3, of Mercier and Johnson (2013)
6. Assumed to be in vicinity of Wells 29 and 30, Plate 1 of Mercier and Johnson (2013).

On a finer scale, many individual rich and lean beds within each rich and lean zone can be traced for considerable distances as well. All of these oil shale zones grade into marginal lacustrine rocks (e.g., Douglas Creek Member) toward the margins of the Piceance Basin, and their marginal equivalents are difficult to identify. Johnson et al. (1988) were able to trace some of the rich and lean zones into their marginal lacustrine equivalents along the eastern margin of the Uinta Basin and western margin of the Piceance Basin.

The cross-section provided by Johnson (2014), reproduced in

, in conjunction with the diagrammatic cross-section of Johnson (2014) reproduced in **Figure 5**, together provide a visual conceptualization of the classification systems. **Figure 4a** provides the location of the project areas with respect to the cross-section line in **Figure 4**. The cross-section shown in **Figure 5** is approximately northwest to southeast, and well U-53 is about 7 miles directly north of the TomCo site. Appendix B includes a southwest to northeast cross section of the Red Leaf project area to the TomCo project area. This cross-section intercepts two coreholes drilled at each site. The Red Leaf coreholes are RL-3, located near the southwest corner of the Red Leaf project area, and RL-4, located near the northeast corner of the project area. The TomCo coreholes are HB-2, located near the southwest corner of the TomCo project area, and HB-7, located near the northeast corner of the project area. The cross-section shows the consistency of geology between the two sites.

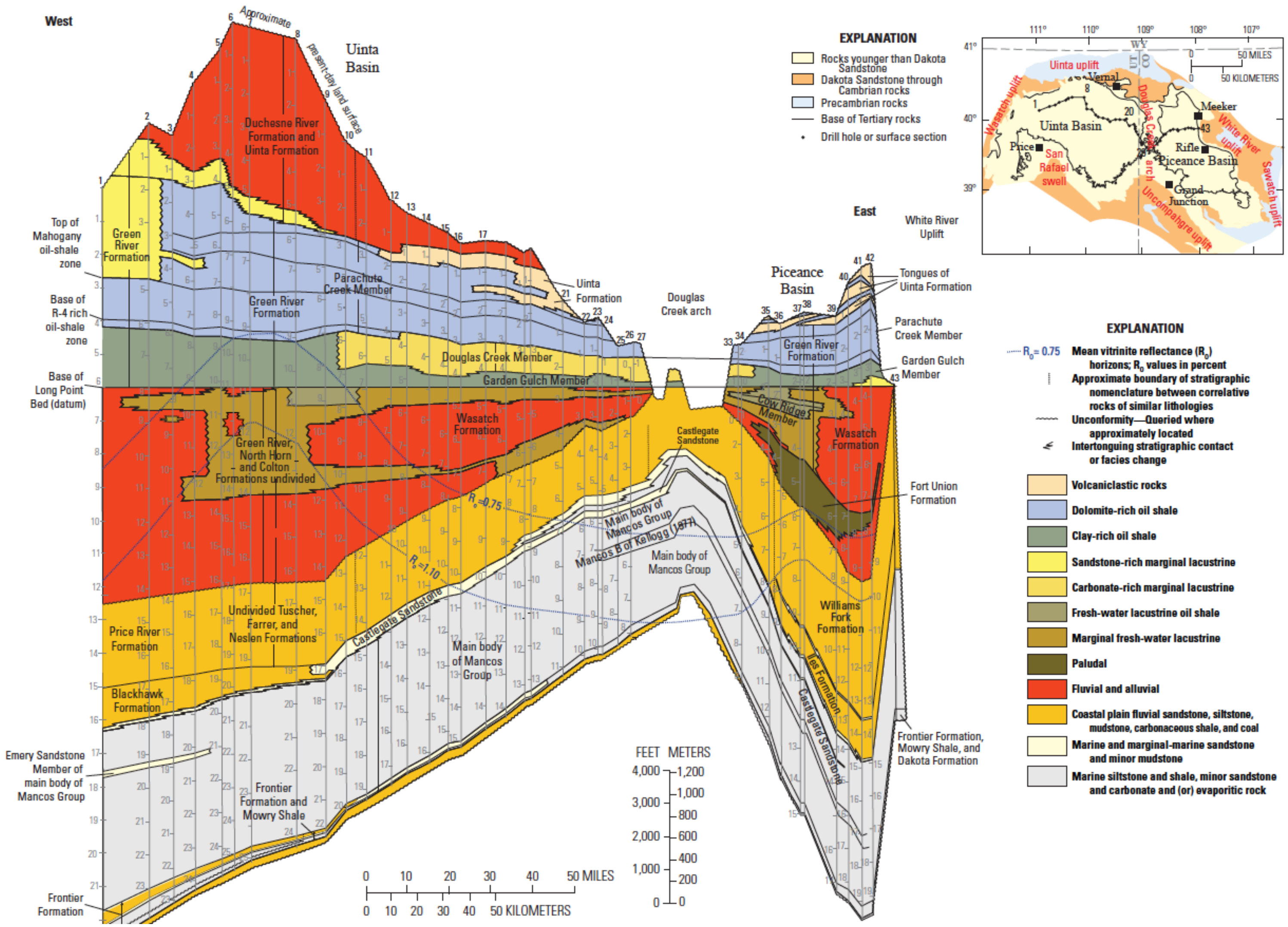


Figure 4. West-east Cross-Section Across Uinta Basin, the Douglas Creek Arch and Piceance Basin (after Johnson 2014).

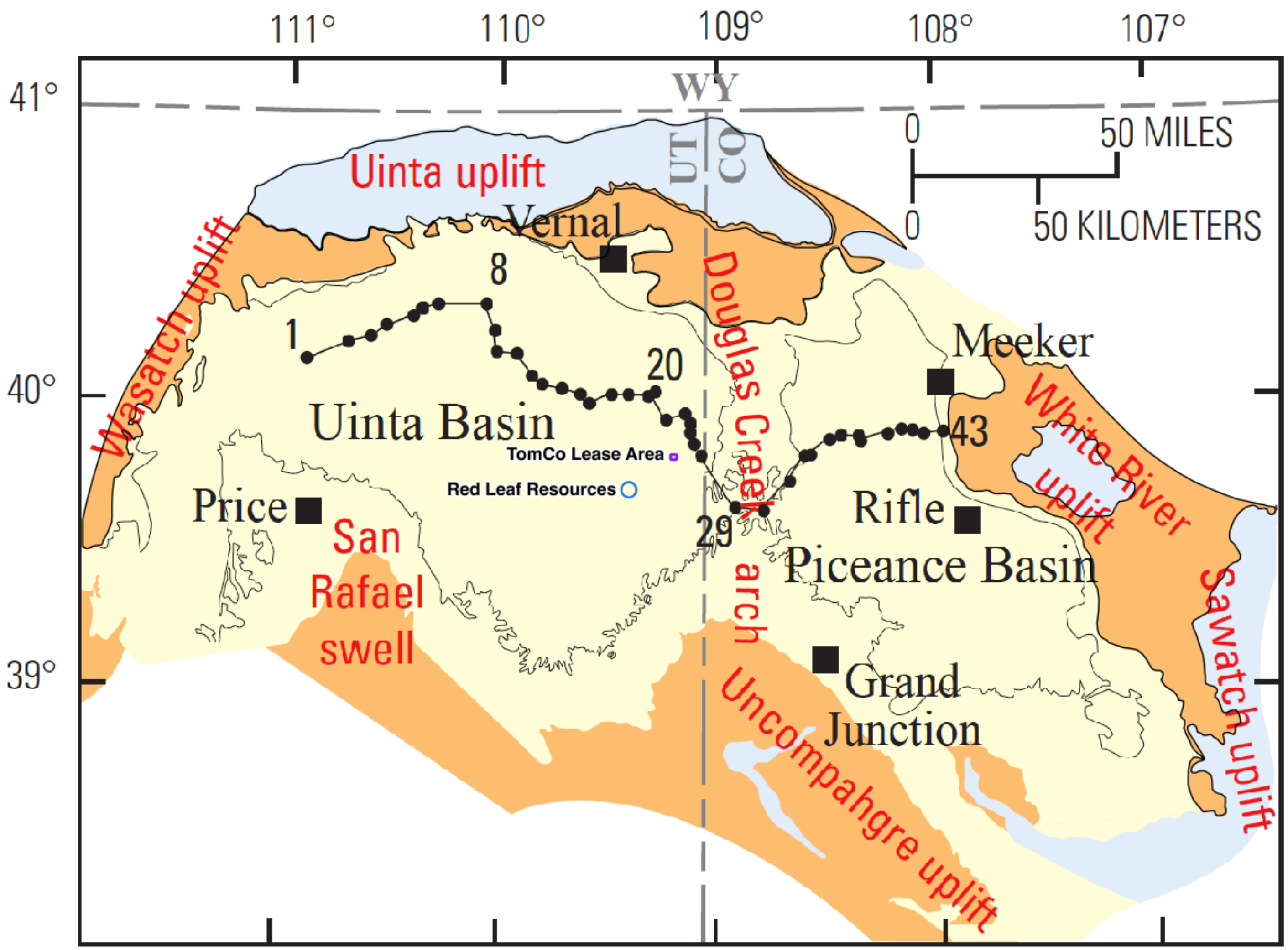


Figure 4a. Location of the Project Areas with Respect to the Cross-Section Shown in Figure 4 (after Johnson 2014).

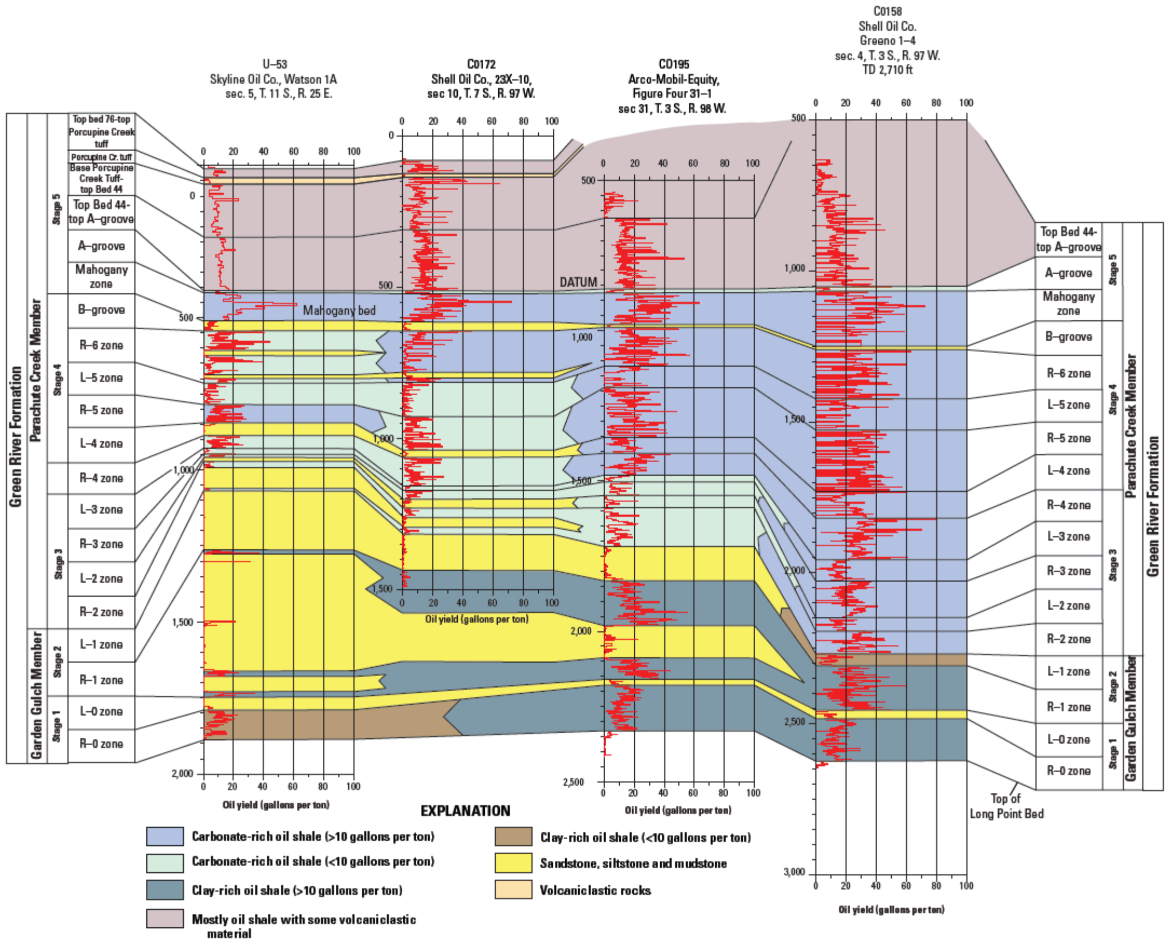


Figure 5. Cross-Section Showing Members of the Green River Formation, Lean-and Rich Oil Shale Zones, and Lake Uinta Stages (after Johnson 2014).

Parachute Creek Member

The Parachute Creek Member is known to be carbonate-rich and more kerogen rich in the center of the Uinta Basin to the northwest, where deeper water levels persisted throughout the period during which the sediments that formed the Parachute Creek Member were deposited. In the center of the basin, oil shale is present in significant quantities (measured in gallons per ton; GPT) throughout the 1,100-foot thickness of the member. To the east and south, toward the Douglas Creek Arch and Uncompahgre Uplift, respectively, deposition of terrigenous clastic sediments below the Mahogany zone increased, forming silty and sandy marlstones and locally siltstone and sandstone horizons.[1] Deposition of carbonate rocks and organic matter occurred when water levels in the lake in which the Green River Formation was deposited (termed Lake Uinta) were high and deep-water; anoxic conditions prevailed. Fluctuations in lake depth over time nearer the basin margins resulted in greater quantities of clastic sediments when lake levels dropped, and more carbonate and organic matter deposition occurred with higher lake levels and deeper water conditions (Keiglin 1977; Pipiringos 1978).

Key stratigraphic markers include the Wavy and Curly Tuffs, the Mahogany Marker (also a tuff) and Mahogany Bed. The latter two are located within the Mahogany Zone. The tuffs, which resulted from volcanic eruptions, are recognized throughout the eastern Uinta Basin and Piceance Basin. Two other units, which are less easily recognized, are the A Groove, a lean interval which generally lies about 20 feet below the Wavy Tuff, and the B Groove, a lean interval which generally marks the bottom of the Mahogany Zone. The Mahogany Bed, the principal ore zone for the TomCo and Red Leaf project areas, is located approximately 400 feet above the bottom of the Parachute Creek Member. Throughout its thickness, the Parachute Creek member is kerogen-rich and is commonly described as oil shale (Vanden Berg 2008).

Garden Gulch Member

The name Garden Gulch Member has been generally applied in the eastern part of the Uinta Basin and throughout the Piceance Basin to the clay-rich (mainly illite) oil shale interval that was deposited in offshore areas early in the history of Lake Uinta (Bradley 1931). More recently however, there is disagreement over the use Garden Gulch terminology in the Uintah Basin in Utah because the illitic oil shale equivalent to that occurring in the Piceance Basin appears to be different.[1] In any case, the R-0 zone consists of the lowermost part of this illitic oil shale interval and the L-1 zone contains the uppermost part. The name Parachute Creek Member is applied in the eastern part of the Uinta Basin and the Piceance Basin to the dolomitic oil shale that overlies the Garden Gulch Member (Bradley, 1931). The name Douglas Creek Member is applied to marginal lacustrine rocks in both the eastern part of the Uinta Basin and the western part of the Piceance Basin.

[1] Personal communication, December 2, 2014, M. Vanden Berg (Utah Geological Survey) to M. Sawyer (Lowham Walsh).

Douglas Creek Member

The Douglas Creek Member contains more massive sandstones than those observed in the younger Parachute Creek Member. The depositional system of the Douglas Creek Member is likely composed of multistoried channel sands of a delta that prograded out into the Green River Basin during a period of time when the lake level was much lower. In the southeast Uintah Basin, it is difficult to determine the boundary between the Parachute Creek Member and the Douglas Creek member. Further north, in the paleodepocenter of ancient Lake Uintah, the boundary is considered to be at the base of the R-2 zone.[2] To the south, the occurrence of sand below the Mahogany Zone greatly increases and is interbedded with dolomitic oil shale.[2]

Groundwater is produced at higher rates in the Douglas Creek Member than in the Parachute Creek Member. The likelihood of any contaminants impacting the Douglas Creek Aquifer from mining activity in the Mahogany Zone seems extremely remote. At least a 400-foot section of mostly impermeable shale and marlstone separates the two formations. Even with occasional sand lenses and secondary porosity resulting from fractured bedrock, there is unlikely to be enough interconnectivity between the two formations for them to communicate hydrologically. Further, the Douglas Creek Aquifer has been recognized in the project areas as confined, which provides additional support for the contention that it is hydrologically separate from the Parachute Creek Member.

Summary of TomCo Geology

Figure 6 provides a type stratigraphic column for the TomCo site.

The Parachute Creek Member is closest to the surface in the Tomco project area, and a mantle of soils overlies it in some places. The Parachute Creek Member outcrops in the southeast portion of the project area and in several small canyons across the site. The Parachute Creek Member is of very low permeability and would be classified as shale or a dolomitic/calcareous marlstone. Coarser sandstone and siltstone beds have been identified above and below the Mahogany Zone. The Douglas Creek Member begins at the base of the Parachute Creek Member and, depending on the elevation across the project area, ranges from 400 to 700 feet below ground surface (bgs).

The Mahogany Zone is the primary ore-bearing zone, and therefore the primary zone of interest in the project area. It is located within the Parachute Creek Member at the base of the Upper Green River Formation and is of Eocene Age. The Mahogany Zone is bounded on two sides by volcanic tuffs, the Wavy Tuff and the Curly Tuff, that have been age dated at 48.7 million years and 49.3 million years, respectively (Birgenheier et al., 2013). The approximate thickness of the zone in the project area is 85 feet. Tests previously performed on the Mahogany Zone in other areas of the Green River Basin indicate that it will produce up to 30

[2] Personal communication, December 2, 2014, M. Vanden Berg (Utah Geological Survey) to M. Sawyer (Lowham Walsh).

gallons of oil per ton (Wallace, 2012). Within the Mahogany Bed itself, which is about 8 feet thick in the project area, production may be as high as 50 GPT (Vanden Berg 2008).

In 2010, TomCo drilled nine coreholes across the project area to determine the thickness and depth of the Mahogany Zone (TomCo 2014). **Figure 7** shows the locations of these coreholes**.** The depth of penetration of the coreholes ranged between 116 to 304 feet bgs. In general, the Mahogany Zone is closest to the surface in the southern portion of the project area, particularly in the southeast, and deepest in the northeast corner where the 304-foot-deep corehole was located. The Mahogany Zone itself was very tight and did not appear to be water bearing. However, a number of sandstones below the Mahogany Zone were recognized in the cores. For the most part, these sandstones were fine-grained, poorly sorted, or filled with tar (i.e., tar sand) and were not classified as aquifer media. Three of the coreholes actually had "shows" of groundwater, suggesting that they could contain limited water bearing zones. Aquifer testing of nearby monitoring wells conducted in 2013 and 2014 showed that the water production rates were very low (below or only slightly above 1 gpm with very slow recharge rates), and that water quality was poor.

Summary of Red Leaf Site Geology

Figure 8 is a typical stratigraphic column for the section penetrated by the core drilling at the Red Leaf site.

The Parachute Creek Member consists mainly of oil shale, which is a dolomitic marlstone (a clayey and/or silty carbonate rock) that contains a solid hydrocarbon material known as kerogen. The oil shale interbeds with minor amounts of siltstone, sandstone, and altered volcanic tuff beds. The Mahogany Oil Shale Zone within the Parachute Creek Member will be the oil shale source for the Red Leaf operation. Depth to the top of the Mahogany Marker is between the surface and 160 feet bgs at the Project Area and occurs at the top of the kerogen-rich Mahogany Zone that is found within the Mahogany Bed.

Based on core drilling in the project area (**Figure 9**), the typical stratigraphic column at the Red Leaf site includes the Mahogany Marker, the Mahogany Bed, a stratigraphic interval located above the Mahogany Marker known as the A Groove, and another interval beneath the ore zone called the B Groove. These two horizons get their names from their appearance in outcrop; unlike the cliff-forming Mahogany zone, they form slopes. The B-Groove is easily identified in outcrop; however, its appearance in the subsurface is difficult to distinguish visibly. As a result, the B-Groove is typically identified in the subsurface by geophysical logs or Fisher assay data as it is a lean zone and easily differentiated from the richer zones by assay or by the density or sonic logs.

The rock types present in all of the coreholes are consistent, and the dominant rock type is oil shale. The other rock types are mudstones that occur in the A-Groove and B-Groove horizons and elsewhere, and thin silicified tuff horizons, most notably the Mahogany Marker. A sandstone bed is located in all holes in the zone to be mined. The sandstone is cemented by calcium carbonate and is apparently not porous (Red Leaf Resources 2013).

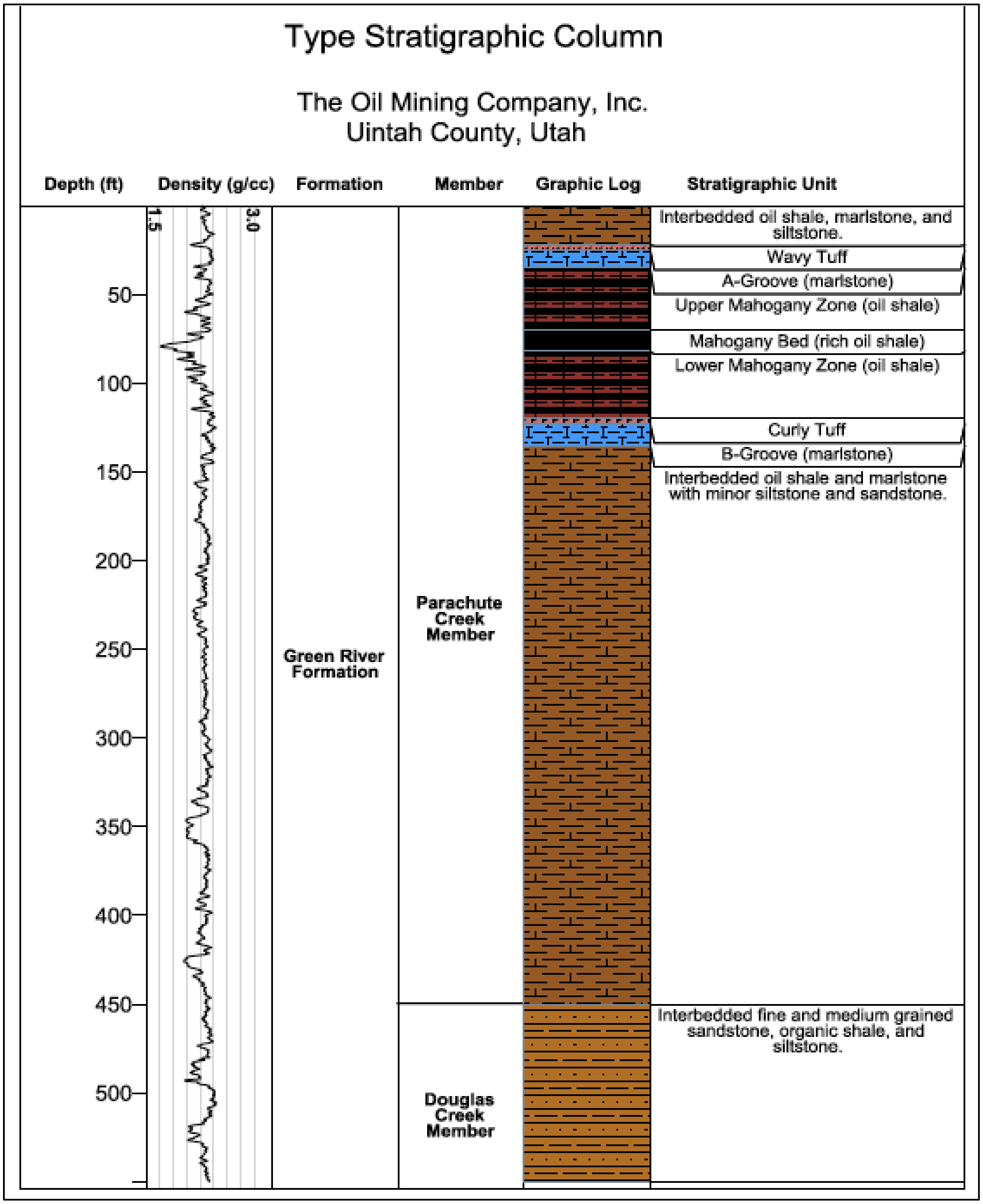


Figure 6. Type Stratigraphic Column for the TomCo Project Area (TomCo 2014).

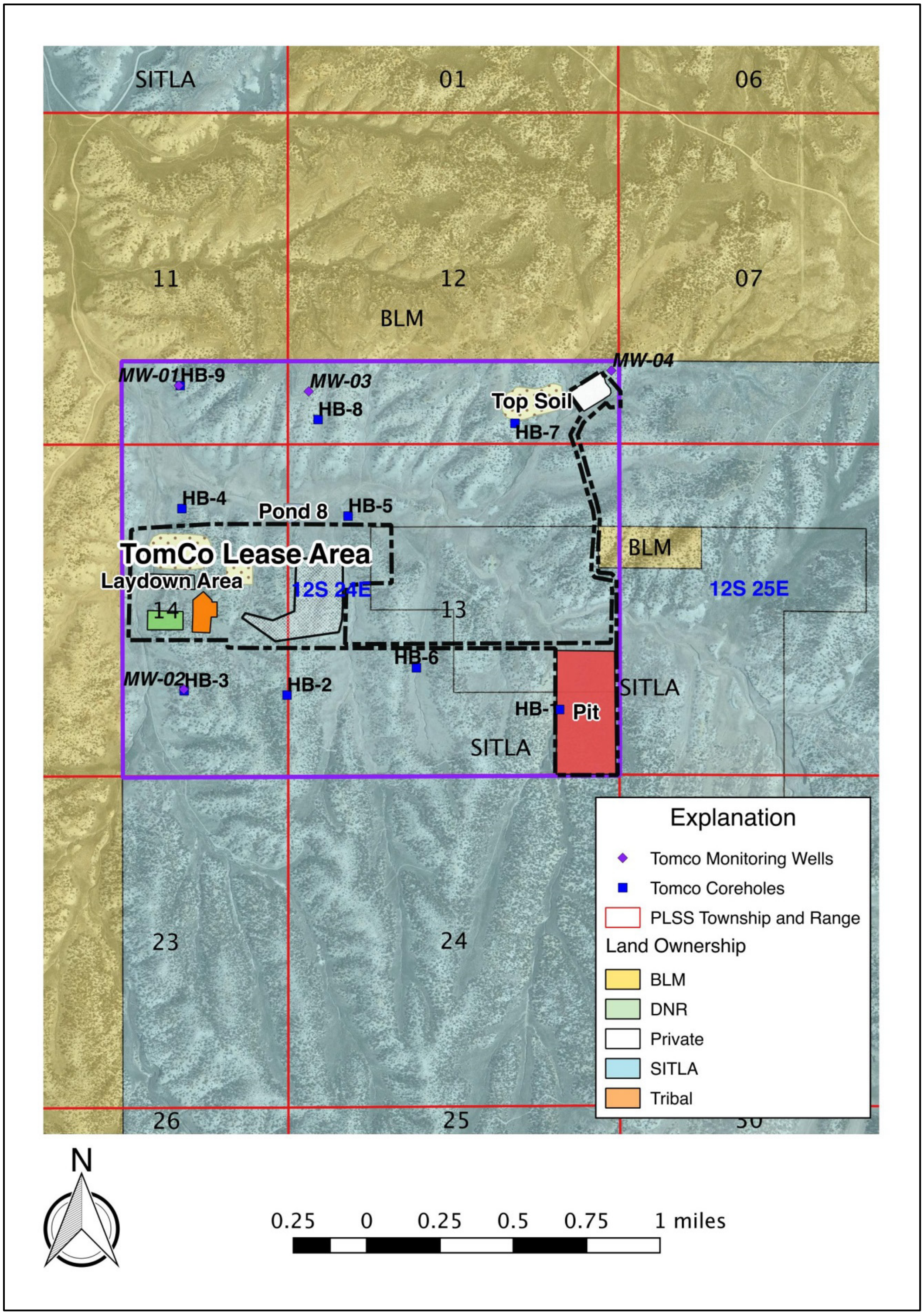


Figure 7. Map Showing Location of TomCo Coreholes and Monitoring Wells.

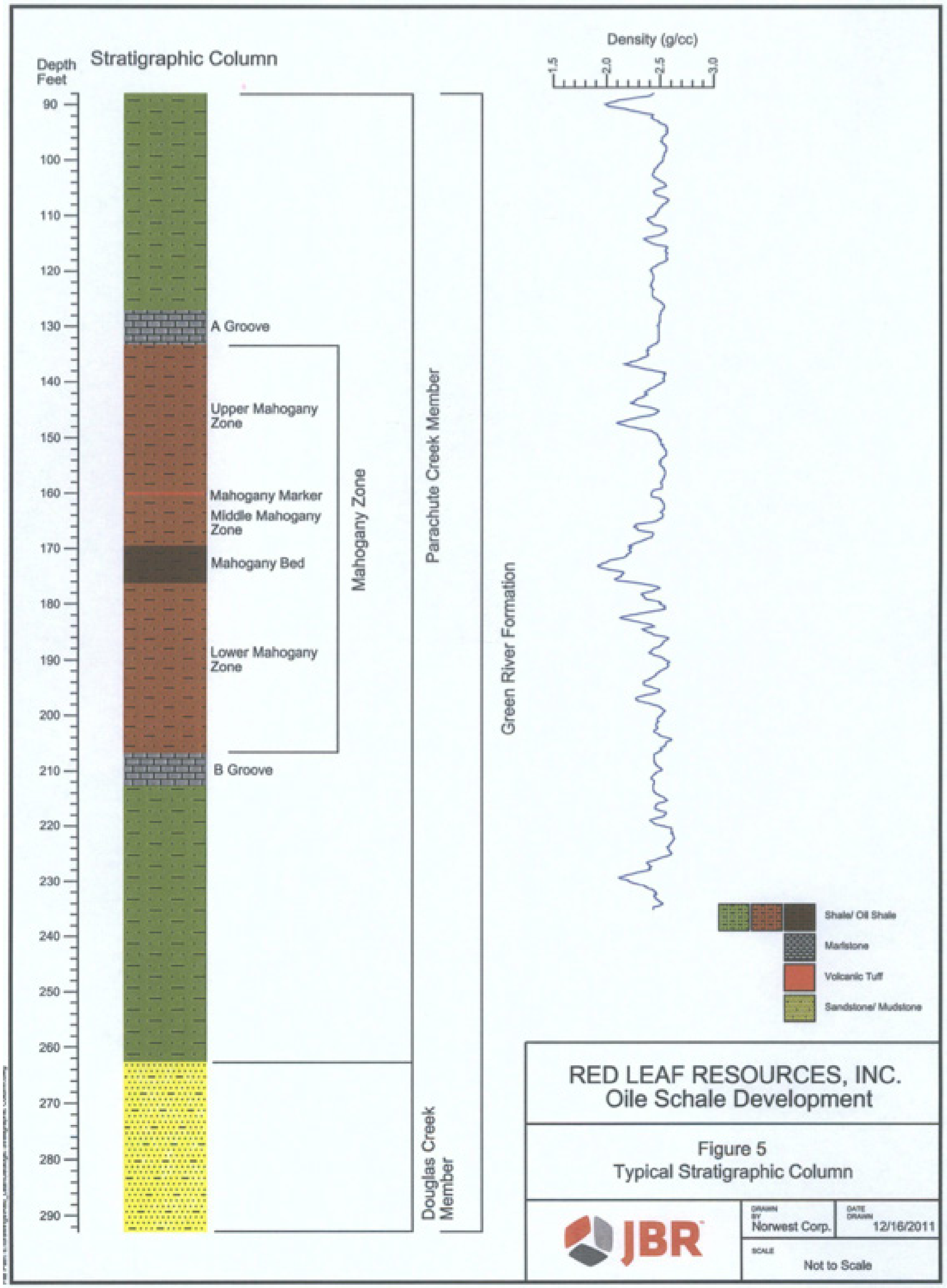


Figure 8. Type Stratigraphic Column for the Red Leaf Resources Project Area (Red Leaf 2013).

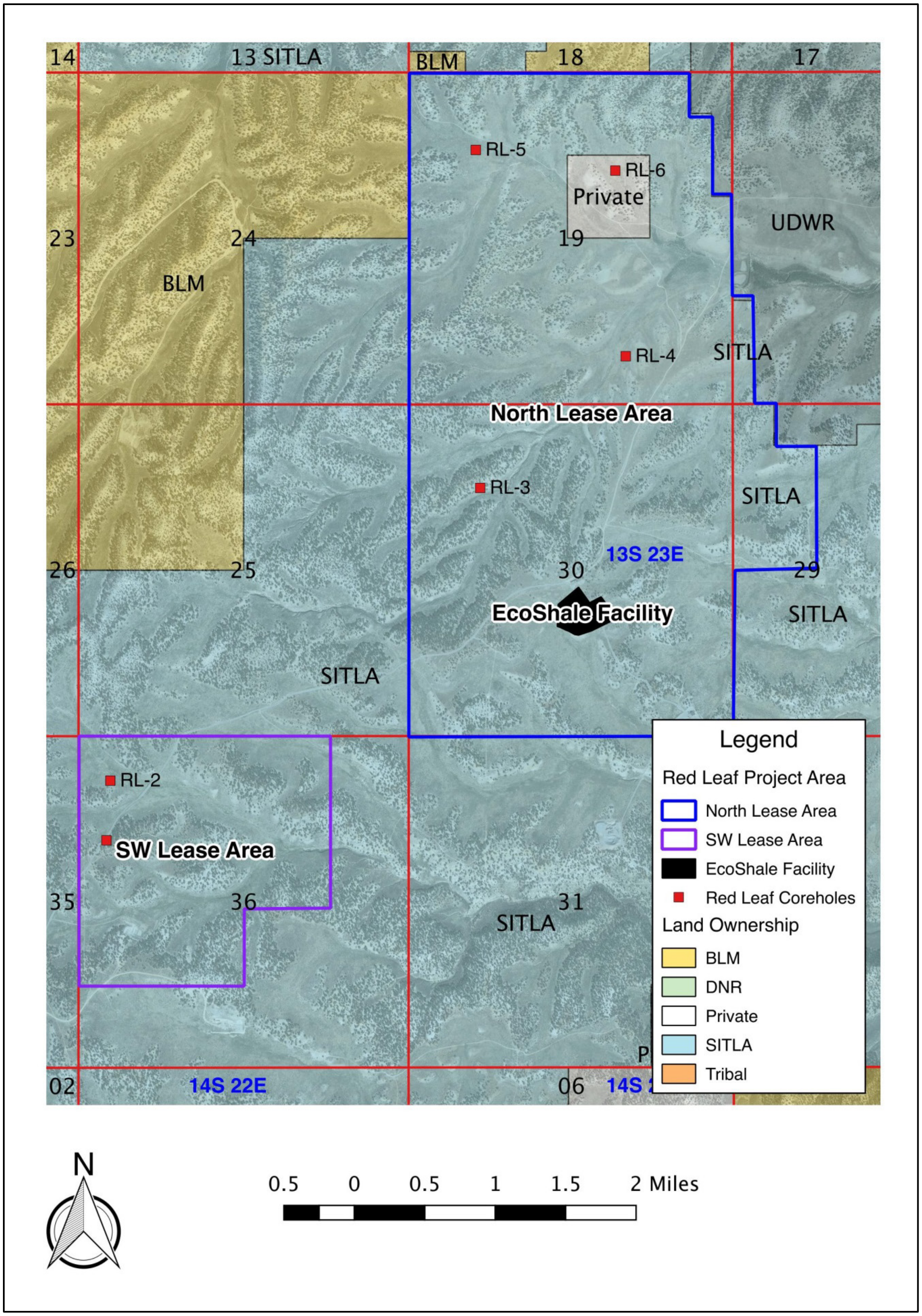


Figure 9. Map Showing Location of Red Leaf Resources Coreholes.

Database and Well Boring Log Review

There was some difficulty in finding wells in the right location with full logs in order illustrate continuity in bedding between the TomCo and Red Leaf sites. Oil companies usually do not bother to log either shallow lithology or geophysics until they are near their target zone, and boreholes drilled specifically for oil shale are usually not deep enough to provide detailed stratigraphic data below, say, R6.

The available data were largely obtained from the USGS Database (Johnson et al., 2010), and data presented in Vanden Berg (2008). Borehole information from the USGS database in the form of a shapefile were imported into a geographic information system (GIS) and plotted. Wells to be reviewed were selected based on location (near and between the TomCo and Red Leaf sites), and then according to whether assay data were available from the database or from Vanden Berg (2008). Selected wells were reviewed within the well database Microsoft Access file. Borehole data from Vanden Berg (2008) were manually parsed and, when the same entry was available in the USGS database, compared to those data to ensure agreement and, in some cases, used to supplement the USGS data. Borehole data reviewed from all sources are tabulated in Appendix A, and boreholes in the vicinity of the TomCo and Red Leaf project areas are nominally presented in Figure A-1 of Appendix A.

Raster data from Johnson et al. (2010) were brought into GIS to produce a series of figures to illustrate the degree of continuity between the TomCo and Red Leaf sites with respect to Fischer assay and bed thicknesses. These data were then visually compared to the Unita Basin-wide graphical presentations contained in Mercier and Johnson (2012) to ensure accuracy of the GIS raster processing.

Representative values for each site were obtained by randomly sampling the raster at multiple locations within the respective site boundaries.

Results

Review of each of the datasets presented in **Figure 10** through **Figure 17** yielded a series of numerical comparisons of bedding and assay values (Table 2), which illustrate the following:

1. A-Groove bedding thickness and Fischer assay results are consistent between the two sites, varying in thickness between about 16 feet at the Red Leaf site to about 9.5 feet at the TomCo site. Fischer assays ranged between about 2.5 GPT oil to about 3.6 GPT oil.
2. Mahogany Zone bedding thickness and Fischer assay results are fairly consistent between the two sites, varying in thickness between about 95 feet at the Red Leaf site to about 65 feet at the TomCo site. Fischer assays ranged between about 17 to about 21 GPT oil. The difference in thickness between the two sites may be a result of erosion as the Mahogany Zone lies near or at ground surface in the vicinity of both sites (see Mahogany Bed outcrop on **Figure 12**). Therefore, it is conceivable that where measurements were obtained, the entire Mahogany zone thickness may not be present.

Table 2. Representative Values of Compared Bed Thicknesses and Assay Values Between TomCo and Red Leaf Sites.

Compared Bed	TomCo Site Representative Bed Thickness (feet)	Red Leaf Site Representative Bed Thickness (feet)		TomCo Site Representative Assay (GPT Oil)	Red Leaf Site Representative Assay (GPT Oil)
A-Groove	9.5	16		3.6	2.5
Mahogany Zone	65	95		21	17
B-Groove	11	7		21	17
Bed R6	235	193		5.2	2.7

3. B-Groove bedding thickness and Fischer assay results are consistent between the two sites, varying in thickness between about 7 feet at the Red Leaf site to about 11 feet at the TomCo site. Fischer assays ranged from about 17 to about 21 GPT oil.
4. Bed R6 bedding thickness and Fischer assay results are fairly consistent between the two sites, varying in thickness between about 235 feet at the Red Leaf site to about 193 feet at the TomCo site. Fischer assays ranged from about 2.7 to about 5.2 GPT oil.

Thus, on the basis of this comparison, the lithologies beneath the sites are continuous, have the same formations and origin, are similar in thickness, and contain similar amounts of oil. Therefore, there is no reason to believe that there is a significant difference in these rock characteristics that would result in a significant difference in waste rock characteristics based upon potential results of SPLP testing.

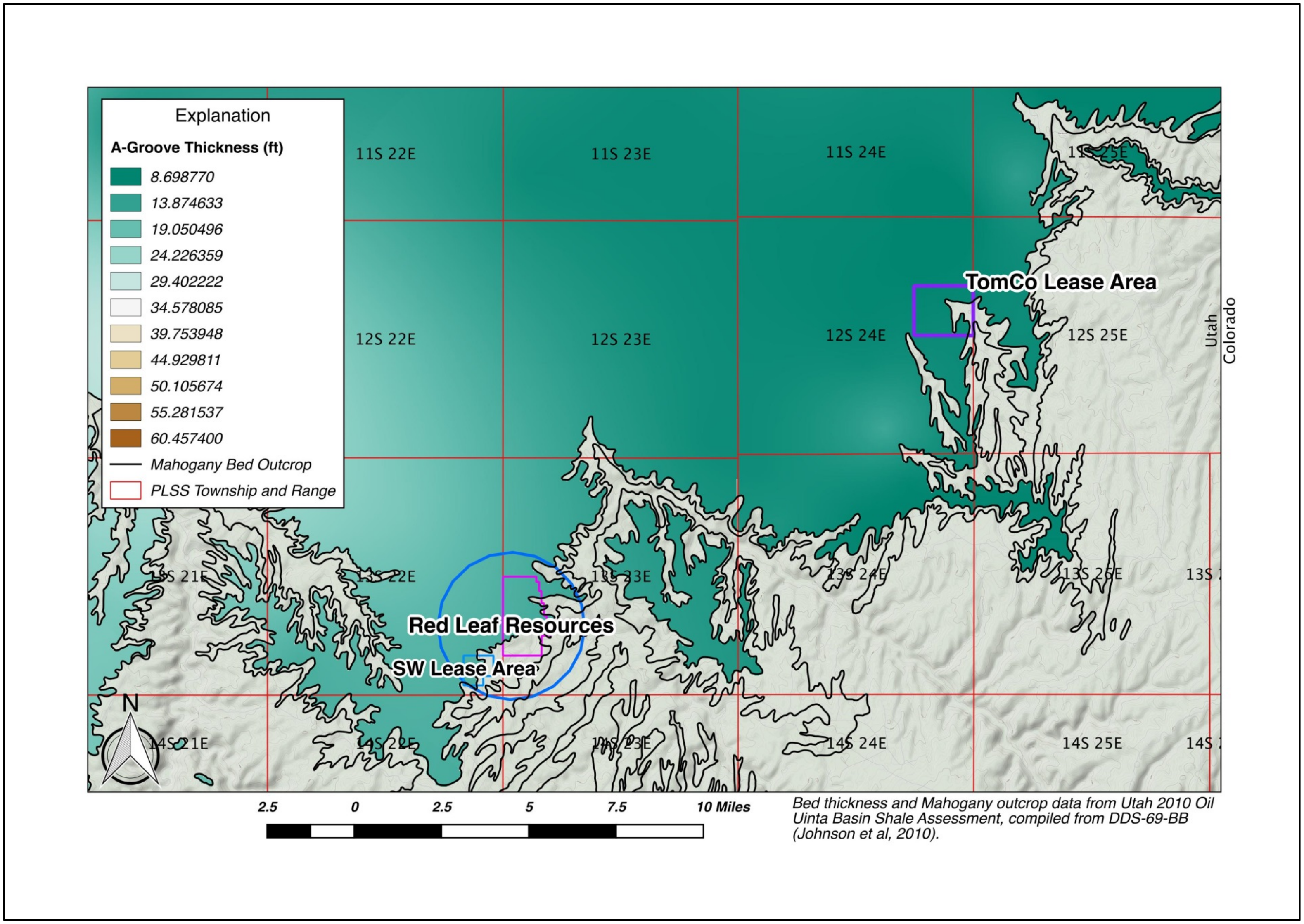


Figure 10. A-Groove Isopach Map For Area Surrounding the TomCo and Red Leaf Sites.

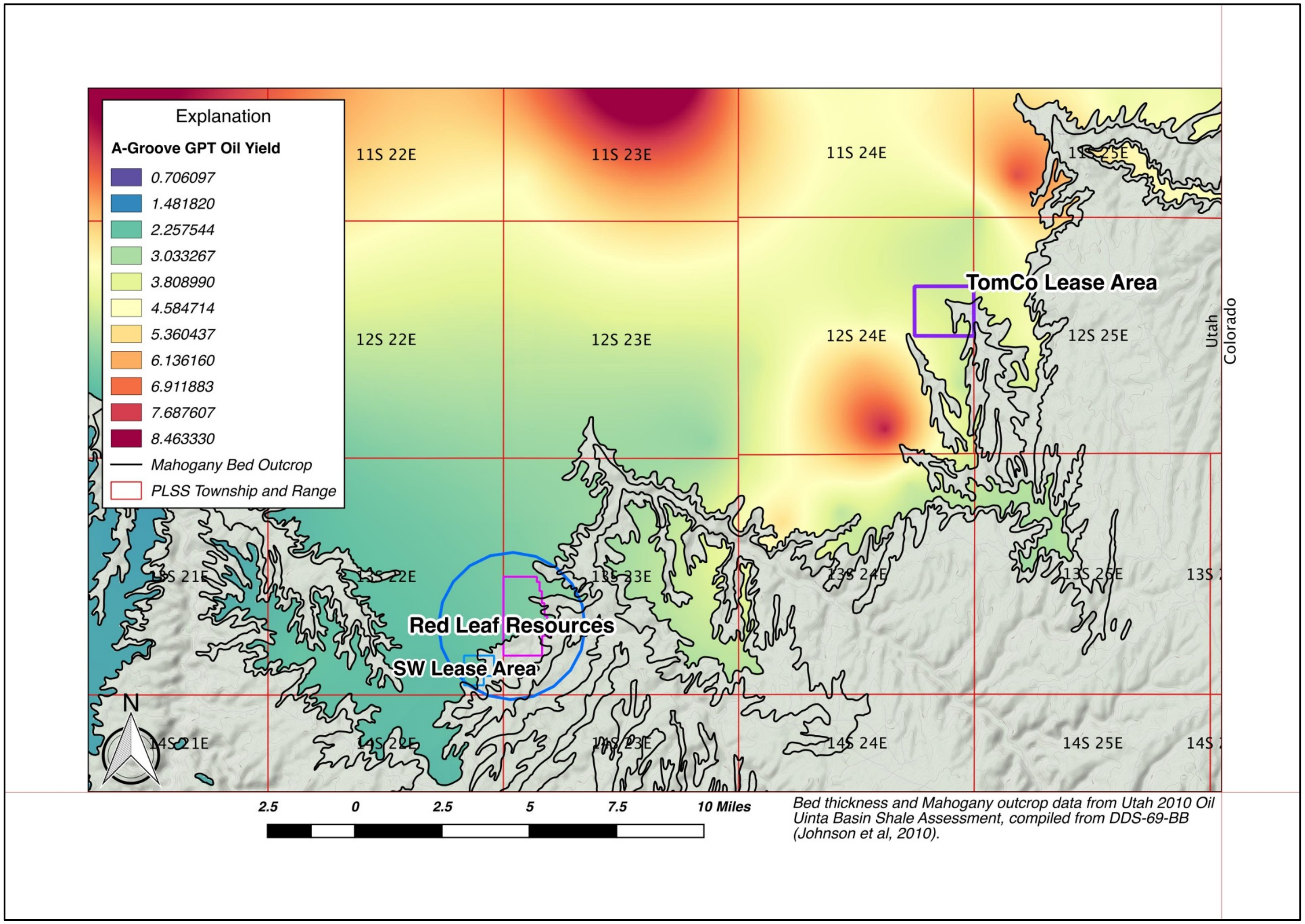


Figure 11. A-Groove Isoresource Map for Area Surrounding the TomCo and Red Leaf Sites.

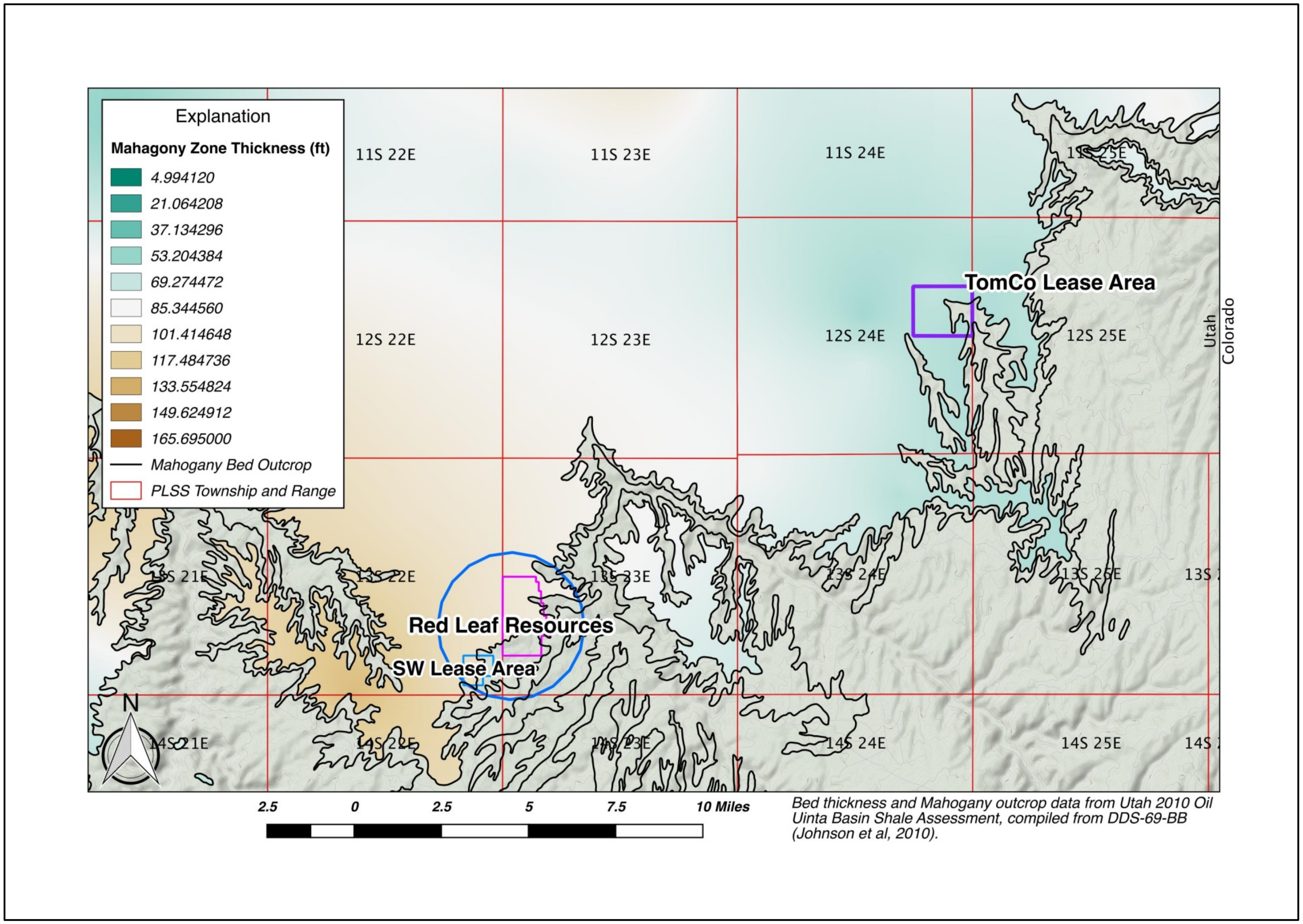


Figure 12. Mahogany Zone Isopach Map For Area Surrounding the TomCo and Red Leaf Sites.

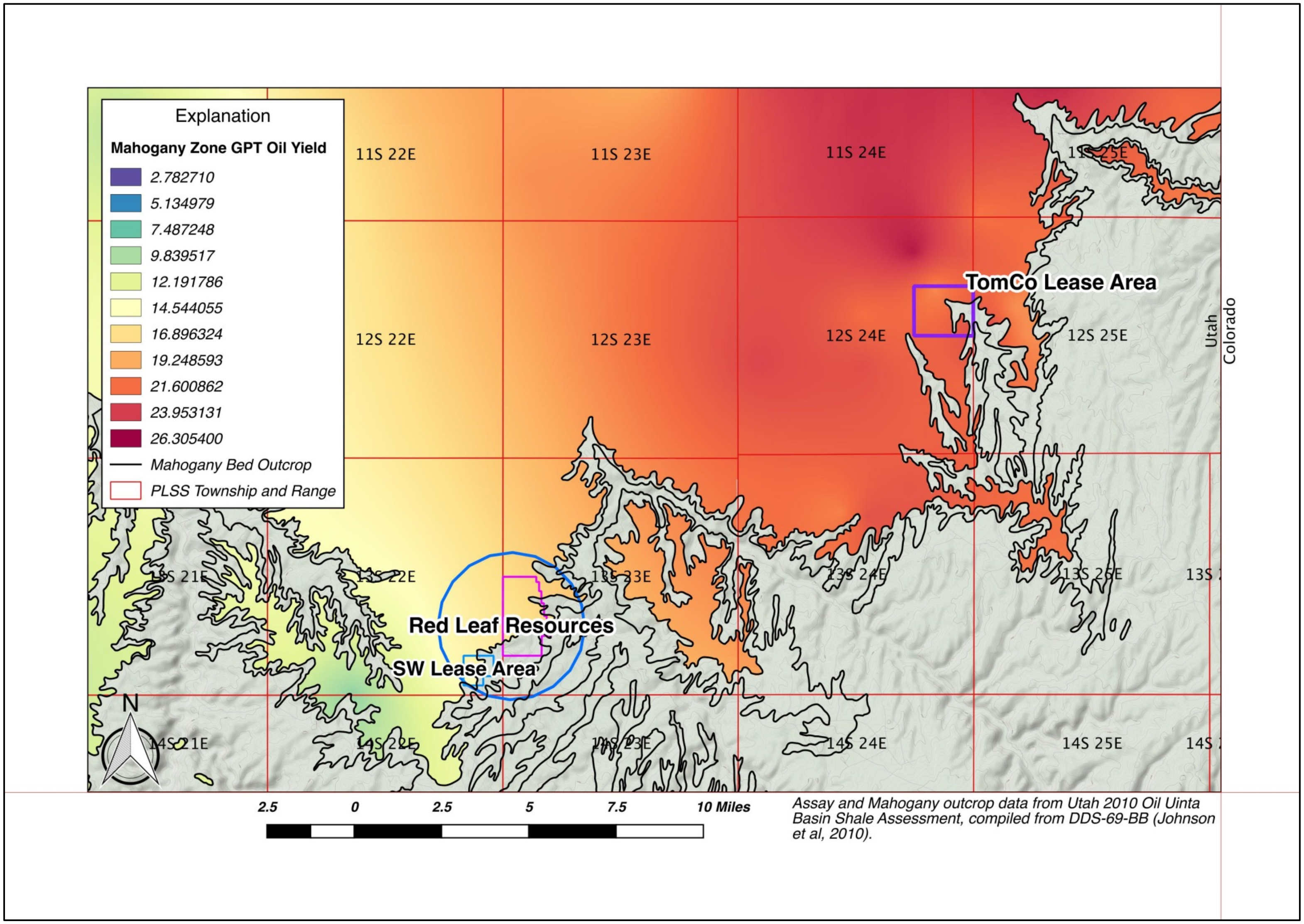


Figure 13. Mahogany Zone Isoresource Map for Area Surrounding the TomCo and Red Leaf Sites.

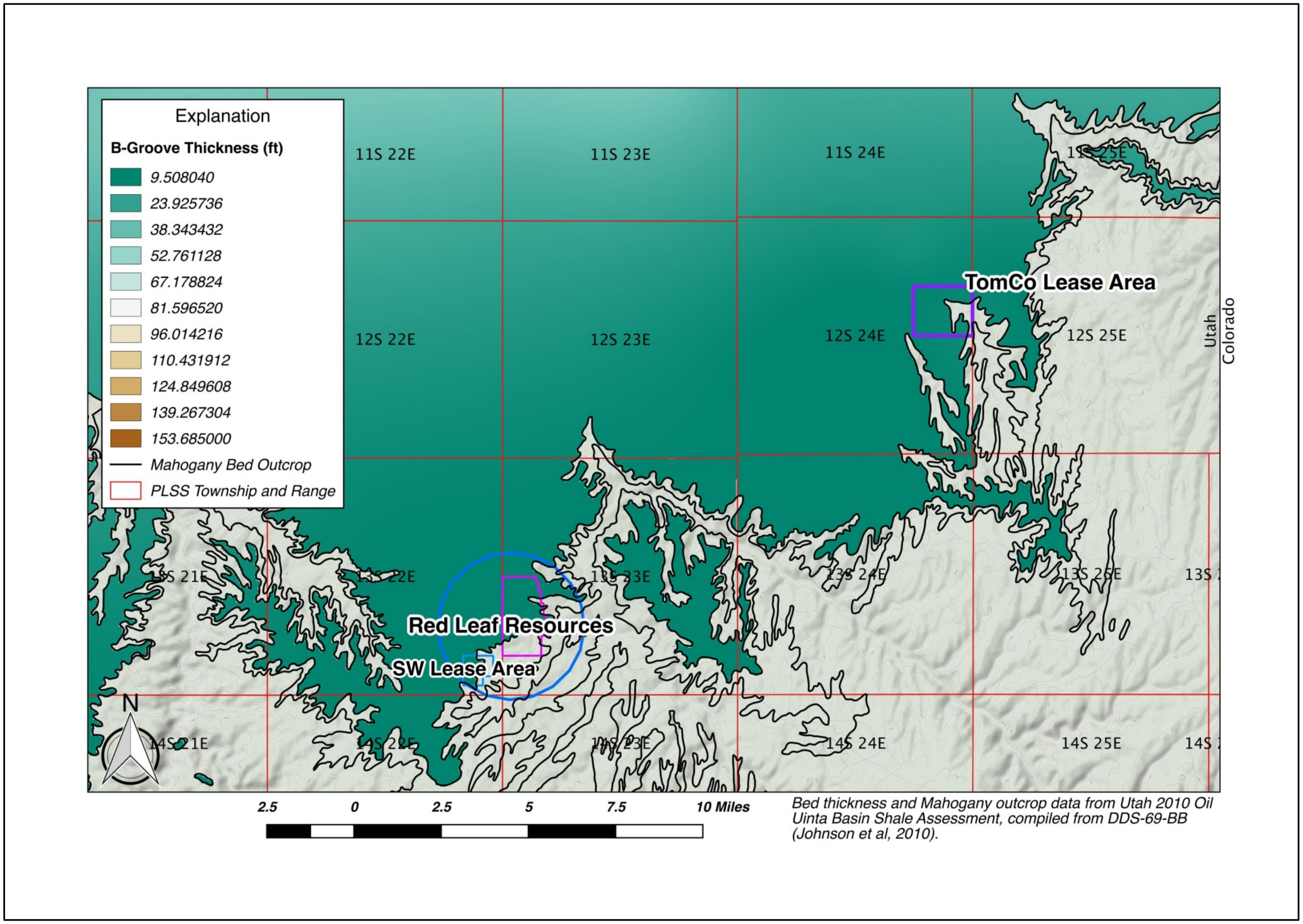


Figure 14. B-Groove Isopach Map For Area Surrounding the TomCo and Red Leaf Sites.

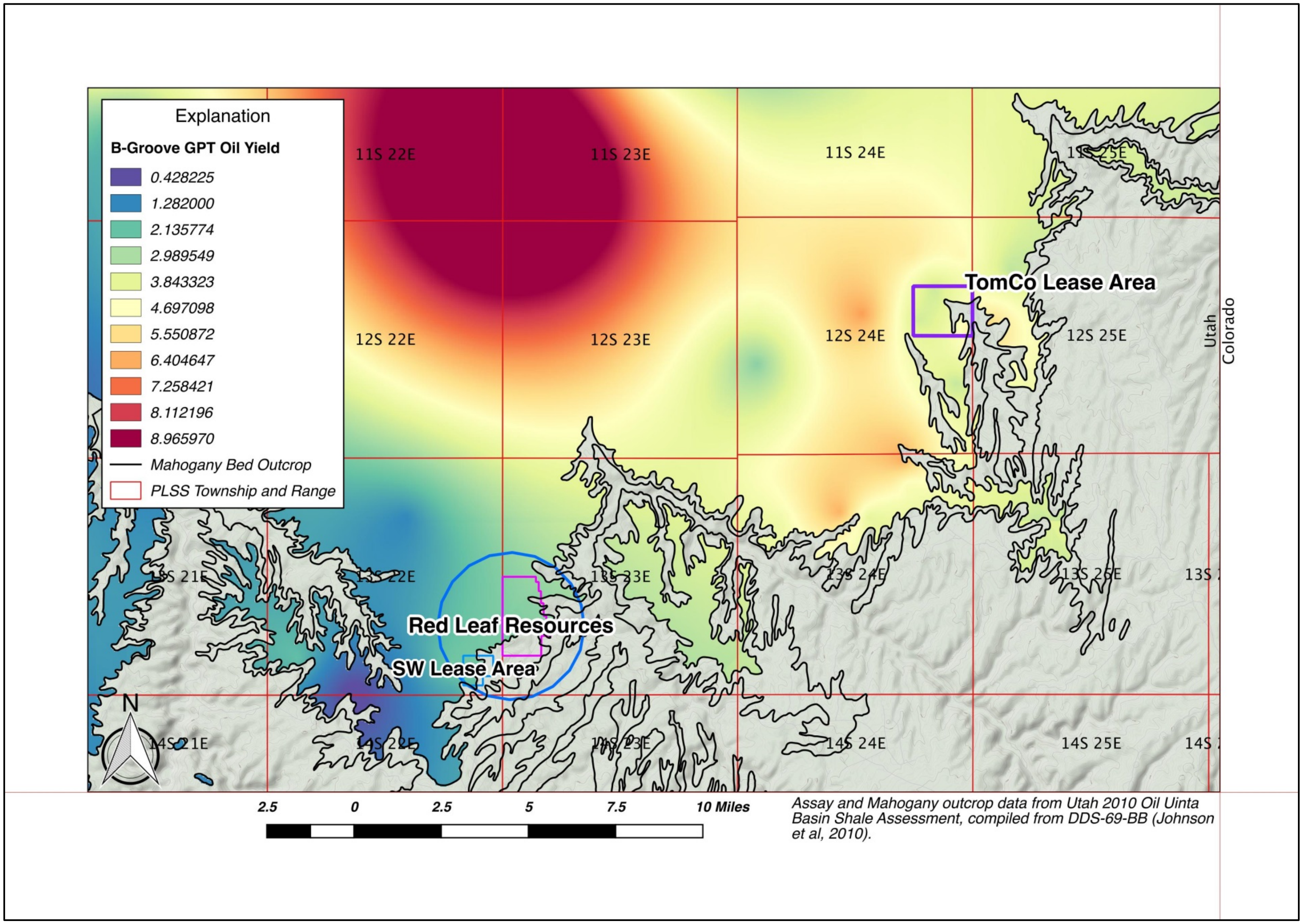


Figure 15. B-Groove Isoresource Map for Area Surrounding the TomCo and Red Leaf Sites.

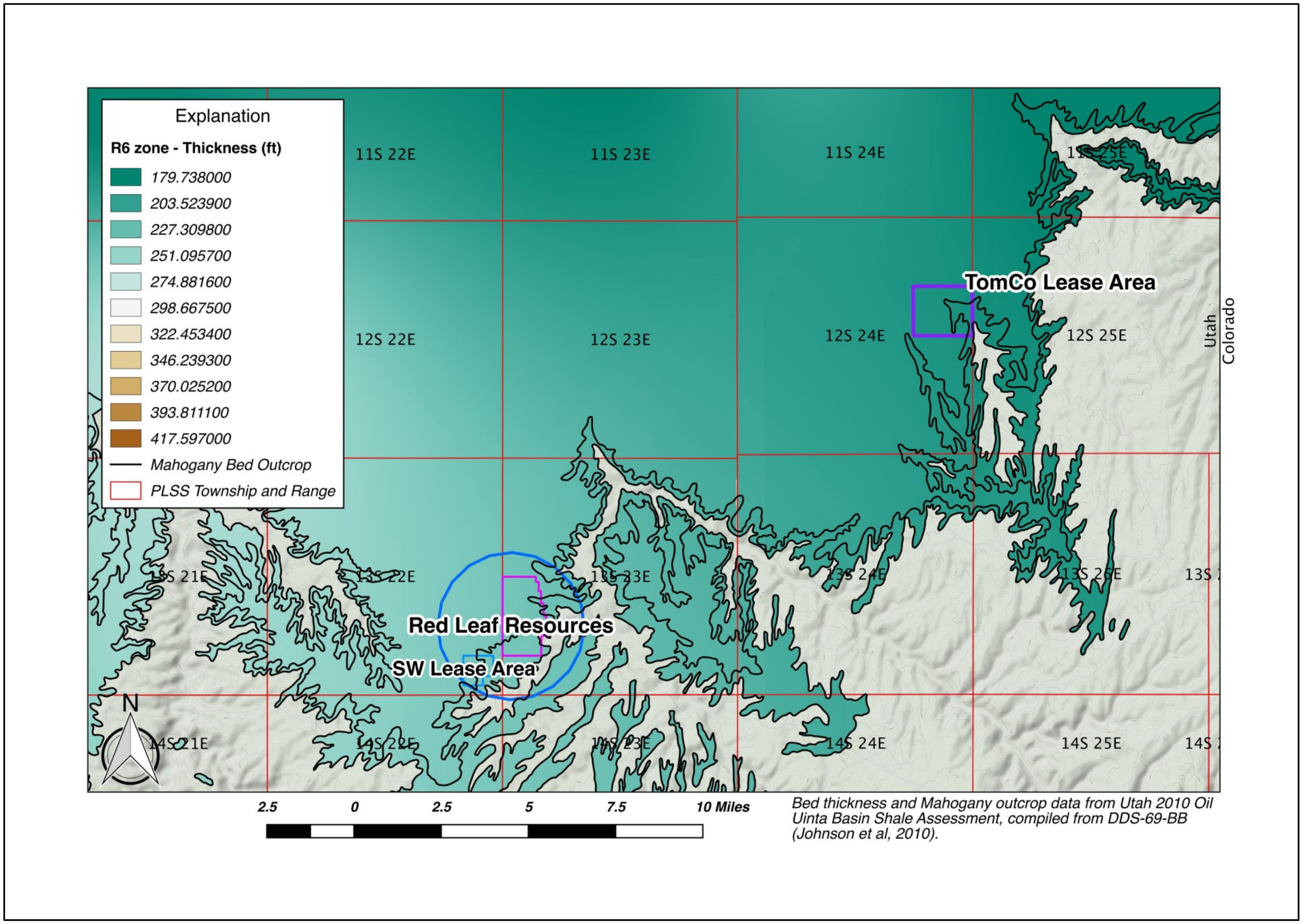


Figure 16. Bed R6 Isopach Map For Area Surrounding the TomCo and Red Leaf Sites.

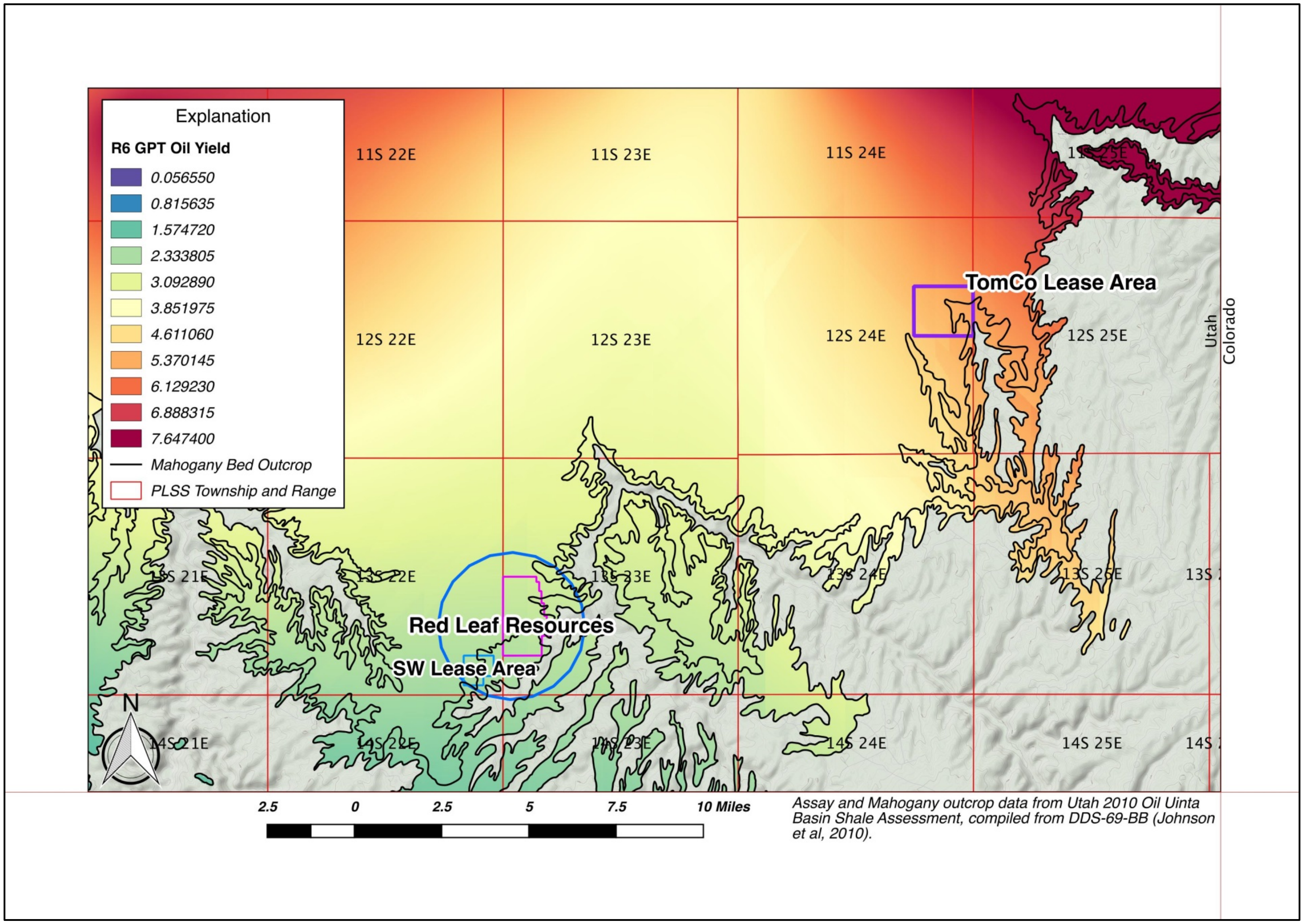


Figure 17. Bed R6 Isoresource Map for Area Surrounding the TomCo and Red Leaf Sites.

4 REFERENCES CITED

Birgenheier, Lauren, Michael Vanden Berg, Morgan Rosenberg, and Leah Toms, 2013., Sedimentology and Stratigraphy of the Green River Formation, Uinta Basin, A Field Trip for GRF Project Sponsor, Total, April 30 – May 3, 2013.

Bradley, W.H., 1931, Origin and microfossils of the oil shale of the Green River Formation of Colorado and Utah: U.S. Geological Survey Professional Paper 168, 58 p.

Cashion, W.B., and Donnell, J.R., 1972, Chart showing correlation of selected key units in the organic-rich sequence of the Green River Formation, Piceance Creek Basin, Colorado, and Uinta Basin, Utah: U.S. Geological Survey Oil and Gas Investigations Chart OC–65.

Cashion, W.B., and Donnell, J.R., 1974, Revision of nomenclature of the upper part of the Green River Formation, Piceance Creek Basin, Colorado, and Eastern Uinta Basin, Utah: U.S. Geological Survey Bulletin 1394–G, 9 p.

Golden Software, 2013, Surfer Gridding and Contouring Software Program, Surface Mapping System version 11, Golden Software, Inc. Golden Colorado.

Johnson, R.C., 1985, Early Cenozoic History of the Uinta and Piceance Creek Basins, Utah and Colorado, with Special Reference to the Development of Eocene Lake Uinta, in Flores, R.M., and Kaplan, S.S., eds., Cenozoic Paleogeography of the West-central United States: The Rocky Mountain Section, Society of Economic Paleontologists and Mineralogists, Rocky Mountain Paleogeography Symposium 3, p. 247–276.

Johnson, R.C., 1989, Detailed Cross Section Correlating the Upper Cretaceous and Lower Tertiary Rocks between the Uinta Basin of Eastern Utah and Western Colorado and the Piceance Basin of western Colorado: U.S. Geological Survey Miscellaneous Investigations Map I–1974.

Johnson, R.C., 2003, Northwest to Southeast Cross Section of Cretaceous and Lower Tertiary Rocks across the Eastern Part of the Uinta Basin, Utah, chap. 11 of U.S. Geological Survey Uinta-Piceance Assessment Team, compilers, Petroleum Systems and Geologic Assessment of Oil and Gas in the Uinta-Piceance Province, Utah and Colorado: U.S. Geological Survey Digital Data Series 69–B, 6 p.

Johnson, R.C., 2014, Detailed north-south cross section showing environments of deposition, organic richness, and thermal maturities of lower Tertiary rocks in the Uinta Basin, Utah: U.S. Geological Survey Scientific Investigations Map 3304, 12 p., 1 sheet, http://dx.doi.org/10.3133/sim3304.

Johnson, R.C., Nichols, D.J., and Hanley, J.H., 1988, Stratigraphic sections of Lower Tertiary strata and charts showing palynomorph and mollusc assemblages, Douglas Creek arch area Colorado and Utah: U.S. Geological Survey Miscellaneous Field Investigations Map MF–1997.

Johnson, R.C., and the U.S. Geological Survey Oil Shale Assessment Team, 2010, Oil Shale Resources of the Uinta Basin, Utah and Colorado: U.S. Geological Survey Digital Data Series DDS-69-BB, [CD-ROM].

Keighin, C.W., 1977, Preliminary Geologic Map of the Cooper Canyon Quadrangle, Uintah County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-874, scale 1:24,000.

Mercier, T.J., and Johnson, R.C., 2012, Isopach and isoresource Maps for Oil Shale Deposits in the Eocene Green River Formation for the Combined Uinta and Piceance Basins, Utah and Colorado: U.S. Geological Survey Scientific Investigations Report 2012–5076, 85 p., 1 pl.

Pipiringos, G.N., 1978, Preliminary Geologic Map of the Bates Knolls Quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Investigations Map MF–1025, scale 1:24,000.

Red Leaf Resources, 2013, Utah Groundwater Discharge permit Application for Red Leaf Resources, Inc., Southwest #1 Project, Submitted to the State of Utah Division of Water Quality, June, 2014.

Stokes, W.L. 1986. Geology of Utah. Utah Museum of Natural History and Utah Geological and Minerals Survey.

TomCo, 2014, Groundwater Discharge Permit Application, Holliday Block, Submitted to the State of Utah Division of Water Quality, February 14, 2014.

Trudell, L.G., Beard, T.N., and Smith, J.W., 1970, Green River Formation Lithology and Oil Shale Correlations in the Piceance Creek Basin, Colorado: U.S. Bureau of Mines Report of Investigations 7357, 11 p., 212 tables.

Vanden Berg, M.D., 2008, Basin-Wide Evaluation of Uppermost Green River Formation's Oil-Shale Resource, Unita Basin, Utah and Colorado, Utah Geological Survey Special Study SS 128.

Wallace, Janea. 2012. Baseline Water Quality and Estimated Quantity for Selected Sites in the Southeastern Uinta Basin, Utah. Open File Report 595, Utah Geological Survey, Utah Department of Natural Resources, 2012, 66 p.

Woods, A.J., Lammers, D.A., Bryce, S.A., Omernik, J.M., Denton, R.L., Domeier, M., and Comstock, J.A., 2001, Ecoregions of Utah (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,175,000)

APPENDIX A: REVIEWED WELLS AND BOREHOLES WITH BEDDING TOPS

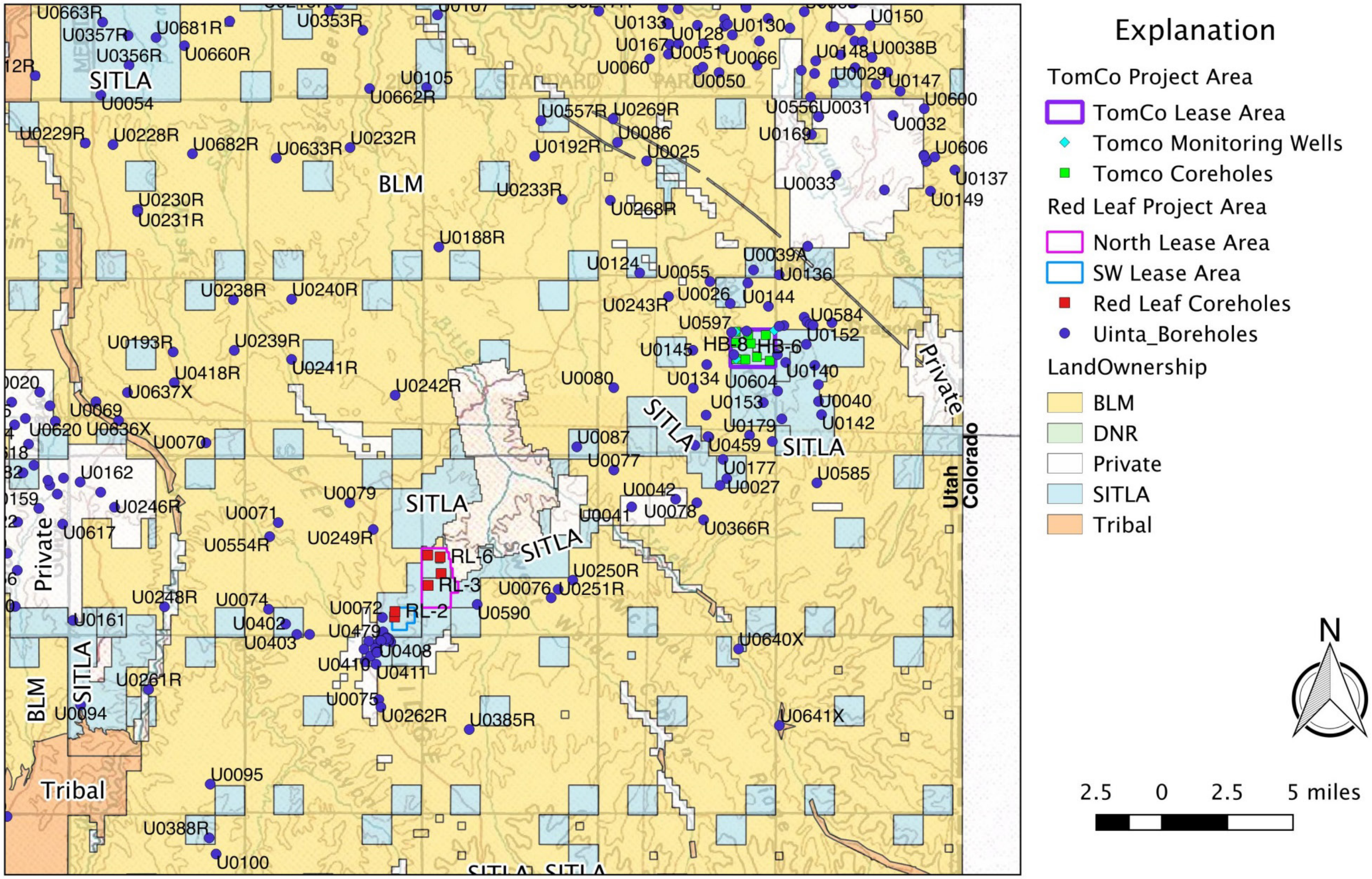


Figure A- 1. Boreholes in Vicinity of the TomCo and Red Leaf Project Area.

Table A- 1. A-Groove Tops (see footnote for sources of data)

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	A-Groove Top (feet amsl)	A-Groove Top (feet bgs)
TomCo MW-01	12S	24E	11	SW SE	654548	4405434	200	6092	6052	40
TomCo MW-02	12S	24E	14	NW SE	654602	4403965	200	6232	6207	25
TomCo MW-03	12S	24E	12	SW SW	655180	4405418	200	6132	6115	17
TomCo MW-04	12S	24E	12	SE SE	656648	4405549	1100	6437	6237	200
TomCo HB-1	12S	24E	13	SE SE	656430	4403904	164.60	6431	6402	29
TomCo HB-2	12S	24E	14	SE SE	655104	4403947	215	6373	6285	88
TomCo HB-4	12S	24E	14	NW NE	654575	4404839	195	6179	6113	66
TomCo HB-7	12S	24E	12	SW SE	656185	4405284	304	6394	6214	180
TomCo HB-9	12S	24E	11	SW SE	654555	4405434	180	6097	6059	38
Red Leaf RL-1	13S	22E	36	SW NW	636298	4389653	138.3	6654	6645.7	8,3
Red Leaf RL-2	13S	22E	36	NW NW	636313	4389943	159	6650	6609.9	40.1
Red Leaf RL-3	13S	23E	30	SW NW	638090	4391395	178.6	6460	6403.9	56.1
Red Leaf RL-4	13S	23E	19	SW SE	638788	4392046	169.2	6355	6313	42
Red Leaf RL-5	13S	23E	19	NW NW	638040	4393033	239.2	6342	6225.7	116.3
Red Leaf RL-6	13S	23E	19	SW NE	638721	4392945	218.7	6306	6219.9	86.1
U021	13S	20E	5	SW NW	610525	4396747		5964	5888.9	75.1
U022	13S	20E	14	NE NW	615775	4394255		6038	5960.8	77.2
U023	13S	20E	1	NE SE	618235	4396672		5836	5747.8	88.2
U025	11S	24E	17	NW NE	649592	4414357		5347	4870	477
U027	13S	24E	2	NE SW	654287	4397281	178	6789	6708	81
U031	11S	25E	5	NE SW	658872	4416933		5533	5131.8	401.2
U032	11S	25E	3	NE SE	662907	4417093		6339	5975.5	363.5
U033	11S	25E	16	NW SW	659877	4413814		5905	5556.9	348.1
U034	11S	25E	22	NW NE	662521	4413059		6144	5802	342
U039	11S	25E	29	SW SW	658422	4409929		6110	5842	268
U041	13S	24E	8	NW SW	649145	4395648	220	6322	6288.2	33.8
U042	13S	24E	9	SW NE	651527	4396110	234	6497	6451.7	45.3
U055	12S	24E	3	NE NE	653158	4407920	498	6137	5710.8	426.2
U070	12S	21E	35	SW NE	625945	4398702		5829	5769.7	59.3
U071	13S	22E	17	NW NW	629942	4394449	347	6183	6155.5	27.5
U072	13S	22E	35	SW NE	635700	4389409	217	6700	6639.8	60.2
U074	13S	22E	31	NE NE	629496	4389749	236	6628	6546.6	81.4
U077	13S	24E	6	SW NE	648138	4397625	276	6268	6124.7	143.3
U078	13S	24E	10	SE NW	652681	4395938	232	6677	6559.6	117.4

Table A- 1. A-Groove Tops (see footnote for sources of data)

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	A-Groove Top (feet amsl)	A-Groove Top (feet bgs)
U079	13S	22E	10	SW NE	633812	4395597	581	6427	6024.6	402.4
U080	12S	24E	19	NW SE	648046	4402078	621	6261	5801.2	459.8
U086	11S	24E	7	SW NE	647995	4415339		5250	4708	542
U087	12S	23E	36	NE SW	646100	4398839	576	6362	5941	421
U088	11S	24E	36	SW SW	655510	4408591		6130	5817	
U090	12S	24E	36	NE SE	656719	4399338	216	6900	6866	
U134	12S	24E	22	NW SW	652365	4402141	249	6225	6128	
U136	11S	25E	31	SW SW	656910	4408355		6295	5915	
U137	11S	25E	13	SE NE	666321	4414219		6700	6648	
U140	12S	25E	18	SE SW	657356	4403625	196	6340	6287	
U141	12S	24E	34	SE NE	653267	4399513	196	6450	6390	
U143	12S	25E	17	SE SW	658938	4403501	338	6700	6546	
U145	12S	24E	15	SW NW	652302	4404186	503	6300	5953	
U149	11S	25E	24	NW NW	665023	4413046		6500	6121	
U153	12S	24E	25	NW NE	656186	4401431	239	6660	6598	
U156	12S	24E	12	SW SW	655201	4405283	200	6110	6074	
U457	12S	25E	8	SW NW	658468	4405835		6430	6325	

SOURCES:
No shading: TomCo GWDP (2014)
Purple: Red Leaf GWDP (2013)
Green: Vanden Berg (2008)
Pink: Vanden Berg (2008); Johnson et al. (2010)
Light Blue: Johnson et al. (2010)

Table A- 2. Mahogany Zone Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Zone Top (feet amsl)
TomCo MW-01	12S	24E	11	SW SE	654548	4405434	200	6092	6037
TomCo MW-02	12S	24E	14	NW SE	654602	4403965	200	6232	6187
TomCo MW-03	12S	24E	12	SW SW	655180	4405418	200	6132	6097
TomCo MW-04	12S	24E	12	SE SE	656648	4405549	1100	6437	6224
TomCo HB-1	12S	24E	13	SE SE	656430	4403904	164.6	6431	6390
TomCo HB-2	12S	24E	14	SE SE	655104	4403947	215	6373	6275

Table A- 2. Mahogany Zone Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Zone Top (feet amsl)
TomCo HB-3	12S	24E	14	NW SE	654604	4403958	145	6231	6195
TomCo HB-4	12S	24E	14	NW NE	654575	4404839	195	6179	6104
TomCo HB-5	12S	24E	13	NW NW	655383	4404819	175	6229	6187
TomCo HB-6	12S	24E	13	NW SW	655730	4404092	155	6319	6301
TomCo HB-7	12S	24E	12	SW SE	656185	4405284	304	6394	6204
TomCo HB-8	12S	24E	12	SW SW	655228	4405283	155	6138	6112
TomCo HB-9	12S	24E	11	SW SE	654555	4405434	180	6097	6049
Red Leaf RL-1	13S	22E	36	SW NW	636298	4389653	138.3	6654	6629.6
Red Leaf RL-2	13S	22E	36	NW NW	636313	4389943	159	6650	6597.8
Red Leaf RL-3	13S	23E	30	SW NW	638090	4391395	178.6	6460	6386.8
Red Leaf RL-4	13S	23E	19	SW SE	638788	4392046	169.2	6355	6295.5
Red Leaf RL-5	13S	23E	19	NW NW	638040	4393033	239.2	6342	6208.6
Red Leaf RL-6	13S	23E	19	SW NE	638721	4392945	218.7	6306	6205.9
U008	13S	19E	14		605853	4393568		6247	6093
U010	13S	19E	34		604747	4388476		6763	6613.7
U017	13S	18E	4		594250	4396676		6090	6060
U018	13S	19E	7		599386	4394268		6275	6256.6
U021	13S	20E	8		610525	4396747		5964	5873.4
U022	13S	20E	14		615775	4394255		6038	5941.2
U023	13S	20E	1		618235	4396672		5836	5723.8
U025	11S	24E	17		649592	4414357		5347	4859
U026	12S	24E	2	SE SW	654279	4406752	270	6059	5905.6
U027	13S	24E	2	NE SW	654287	4397281	178	6789	6699.1
U031	11S	25E	5		658872	4416933		5533	5121.8
U032	11S	25E	3		662907	4417093		6339	5964.7
U033	11S	25E	16		659877	4413814		5905	5549
U034	11S	25E	22		662521	4413059		6144	5793.4
U039	11S	25E	29		658422	4409929		6110	5828.5
U041	13S	24E	8	NW SW	649145	4395648	220	6322	6283.1
U042	13S	24E	9	SW NE	651527	4396110	234	6497	6442
U055	12S	24E	3	NE NE	653158	4407920	498	6137	5701.7
U070	12S	21E	35		625945	4398702		5829	5741.5
U071	13S	22E	17	NW NW	629942	4394449	347	6183	6126.6

Table A- 2. Mahogany Zone Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Zone Top (feet amsl)
U072	13S	22E	35	SW NE	635700	4389409	217	6700	6622.7
U073	13S	22E	35	SW SE	635749	4388635	137	6727	6715.6
U074	13S	22E	31	NE NE	629496	4389749	236	6628	6530.4
U075	14S	22E	14	NW NE	635581	4384956	139	6989	6978
U076	13S	23E	26	NE SW	644861	4390642	118	6419	6412
U077	13S	24E	6	SW NE	648138	4397625	276	6268	6114.5
U078	13S	24E	10	SE NW	652681	4395938	232	6677	6551
U079	13S	22E	10	SW NE	633812	4395597	581	6427	6003.5
U080	12S	24E	19	NW SE	648046	4402078	621	6261	5791.2
U086	11S	24E	7		647995	4415339		5250	4697
U087	12S	23E	36	NE SW	646100	4398839	576	6362	5931
U088	11S	24E	36		655510	4408591		6130	5810
U090	12S	24E	36	NE SE	656719	4399338	216	6900	6856
U094	14S	21E	18		619353	4384393		6760	6740
U095	14S	21E	26		626480	4380217		7002	6944
U134	12S	24E	22	NW SW	652365	4402141	249	6225	6118
U135	12S	25E	7	SE NE	658311	4406094	443	6540	6262.3
U136	11S	25E	31		656910	4408355		6295	5906
U137	11S	25E	13		666321	4414219		6700	6639
U140	12S	25E	18	SE SW	657356	4403625	196	6340	6277
U141	12S	24E	34	SE NE	653267	4399513	196	6450	6265
U143	12S	25E	17	SE SW	658938	4403501	338	6700	6536
U144	12S	24E	1	SE SE	656357	4406641	440	6340	6060
U145	12S	24E	15	SW NW	652302	4404186	503	6300	5944
U149	11S	25E	24		665023	4413046		6500	6114
U152	12S	25E	17	NW NW	658452	4404632	341	6600	6416
U153	12S	24E	25	NW NE	656186	4401431	239	6660	6588
U156	12S	24E	12	SW SW	655201	4405283	200	6110	6065
U160	13S	20E	26		615712	4389681		6388	6378
U161	13S	21E	31		618866	4388973		6457	6440
U177	13S	24E	2	NW NW	654056	4398315		6611	6595
U178	13S	24E	2	SW SW	653924	4396901	128	6933	6902
U179	12S	24E	36	SW NW	655473	4399653	100	6804	6784
U457	12S	25E	8	SW NW	658468	4405835		6430	6315

Table A- 2. Mahogany Zone Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Zone Top (feet amsl)
(D-11-24) 7acd-1	11S	24E	7	SW NE	647997	4415545	2650	5245	4665
CHORNEY B-NCT 1	13S	22E	23	SE SW	635133	4392769	13125	6624	6209

SOURCES:
No shading: TomCo GWDP (2014)
Purple: Red Leaf GWDP (2013)
Yellow: Holmes (1980)
Blue: Sprinkel (2009); DOGM OOGIS
Green: Vanden Berg (2008)
Pink: Vanden Berg (2008); Johnson et al. (2010)
Lt. Blue: Johnson et al. (2010)

Table A- 3. Mahogany Bed Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Bed Top (feet amsl)
TomCo HB-1	12S	24E	13	SE SE	656430	4403904	164.60	6431	6366
TomCo HB-2	12S	24E	14	SE SE	655104	4403947	215	6373	6245
TomCo HB-3	12S	24E	14	NW SE	654604	4403958	145	6231	6186
TomCo HB-4	12S	24E	14	NW NE	654575	4404839	195	6179	6073
TomCo HB-5	12S	24E	13	NW NW	655383	4404819	175	6229	6161
TomCo HB-6	12S	24E	13	NW SW	655730	4404092	155	6319	6280
TomCo HB-7	12S	24E	12	SW SE	656185	4405284	304	6394	6178
TomCo HB-8	12S	24E	12	SW SW	655228	4405283	155	6138	6103
TomCo HB-9	12S	24E	11	SW SE	654555	4405434	180	6097	6021
TomCo MW-01	12S	24E	11	SW SE	654548	4405434	200	6092	6014
TomCo MW-02	12S	24E	14	NW SE	654602	4403965	200	6232	6147
TomCo MW-03	12S	24E	12	SW SW	655180	4405418	200	6132	6052
TomCo MW-04	12S	24E	12	SE SE	656648	4405549	1100	6437	6179
Red Leaf RL-1	13S	22E	36	SW NW	636298	4389653	138.3	6654	6592
Red Leaf RL-2	13S	22E	36	NW NW	636313	4389943	159	6650	6564
Red Leaf RL-3	13S	23E	30	SW NW	638090	4391395	178.6	6460	6351.1
Red Leaf RL-4	13S	23E	19	SW SE	638788	4392046	169.2	6355	6262.1
Red Leaf RL-5	13S	23E	19	NW NW	638040	4393033	239.2	6342	6172.7
Red Leaf RL-6	13S	23E	19	SW NE	638721	4392945	218.7	6306	6172.2
U008	13S	19E	14		605853	4393568		6247	6086.4

Table A- 3. Mahogany Bed Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Bed Top (feet amsl)
U010	13S	19E	34		604747	4388476		6763	6605
U017	13S	18E	4		594250	4396676		6090	5966.2
U018	13S	19E	7		599386	4394268		6275	6160
U021	13S	20E	8		610525	4396747		5964	5798.7
U022	13S	20E	14		615775	4394255		6038	5880
U023	13S	20E	1		618235	4396672		5836	5669
U025	11S	24E	17		649592	4414357		5347	4829
U026	12S	24E	2	SE SW	654279	4406752	270	6059	5879.5
U027	13S	24E	2	NE SW	654287	4397281	178	6789	6669.4
U031	11S	25E	5		658872	4416933		5533	5085
U032	11S	25E	3		662907	4417093		6339	5933
U033	11S	25E	16		659877	4413814		5905	5522
U034	11S	25E	22		662521	4413059		6144	5762
U039	11S	25E	29		658422	4409929		6110	5800
U040	12S	25E	29	NE NW	659186	4401554	62	6799	6779
U041	13S	24E	8	NW SW	649145	4395648	220	6322	6258.3
U042	13S	24E	9	SW NE	651527	4396110	234	6497	6410.6
U055	12S	24E	3	NE NE	653158	4407920	498	6137	5672.7
U070	12S	21E	35		625945	4398702		5829	5700
U071	13S	22E	17	NW NW	629942	4394449	347	6183	6081.8
U072	13S	22E	35	SW NE	635700	4389409	217	6700	6580
U073	13S	22E	35	SW SE	635749	4388635	137	6727	6674.9
U074	13S	22E	31	NE NE	629496	4389749	236	6628	6480.4
U075	14S	22E	14	NW NE	635581	4384956	139	6989	6940
U076	13S	23E	26	NE SW	644861	4390642	118	6419	6387
U077	13S	24E	6	SW NE	648138	4397625	276	6268	6078.1
U078	13S	24E	10	SE NW	652681	4395938	232	6677	6522.6
U079	13S	22E	10	SW NE	633812	4395597	581	6427	5966.7
U080	12S	24E	19	NW SE	648046	4402078	621	6261	5758
U086	11S	24E	7		647995	4415339		5250	4669
U087	12S	23E	36	NE SW	646100	4398839	576	6362	5897
U088	11S	24E	36		655510	4408591		6130	5781
U090	12S	24E	36	NE SE	656719	4399338	216	6900	6827
U091	12S	24E	14	NW SE	654533	4403991	176	6165	6116
U094	14S	21E	18		619353	4384393		6760	6679
U095	14S	21E	26		626480	4380217		7002	6939

Table A- 3. Mahogany Bed Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (feet bgs)	Collar (feet amsl)	Mahogany Bed Top (feet amsl)
U134	12S	24E	22	NW SW	652365	4402141	249	6225	6087
U135	12S	25E	7	SE NE	658311	4406094	443	6540	6238
U136	11S	25E	31		656910	4408355		6295	5877
U137	11S	25E	13		666321	4414219		6700	6610
U140	12S	25E	18	SE SW	657356	4403625	196	6340	6249
U141	12S	24E	34	SE NE	653267	4399513	196	6450	6350
U143	12S	25E	17	SE SW	658938	4403501	338	6700	6508
U144	12S	24E	1	SE SE	656357	4406641	440	6340	6036
U145	12S	24E	15	SW NW	652302	4404186	503	6300	5916.6
U149	11S	25E	24		665023	4413046		6500	6082
U152	12S	25E	17	NW NW	658452	4404632	341	6600	6388
U153	12S	24E	25	NW NE	656186	4401431	239	6660	6560
U156	12S	24E	12	SW SW	655201	4405283	200	6110	6035
U159	13S	20E	11		616915	4395010		5908	5832
U160	13S	20E	26		615712	4389681		6388	6310
U161	13S	21E	31		618866	4388973		6457	6387
U177	13S	24E	2	NW NW	654056	4398315		6611	6567
U178	13S	24E	2	SW SW	653924	4396901	128	6933	6876
U179	12S	24E	36	SW NW	655473	4399653	100	6804	6776
U457	12S	25E	8	SW NW	658468	4405835		6430	6290
4304732558	11S	23E	30		638393	4409510		5764	4816
4304732853	11S	23E	35		644834	4407987		5941	5137
4304734252	11S	23E	10		643568	4414792		5687	4576
4304734371	11S	23E	9		642057	4414970		6111	4443
(D-11-24) 7acd-1	11S	24E	7	SW NE	647997	4415545	2650	5245	4665

SOURCES:
No shading: TomCo GWDP (2014)
Purple: Red Leaf GWDP (2013)
Yellow: Holmes (1980)
Green: Vanden Berg (2008)
Pink: Vanden Berg (2008); Johnson et al. (2010)
Lt. Blue: Johnson et al. (2010)

Table A- 4. B-Groove Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (ft bgs)	Collar (ft amsl)	B-Groove Top (ft amsl)
TomCo HB-1	12S	24E	13	SE SE	656430	4403904	164.60	6431	5431
TomCo HB-2	12S	24E	14	SE SE	655104	4403947	215	6373	6209
TomCo HB-3	12S	24E	14	NW SE	654604	4403958	145	6231	6140
TomCo HB-6	12S	24E	13	NW SW	655730	4404092	155	6319	6242
TomCo HB-7	12S	24E	12	SW SE	656185	4405284	304	6394	6140
TomCo HB-8	12S	24E	12	SW SW	655228	4405283	155	6138	6063
TomCo HB-9	12S	24E	11	SW SE	654555	4405434	180	6097	5978
TomCo MW-01	12S	24E	11	SW SE	654548	4405434	200	6092	5967
TomCo MW-02	12S	24E	14	NW SE	654602	4403965	200	6232	6112
TomCo MW-03	12S	24E	12	SW SW	655180	4405418	200	6132	6009
TomCo MW-04	12S	24E	12	SE SE	656648	4405549	1100	6437	6134
Red Leaf RL-1	13S	22E	36	SW NW	636298	4389653	138.3	6654	6542.9
Red Leaf RL-2	13S	22E	36	NW NW	6363123	4389943	159	6650	6512
Red Leaf RL-3	13S	23E	30	SW NW	638090	4391395	178.6	6460	6300
Red Leaf RL-4	13S	23E	19	SW SE	638788	4392046	169.2	6355	6211
Red Leaf RL-5	13S	23E	19	NW NW	638040	4393033	239.2	6342	6122
Red Leaf RL-6	13S	23E	19	SW NE	638721	4392945	218.7	6306	6121
U008	13S	19E	14		605853	4393568		6247	6055.4
U010	13S	19E	34		604747	4388476		6763	6590.8
U017	13S	18E	4		594250	4396676		6090	5939.8
U018	13S	19E	7		599386	4394268		6275	6128.3
U021	13S	20E	8		610525	4396747		5964	5732.6
U022	13S	20E	14		615775	4394255		6038	5811
U023	13S	20E	1		618235	4396672		5836	5602.3
U026	12S	24E	2	SE SW	654279	4406752	270	6059	5841.8
U027	13S	24E	2	NE SW	654287	4397281	178	6789	6630.2
U032	11S	25E	3		662907	4417093		6339	5879
U033	11S	25E	16		659877	4413814		5905	5473.1
U041	13S	24E	8	NW SW	649145	4395648	220	6322	6205.7
U042	13S	24E	9	SW NE	651527	4396110	234	6497	6367.7
U070	12S	21E	35		625945	4398702		5829	5633.9
U071	13S	22E	17	NW NW	629942	4394449	347	6183	6019.5
U072	13S	22E	35	SW NE	635700	4389409	217	6700	6519.9

Table A- 4. B-Groove Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼- ¼	UTM E	UTM N	TD (ft bgs)	Collar (ft amsl)	B-Groove Top (ft amsl)
U073	13S	22E	35	SW SE	635749	4388635	137	6727	6611.9
U074	13S	22E	31	NE NE	629496	4389749	236	6628	6415
U075	14S	22E	14	NW NE	635581	4384956	139	6989	6870.4
U076	13S	23E	26	NE SW	644861	4390642	118	6419	6334
U077	13S	24E	6	SW NE	648138	4397625	276	6268	6030.6
U078	13S	24E	10	SE NW	652681	4395938	232	6677	6478.8
U079	13S	22E	10	SW NE	633812	4395597	581	6427	5904.2
U080	12S	24E	19	NW SE	648046	4402078	621	6261	5710.5
U086	11S	24E	7		647995	4415339		5250	4622
U091	12S	24E	14	NW SE	654533	4403991	176	6165	6077
U094	14S	21E	18		619353	4384393		6760	6670
U095	14S	21E	26		626480	4380217		7002	6913
U134	12S	24E	22	NW SW	652365	4402141	249	6225	6042
U135	12S	25E	7	SE NE	658311	4406094	443	6540	6200
U136	11S	25E	31		656910	4408355		6295	5836
U137	11S	25E	13		666321	4414219		6700	6563
U140	12S	25E	18	SE SW	657356	4403625	196	6340	6217
U143	12S	25E	17	SE SW	658938	4403501	338	6700	6470
U144	12S	24E	1	SE SE	656357	4406641	440	6340	5996
U145	12S	24E	15	SW NW	652302	4404186	503	6300	5886
U149	11S	25E	24		665023	4413046		6500	6026
U152	12S	25E	17	NW NW	658452	4404632	341	6600	6351
U153	12S	24E	25	NW NE	656186	4401431	239	6660	6525
U156	12S	24E	12	SW SW	655201	4405283	200	6110	5996
U160	13S	20E	26		615712	4389681		6388	6284
U161	13S	21E	31		618866	4388973		6457	6366
U177	13S	24E	2	NW NW	654056	4398315		6611	6527
U178	13S	24E	2	SW SW	653924	4396901	128	6933	6838
U179	12S	24E	36	SW NW	655473	4399653	100	6804	6736
U457	12S	25E	8	SW NW	658468	4405835		6430	6237

SOURCES:
No shading: TomCo GWDP (2014)
Purple: Red Leaf GWDP (2013)
Green: Vanden Berg (2008)
Pink: Vanden Berg (2008); Johnson et al. (2010)
Lt. Blue: Johnson et al. (2010)

Table A- 5. Bed R6 Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼ - ¼	UTM E	UTM N	TD (ft bgs)	Collar (ft amsl)	R6 Top (ft amsl)
TomCo HB-1	12S	24E	13	SE SE	656430	4403904	164.60	6431	6307
TomCo HB-2	12S	24E	14	SE SE	655104	4403947	215	6373	6193
TomCo HB-6	12S	24E	13	NW SW	655730	4404092	155	6319	6222
TomCo HB-7	12S	24E	12	SW SE	656185	4405284	304	6394	6124
TomCo HB-8	12S	24E	12	SW SW	655228	4405283	155	6138	6050
TomCo HB-9	12S	24E	11	SW SE	654555	4405434	180	6097	5957
TomCo MW-01	12S	24E	11	SW SE	654548	4405434	200	6092	5957
TomCo MW-02	12S	24E	14	NW SE	654602	4403965	200	6232	6102
TomCo MW-03	12S	24E	12	SW SW	655180	4405419	200	6132	5999
TomCo MW-04	12S	24E	12	SE SE	656648	4405549	1100	6437	6124
U023	13S	20E	1		618235	4396672		5836	5579
U026	12S	24E	2	SE SW	654279	4406752	270	6059	5825.9
U027	13S	24E	2	NE SW	654287	4397281	178	6789	6625.7
U041	13S	24E	8	NW SW	649145	4395648	220	6322	6195.6
U042	13S	24E	9	SW NE	651527	4396110	234	6497	6358.6
U070	12S	21E	35		625945	4398702		5829	5617.5
U071	13S	22E	17	NW NW	629942	4394449	347	6183	6008.4
U072	13S	22E	35	SW NE	635700	4389409	217	6700	6514.5
U073	13S	22E	35	SW SE	635749	4388635	137	6727	6607.4
U074	13S	22E	31	NE NE	629496	4389749	236	6628	6404.5
U075	14S	22E	14	NW NE	635581	4384956	139	6989	6867.2
U076	13S	23E	26	NE SW	644861	4390642	118	6419	6328
U077	13S	24E	6	SW NE	648138	4397625	276	6268	6021.6
U078	13S	24E	10	SE NW	652681	4395938	232	6677	6470.8
U079	13S	22E	10	SW NE	633812	4395597	581	6427	5894.4
U080	12S	24E	19	NW SE	648046	4402078	621	6261	5701.9
U086	11S	24E	7		647995	4415339		5250	4591.4
U091	12S	24E	14	NW SE	654533	4403991	176	6165	6067
U135	12S	25E	7	SE NE	658311	4406094	443	6540	6190
U140	12S	25E	18	SE SW	657356	4403625	196	6340	6202
U143	12S	25E	17	SE SW	658938	4403501	338	6700	6462
U144	12S	24E	1	SE SE	656357	4406641	440	6340	5984
U145	12S	24E	15	SW NW	652302	4404186	503	6300	5880
U149	11S	25E	24		665023	4413046		6500	5999
U152	12S	25E	17	NW NW	658452	4404632	341	6600	6341
U153	12S	24E	25	NW NE	656186	4401431	239	6660	6514
U156	12S	24E	12	SW SW	655201	4405283	200	6110	5986

Table A- 5. Bed R6 Tops (see footnote for sources of data).

Well ID	Tnp	Rng	Sec	¼ - ¼	UTM E	UTM N	TD (ft bgs)	Collar (ft amsl)	R6 Top (ft amsl)
U177	13S	24E	2	NW NW	654056	4398315		6611	6521
U178	13S	24E	2	SW SW	653924	4396901	128	6933	6831
U179	12S	24E	36	SW NW	655473	4399653	100	6804	6714
U457	12S	25E	8	SW NW	658468	4405835		6430	6215.3

SOURCES:
No shading: TomCo GWDP (2014)
Green: Vanden Berg (2008)
Pink: Vanden Berg (2008); Johnson et al. (2010)
Lt. Blue: Johnson et al. (2010)

APPENDIX B: SOUTHWEST TO NORTHEAST CROSS SECTION OF THE RED LEAF PROJECT AREA TO THE TOMCO PROJECT AREA

SW to NE Cross Section - Red Leaf Project Area to TomCo Project Area