M/047/0103
cc: Leslie
Task 4561

Utah Ground Water Discharge Permit Application
for
Red Leaf Resources, Inc.
Southwest #1 Project

December 20, 2011

Prepared for:

Red Leaf Resources, Inc.
200 West Civic Center Drive, Suite 190
Sandy, Utah 84070

Prepared by:

JBR Environmental Consultants, Inc.
8160 South Highland Drive
Sandy, Utah 84093

RECEIVED

DEC 21 2011

DIV. OF OIL, GAS & MINING

Form MR-REV-att (DOGM – Revise/Amend Change Form)
(Revised September 14, 2005)

Application for Mineral Mine Plan Revision or Amendment

Operator: Red Leaf Resources

Mine Name: Southwest #1 **File Number:** M/047 0103

Provide a detailed listing of all changes to the mining and reclamation plan that will be required as a result of this change. Individually list all maps and drawings that are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise or amend the existing Mining and Reclamation Plan. **Include page, section and drawing numbers as part of the description.**

DETAILED SCHEDULE OF CHANGES TO THE MINING AND RECLAMATION PLAN

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
X ADD	□ REPLACE	□ REMOVE	Appendix 5 "Application to DWQ for Groundwater Discharge Permit"
□ ADD	□ REPLACE	□ REMOVE	
□ ADD	□ REPLACE	□ REMOVE	
□ ADD	□ REPLACE	□ REMOVE	
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I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments and obligations, herein.

Dr, James Patten, CEO
Print Name

, CEO
Sign Name, Position

12/21/11
Date

Return to:

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801
Phone: (801) 538-5291 Fax: (801) 359-3940

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FOR DOGM USE ONLY:
File #: M/ /
Approved:
Bond Adjustment: from ($)
to $

Appendix "S"

Application to Utah Division of Water Quality for Ground Water Discharge Permit Southwest #1 mine

Utah Ground Water Discharge Permit Application
for
Red Leaf Resources, Inc.
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December 20, 2011

Prepared for:

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List of Figures

List of Tables

List of Appendices

Appendix A	Selected Figures from the Utah Division of Oil, Gas and Mining Notice of Intent
Appendix C	Stacked Capsule Backing Wall Stability Analysis by Norwest Corporation
Appendix B	Operations and Reclamation Drainage Design Plan for Red Leaf Resources by Norwest Corporation
Appendix D	Steel Specifications for Collection Pan and Capsule Piping
Appendix E	SPLP Leachate Analysis by American West Analytical Laboratories
Appendix F	Reclamation Cover Performance Modeling (HELP)

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Utah Ground Water Discharge Permit Information
for
Red Leaf Resources, Inc.
Southwest #1 Project

1. Introduction

The Red Leaf Resources, Inc. (RLR), a privately held corporation, has developed a new process, EcoShale™ In-Capsule Technology, to extract oil reserves from oil shale. RLR is proving the new technology at a location in eastern Utah, while pursuing the necessary permits to begin full scale production. The RLR business office is located at 200 West Civic Center Drive, Suite 190, Sandy, Utah 84070, United States of America. RLR can be contacted by phone at (801) 878-8100, or by fax at (801) 878-8101, and the company maintains a website at http://www.redleafinc.com/ with general information.

The new mining operation, Southwest #1 Project, is located approximately 55 miles south of Vernal, in Uintah County, Utah (Figure 1, Location Map), and is comprised property in Township 13 South (T13S), Ranges 22 and 23 East (R22E and R23E) of the Salt Lake Base & Meridian. Combined these parcels comprise the project area of 1,656.78 acres.

2. Background Information

In February 2007, RLR filed the first technology patents for the EcoShale™ In-Capsule Technology. The original filing was modified in February 2008 and three U.S. patents have been published while others are still in process.

In October 2008, RLR initiated construction of a test facility under its Exploration Permit. RLR has been in continuous permitted operation since 2008 with activities including site construction, testing and scale-up of the EcoShale™ In-Capsule Technology test unit, operations and maintenance. The EcoShale™ In-Capsule Technology is used to extract kerogen deposits from sedimentary shale deposits. The operation consists of simultaneous mining the oil shale and creating the heating capsules for processing the mined ore.

The facility is currently operating under the authority of a Small Mine Operation (SMO) Permit. RLR intends to expand activities at Southwest #1 small mine site by converting to a Large Mining Operation (LMO). Mining will initiate in SE1/4 of Section 30, T13S, R23E, and progress east to west and south to north.

3. Administrative Information

3.1. Applicant Name and Address

Red Leaf Resources, Inc.
200 West Civic Center Drive
Suite 190
Sandy, Utah 84070
United States of America
Attn: Dr. Laura Nelson, VP of Energy and Environmental Development

3.2. Contact Information

Phone: (801) 878-8100
Fax: (801) 878-8101
Website: a website at http://www.redleafinc.com/

3.3. Authorized Company Representative

Dr. Laura Nelson is duly authorized to represent Red Leaf Resources, Inc. with regard to this application for a ground water discharge permit for the Southwest #1 mine.

3.4. Facility Legal Location

The RLR Southwest #1 Mine is located in portions of Sections 19, 20, 29 and 30 in Township 13 South, Range 23 East; and in portions of Sections 25 and 36 of Township 13 South, Range 22 East. All sections are located in Uintah County, Utah. The Universal Transverse Mercator Geographic Coordinate System (UTM) coordinates for the facility are: Zone 12 Northing 4390671.43, Easting 638650.23.

4. General Information

4.1. Owner and Operator Information

The owner and operator information is the same as the applicant information: Red Leaf Resources, Inc. is the owner and operator for this facility.

4.2. Facility Information

Southwest #1 Mine Project
Red Leaf Resources, Inc.
Vernal, UT
VP, Field Operations: Lester Thompson, Field Operations

4.3. Contact Information

Phone: 801-994-1830

Mr. Thompson supervises the daily operations and maintenance of the EcoShale™ In-Capsule test site. He will continue in this capacity for the Southwest #1 Mine Project.

5. Facility Location, Type, and Classification

The Southwest #1 Mine Project will use the new EcoShale™ In-Capsule Technology to extract energy reserves from oil shale. The new mining operation is located approximately 55 miles south of Vernal, in Uintah County, Utah (Figure 1, Location Map), and is comprised property in Township 13 South (T13S), Ranges 22 and 23 East (R22E and R23E) of the Salt Lake Base & Meridian. Combined these parcels comprise the project area of 1,656.78 acres. The processed shale will be encapsulated in place for final disposition, with no identified impact to surface or ground water reserves. A detailed description is presented in the Large Mining Operation Project Background, Setting and Operations Description.

5.1. Facility Classification

The Southwest #1 Mine will be a new, to-be-constructed large mine operation.

5.2. Type of Facility

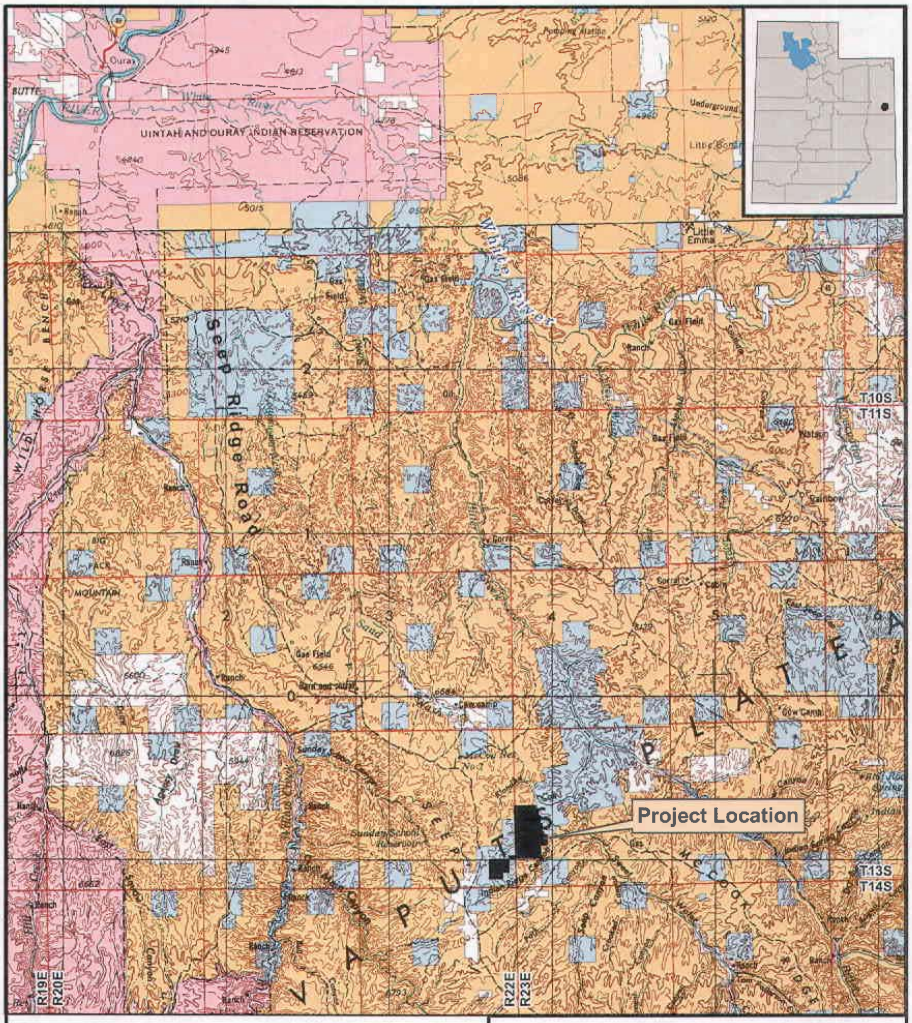
The new facility will be an oil shale production operation to include the processing and beneficiating of mined oil shale ore. It includes equipment maintenance and laboratory support facilities and ancillary facilities, as necessary.

5.3. 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 kerogen processing and oil shale mining and beneficiating.

5.4. Project Facility Life

The initial life of mining operation is 30 years. As the operation progresses additional reserves maybe discovered which could extend the life of the facility.



drawings\Red_Leaf\Figures\Figure 1 Location Map 060111 WR Oil Gas GaugeStation.mxd

6. Red Leaf Resources Oil Shale Mine Operation and Processing Description

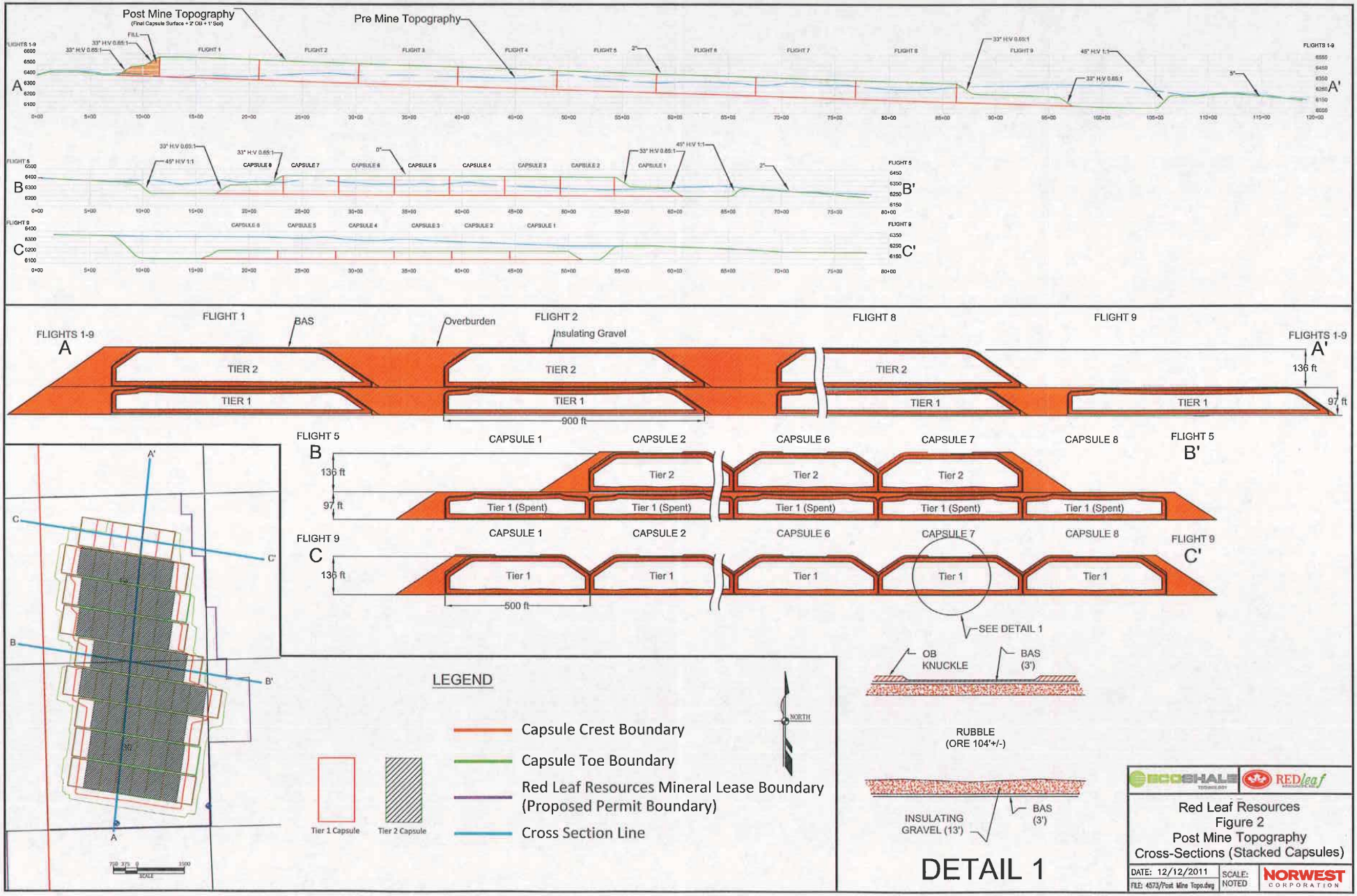
The EcoShale™ In-Capsule Technology uses heat to extract kerogen from oil shale deposits to produce crude oil. The operation is designed to maximize resource recovery and accommodate construction of "capsules" designed for low temperature heating of the shale to extract the hydrocarbons as gases and liquids. The mining process consists of the simultaneous mining of the oil shale and the construction of the heating capsules. All materials mined are utilized completely and play a role in the Red Leaf integrated process for capsule construction, hydrocarbon extraction and reclamation. The general mining sequence will consist of the following unit operations:

- Land clearing (where required)
- Soil removal and stockpiling
- Pre-stripping of unconsolidated overburden (when required)
- Drilling, blasting overburden
- Overburden removal
- Overburden loading, hauling, and screening
- Drilling, blasting of ore and interburdens
- Ore and interburden loading, hauling, and screening
- Selective use of screened materials in construction of capsules
- Heating and kerogen recovery
- Final grading
- Soil placement and revegetation

Mining will begin in the SE¼ of Section 30, T13S R23E, progressing east to west and south to north with production ending in Section 19, T 13 S, R 23 E. (. After mining is completed in Section 30, the lease that comprises one half of Section 36, T13S, R22E will be mined (See NOI Figure 2, Life of Mine Ore Plan Layout in Appendix A).The mine plan includes clearing and grubbing operations, installation of stormwater control, salvaging of soil, followed by mining of the soil overburden, interburden, and oil shale. Topsoil is salvaged and carefully stockpiled to be used during the reclamation phase. NOI Figure 12, Capsule Construction Progression Plan (Appendix A) is a diagrammatic, conceptual representation of the capsule construction and operation advance in a typical pit.

Figure 2 shows capsule construction sequence, major construction components, construction details, and pre-mining and post-reclamation topography.

Once enough overburden is removed from the pit area to create a capsule, an impermeable liner of bentonite-amended shale (BAS) is placed on the bottom of the capsule to prevent impacts to groundwater and the surrounding ecosystem. Manufacture of the capsule-sealing BAS involves using a special size fraction of non-ore materials mixed with bentonite and appropriate quantities of water in a pug mill to produce a bentonite sealing material for placement in the capsules. The BAS will be mixed, placed at optimal moisture content and compacted to 95%. The permeability of the BAS layer will be 10 x 10^{-07}cm/sec or less. A 3-foot layer of BAS will surround each capsule, top, bottom, sides and ends (RLR 2011).



Red Leaf Resources
Figure 2
Post Mine Topography
Cross-Sections (Stacked Capsules)

DATE: 12/12/2011 | SCALE: NOTED

FILE: 4573/Post Mine Topo.dwg

NORWEST CORPORATION

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. A metal liquids collection pan will be installed above the insulating layer at the bottom of each capsule to direct the liberated petroleum liquids to a collection sump and to prevent loss of oil to the underlying liner or the environment. The pans are sloped to direct liquids to the collection sumps.

Above the metal collection pan, 100 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. Collection pipes are placed along the bottom of the capsule. The mined material is placed above the collection pipes followed by placement of heat conducting pipe that will be installed throughout the capsule within the encapsulated ore. The ore and heating pipes will be incrementally stacked on top of one another in the heating capsules. Initially, each capsule would be heated to approximately the boiling point of water for two weeks to steam off the water prior to increasing the heat to pyrolysis temperatures. The heating pipes heat the ore to a maximum temperature of approximately 725 °F and, through pyrolysis, separate the compounds that comprise kerogen into liquid phases. Separate collection channels and pipes conduct the liquids and gases, respectively, to a collection manifold on the interior side of the north end of each capsule. Capsules will be stacked in two levels or tiers. Process components (i.e., collection tanks, compressors) are mobile and are located adjacent to each cell. The sequence and rate of capsule construction is designed to produce and sustain a target production rate of approximately 9,500 barrels per day of oil.

Capsule size is critical to ensure that capsule construction does not overtake the progression of mining. Based on this goal, RLR has developed a capsule design that includes stacking capsules two layers or "tiers" high. The aerial dimensions are approximately 500 by 900 feet for all capsules. The capsules are approximately 136 feet high prior to heating. The edges or "knuckles" of the capsules are slightly higher to accommodate settling at the edge to protect the constructed BAS wall which seals the capsule. Once the bottom capsule cools and settles to approximately 97 feet, the second tier of capsules is constructed on top of the bottom tier, bringing the maximum height of the top surface to approximately 233 feet (136 feet plus 97 feet) prior to heating the second tier capsule. After heating, the second tier capsule cools and settles to approximately 97 feet similar to the bottom capsules, bringing the total height of the stacked capsule design to approximately 194 feet before the addition of 1-2 feet of suitable overburden and 6 inches of growing medium. (RLR 2011). Capsule construction is further discussed below in Section 11, Capsule Design Report.

Initial overburden materials and ore from a portion of the first year of operation will have to be temporarily stockpiled outside of the pit. Once sufficient pit area is opened, the oil shale and other materials can then be sequentially handled prior to placement on the pit floor where construction of the recovery capsules occurs.

Most overburden, interburden, and all ore will be sized through mobile, skid mounted, crushing, screening and stacking conveyor systems. The mobile systems can move with the pit advance, and, consequently, haul distances will remain relatively constant throughout the life of the project. Geotechnical data on the materials that will be used in capsule construction are found in Appendix B - Stacked Capsule Backing Wall Stability Analysis.

The sideslopes of the capsules will consist of backfilled overburden constructed and compacted in shallow lifts to provide support to the BAS layer on the capsule sidewalls. Backfilled sideslopes of the capsules are anticipated to be approximately 1.5H:1V, with a small terrace, used as a ramp during capsule construction, remaining between the bottom tier and top tier of capsules (Figure 2).

A series of clean water diversions and sumps will be constructed to manage upland runoff from offsite tributaries at the western perimeter of the project site to prevent impacts to water resources and minimize erosion potential. (See the Drainage Design Plan [Norwest 2011], attached as Appendix C). Due to the site topography, the diversions cannot convey all the runoff that would flow towards the mining pits. Areas that cannot be diverted require the use of ponds or sumps to contain runoff. The operational sumps are sized according the area of contributing watersheds and the 10-year 24-hour storm event. The sump locations and contributing watersheds are shown on Figures 1 and 2 of the Drainage Design Plan Appendix C. Most of the sumps would be on-channel structures and would resemble a typical stock reservoir. RLR plans to use water collected in the sumps for its operations to supplement well water and water removed from the ore during processing (Norwest 2011).

6.1. Reclamation

Reclamation is integrated as part of the Red Leaf process, with overburden placed on top of the capsule prior to heating. Once the kerogen liquid and gas compounds are extracted from the ore and the capsule temperature has been sufficiently reduced on the second (top) tier of capsules final grading and reseeding will occur The capsule reclamation and mining activities will occur simultaneously throughout the site. 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 Utah Division of Oil Gas and Mining (DOGM) rules and minimize potential safety hazards.

With the exception of pit endwalls and the final highwall in each of the two lease parcels, the final configuration of the capsules represents the topographic surface that will require grading. After the heaters have been removed from each capsule, a cooling period will be allowed. After cooling and settlement is completed, the capsules will be ready for regrading and final reclamation. Final grading to achieve acceptable surface contours for positive drainage will be completed using overburden material not used in capsule construction and is expected to include both shot rock and unconsolidated material. The latter may also be used as supplemental plant growth material if its chemical characteristics are suitable. Salvaged soil will then be used for suitable plant growth material to cover the final graded capsule.

The final top surface of the capsules will be regraded in some areas to reduce runoff on to the sideslopes and minimize erosion potential. Small areas will be left with a concave surface to collect precipitation; encourage establishment of more mesic vegetation communities; and reduce run-off. Given the limited precipitation and high evapo-transporation rates for the Uinta Basin, puddling of moisture is not anticipated to last for extended periods of time. With a total thickness of cover material of approximately 20-24 feet, including 3 feet of BAS, puddled water will not enter the hydrocarbon

recovery zone of the capsules. By managing the relatively flat top surfaces of the capsules in this manner, run-off from the top surface to the sideslopes will be limited, as will resultant erosion.

All disturbed areas will be left in a stable configuration and planted with varying seed mixes suited for the different slopes, aspects and topographic positions established in the regrading plan.

The residual hydrocarbon in the capsules following the retort process is coke (RLR 2010), which is a gray, hard, porous, insoluble solid that consists of fused mineral matter and fixed carbon (Bates and Jackson 1984).

7. Issued and Pending Permits

7.1. Permit History

Permitted activities include site construction under an Exploration Permit (EXP 047/0055) issued in October 2008, operation, testing and scale-up of the EcoShale™ In-Capsule Technology and site management, operations, maintenance and testing through its Small Mining Operation (SMO) # S/047/0102.

7.2. Pending Permits

A Notice of Intention to Commence Large Mining Operations (NOI) has been filed with the DOGM on August 4, 2011. DOGM has issued tentative approval of the NOI conditional upon receiving other necessary permits and approvals, including that of the Division of Water Quality.

The project area is located in Indian Country and most federal permits are therefore under the jurisdiction of the U.S. EPA.

Nationwide permits for Storm Water discharge under the federal National Pollutant Discharge Elimination System (NPDES) will be obtained from EPA Region 8 for both construction of the facility and facility operations. Storm Water Pollution Prevention Plans (SWPPPs) have been prepared and will be kept current. Plans will be available on site prior to commencement of construction or mining activities.

Red Leaf has filed a notice of intent to construct a sediment basin within Waters of the U.S. with the U.S. Army Corps of Engineers. Review of the notice is in progress by the Corps staff in Bountiful, Utah.

Red Leaf Resources operates as a minor source emitter in continuous operations since the start-up of its initial small capsule operation under the DOGM SMO referenced above. Thus, the facilities are not subject to the recent implementation of a minor source permitting program.

The Southwest No. 1 project will 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 upon commencement of the proposed operations be collected and removed from the site by a licensed contractor. Solid waste will be collected and taken to a municipal landfill.

8. Water Information

8.1. Well and Spring Identification

Water sources within a one-mile radius of the mine operation are identified on Figure 3, Project Area. No drinking water wells within a one-mile radius have been identified. The hydrogeology report, below, further discusses these wells.

The United States Geological Survey (USGS) National Hydrography Dataset shows no springs in or near the mine area (USGS 2010, JBR 2011).

8.2. Surface Water Body Identification

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

8.3. Drainage Identification

The Southwest #1 Mine Project Area is dissected by numerous ephemeral drainages typical of high-desert landscapes, and does not contain any perennial surface water sources. Nearly all land surrounding the RLR project slopes down to the east to drain to Sweetwater Canyon Creek via Indian Ridge Canyon and its tributaries. A small portion at the north end of the area drains to Klondike Canyon, which is another tributary of Sweetwater Canyon. Sweetwater Canyon Creek is an eventual tributary of the White River. The confluence of Sweetwater Canyon Creek and Bitter Creek is approximately 3 miles northeast of the RLR site.

No drainages that allow surface water to discharge from the site have been identified within a one-mile radius of the mine operation.

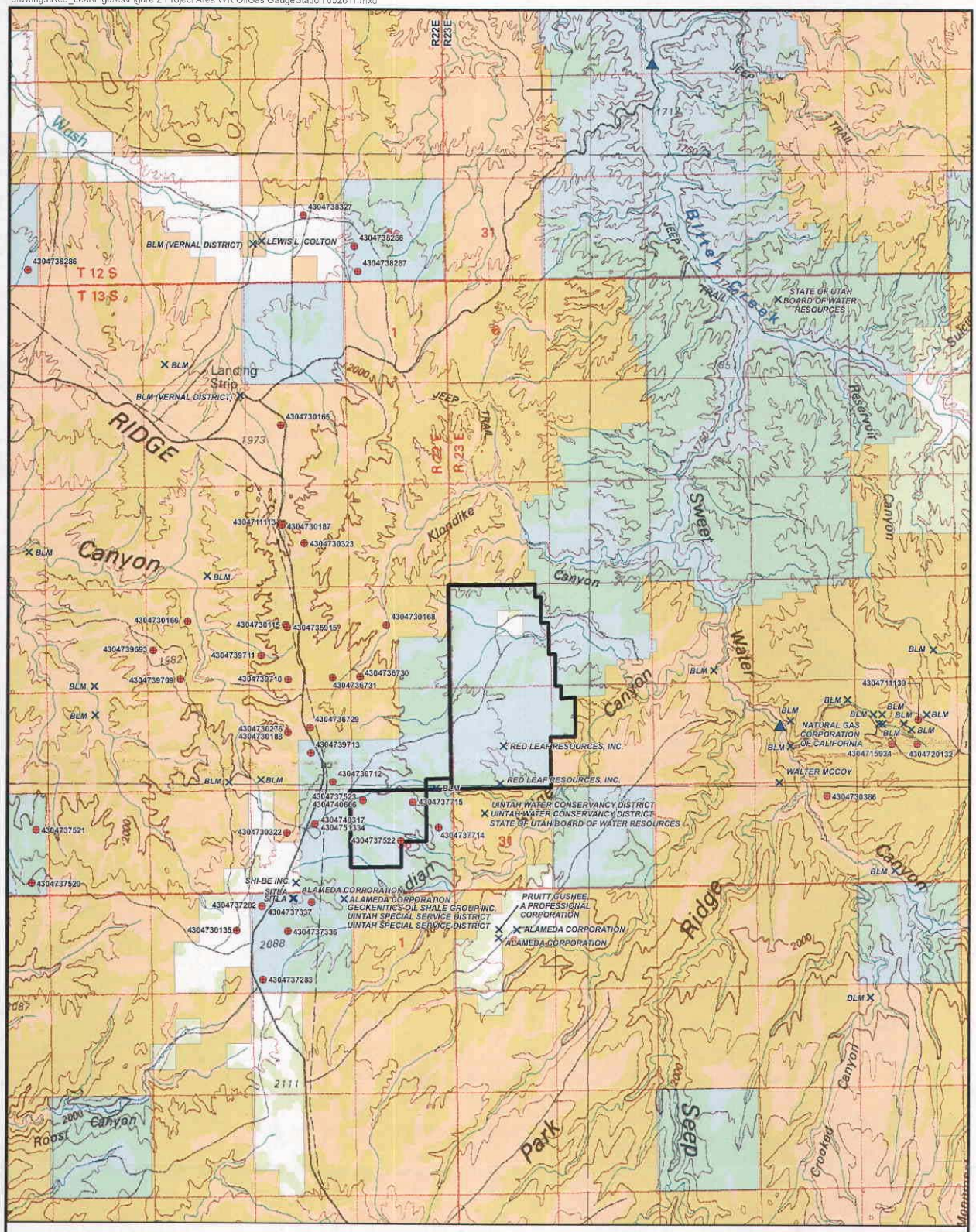
8.4. Well-head Protection Area Identification

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

8.5. Drinking Water Source Identification

No drinking water sources within a one-mile radius of the mine operation are identified on Figure 3, Project Area. No drinking water sources subject to the protection of Utah Administrative Code (UAC) 309-600 have been identified within a one-mile radius of the mine operation.

drawings\Red_Leaf\Figures\Figure 2 Project Area WR OilGas GaugeStation 052611.mxd



BASE MAP: USGS 1:100,00-SCALE METRIC TOPOGRAPHIC MAP

Legend

- Lease Boundary
- USFS Gaging Station
- Water Right Point of Diversion (Owner)
- Oil / Gas Well (API #)

Land Ownership

- Federal
- State
- Private

N

5,000 0 5,000 Feet

RED LEAF RESOURCES, INC.
Southwest #1 Project

FIGURE 3
PROJECT AREA

JBR

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CP	05/26/2011

SCALE 1:60,000

8.6. Well Logs

Wells in the area are owned by the Bureau of Land Management (BLM), one private owner, and Red Leaf Resources. The RLR water is permitted for industrial use, the other water is designated for wildlife or stock use. Well logs and area hydrogeology are discussed in the hydrogeology report, below.

9. General Discharge Identification

9.1. Discharge Point Identification

This mine operation is designed to be a zero-discharge operation. There are no point discharges from the operation. The facility is conservatively designed. Containment of all product liquids and gases is insured through secondary containment of all tanks and clay seals 3-feet thick surrounding each ore processing capsule.

9.2. Planned Discharges

This mine operation is designed to be a no-discharge operation. There is no planned discharge water or other liquid for the operation. Storm water will not contact waste materials and will be managed on site for use as part of the project's water supply. Any storm water discharges will be in compliance with the facility's Nationwide NPDES Storm Water Discharge Permit for storm water management.

9.3. Potential Discharges

This mine operation is designed to be a no-discharge operation. There is no potential for discharge of non-storm-water-induced water or other liquids from the operations.

9.4. Means of Discharge

The process capsules are designed to prevent both infiltration of precipitation-derived water into them and discharge of fluids from them. The capsules are conservatively designed as discussed further below in this document. The cover material is engineered as an impermeable cap that will be graded and revegitated negating the necessity of post closure care after revegetative cover has been established.

Stockpiles of mined ore are not potential sources of contamination due to contact with precipitation and subsequent discharge. Following the commencement of capsule construction, ore will be mined and placed in open capsules, all of which will be contained in the open pit, thereby preventing discharge of any contact water.

9.5. Flows, Sources of Pollution, and Treatment Technology

All process flows will be contained in both primary and secondary containment. There are no process discharges from the facility. No treatment of waste water or waste solid is required as there are no process-associated waste streams. Solid wastes are fully encapsulated in the process capsules. Storm

water will be collected for beneficial use and discharges will only occur during excessive storm events as allowed under the Nationwide NPDES Storm Water Discharge Permit.

9.6. Discharge Effluent Characteristics

This mine operation is designed to be a no-discharge operation. There is no planned discharge water or other liquid from the operation.

10. Hydrogeology Report

10.1. Regional Geology and Landform

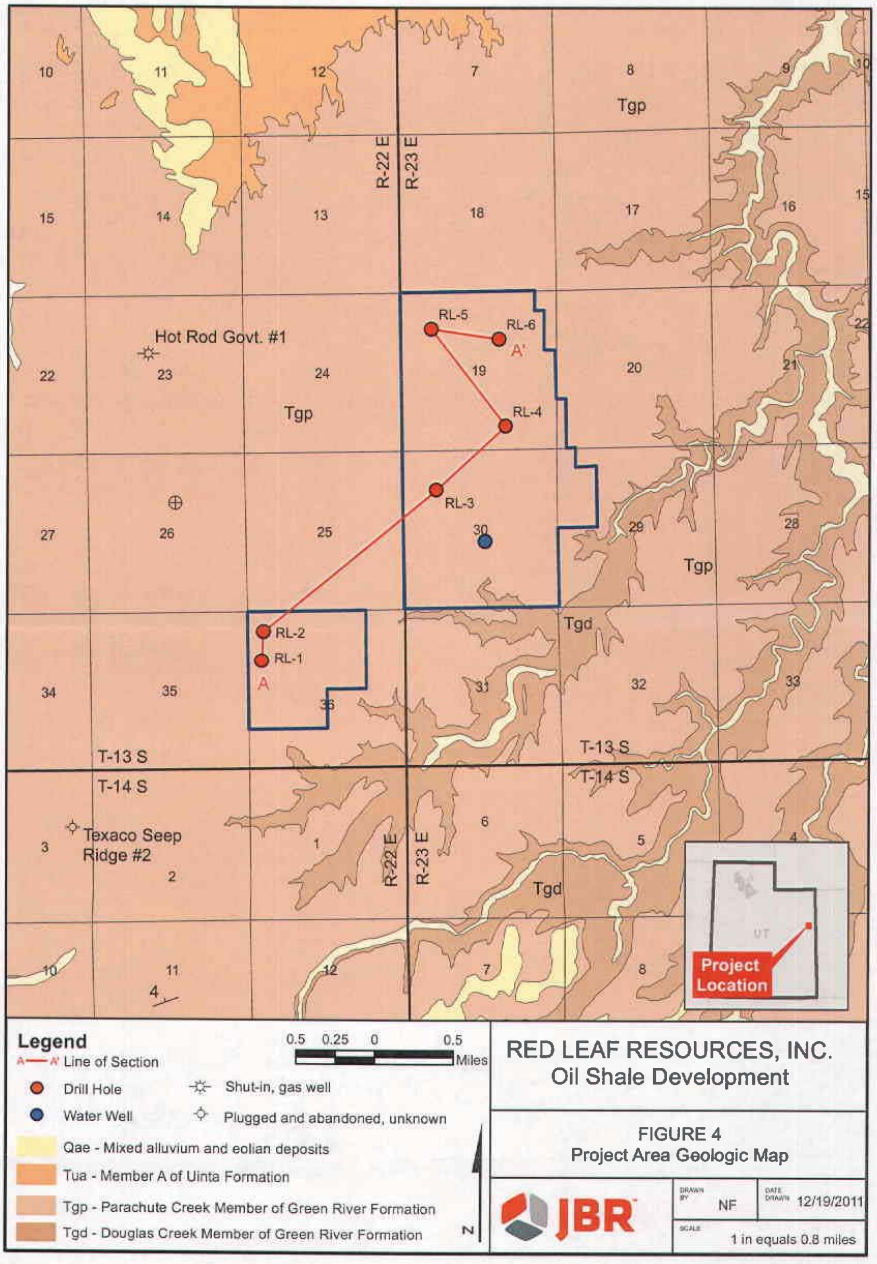
The RLR Project Area is located in the Uinta Basin section of the Colorado Plateau physiographic province (Stokes 1986). This physiographic province is also known as the Colorado Plateaus Level III Ecoregion (Woods et al 2001).

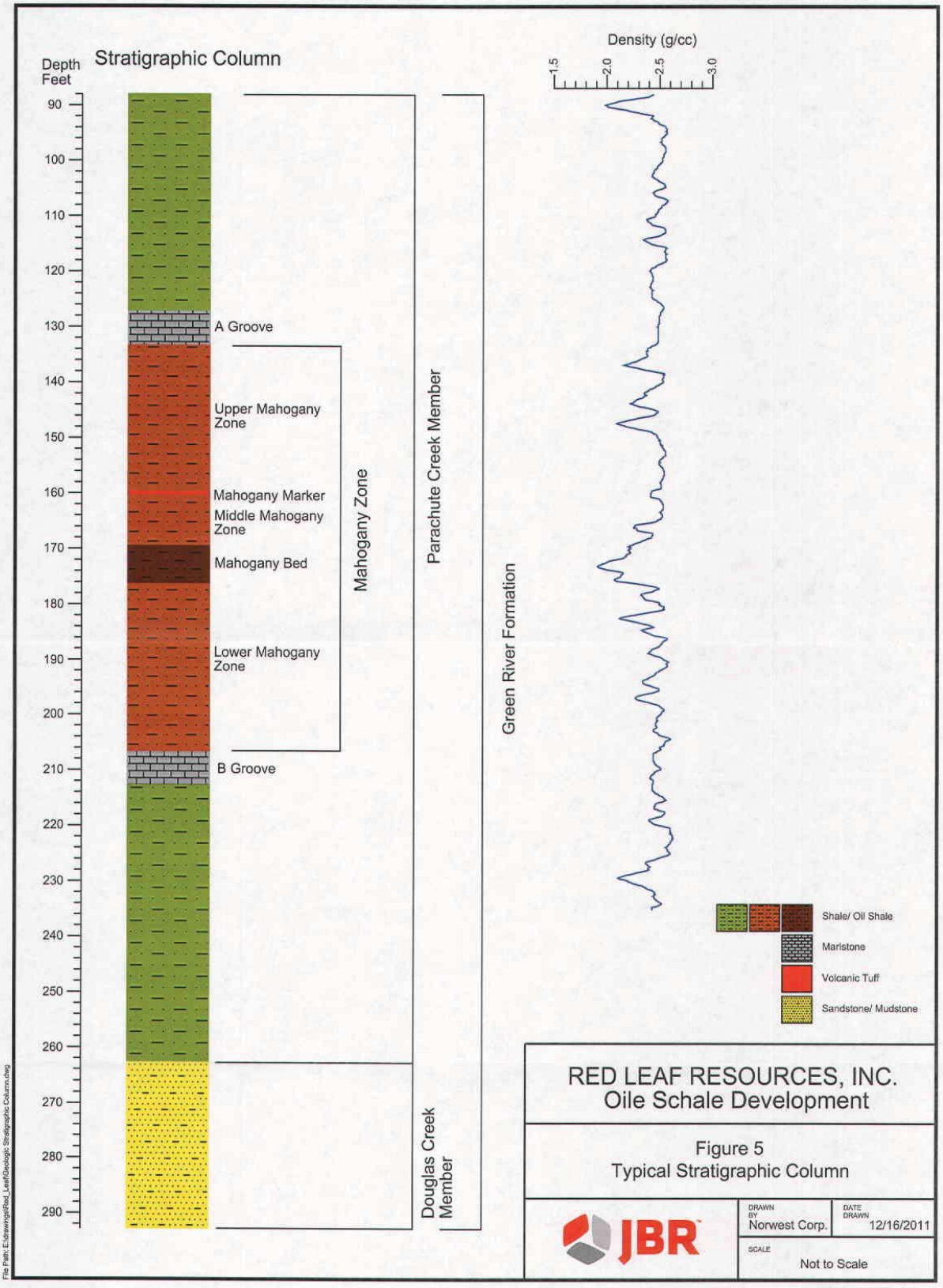
The Uinta Basin is a structural depression. The Project Area is located in the southern part of the basin and is underlain by northwesterly dipping Tertiary strata. The region is characterized by a dissected plateau with strong relief (Stokes 1986). Approximate elevation in the Project Area ranges from 6,200 feet in the northwest corner of Section 19, T13S, R23E to 6,600 feet in the southwest corner of Section 36, T13S, R22E.

10.2. Project Area and Local Geology

Bedrock at the RLR project area is the Tertiary, oil shale-bearing Parachute Creek Member of the Green River Formation. Figure 4 is a geologic map of the project area and vicinity. The Parachute Creek Member consists mainly of oil shale, which is a marlstone 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 proposed operation. Depth to the top of the Mahogany Marker, which identifies the top of the kerogen-rich Mahogany Zone, is between the surface and 160 feet below ground surface (bgs) in the Project Area. Six core holes were drilled on the property for RLR by Norwest in 2010. The holes were cored in their entirety and ranged in depth from 140 to 240 feet, depending on overburden thickness. Figure 5 is a typical stratigraphic column for the section penetrated by the 6 core holes at Red Leaf and prepared by Norwest.

The typical stratigraphic column depicts rock types encountered and the locations of key stratigraphic zones or markers in the oil shale horizon including 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, which is called the B Groove. These two horizons get their names from their appearance in outcrop where, unlike the cliff-forming Mahogany zone, they are slope formers.


Hot Rod Govt. #1
Texaco Seep Ridge #2
RL-1
RL-2
RL-3
RL-4
RL-5
RL-6
A
A'
Tgp
Tgd
R-22 E
R-23 E
T-13 S
T-14 S
Project Location
UT
Legend
A—A' Line of Section
Drill Hole
Water Well
Shut-in, gas well
Plugged and abandoned, unknown
Qae - Mixed alluvium and eolian deposits
Tua - Member A of Uinta Formation
Tgp - Parachute Creek Member of Green River Formation
Tgd - Douglas Creek Member of Green River Formation
0.5 0.25 0 0.5
Miles
N
RED LEAF RESOURCES, INC.
Oil Shale Development
FIGURE 4
Project Area Geologic Map
JBR
DRAWN BY NF
DATE DRAWN 12/19/2011
SCALE 1 in equals 0.8 miles


Stratigraphic Column
Depth Feet
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
A Groove
Upper Mahogany Zone
Mahogany Marker
Middle Mahogany Zone
Mahogany Bed
Lower Mahogany Zone
B Groove
Mahogany Zone
Parachute Creek Member
Green River Formation
Douglas Creek Member
Density (g/cc)
1.5
2.0
2.5
3.0
Shale/ Oil Shale
Marlstone
Volcanic Tuff
Sandstone/ Mudstone
RED LEAF RESOURCES, INC.
Oile Schale Development
Figure 5
Typical Stratigraphic Column
JBR
DRAWN BY
Norwest Corp.
DATE DRAWN
12/16/2011
SCALE
Not to Scale
File Path: E:\Drawings\Red_Leaf\Geologic Stratigraphic Column.dwg

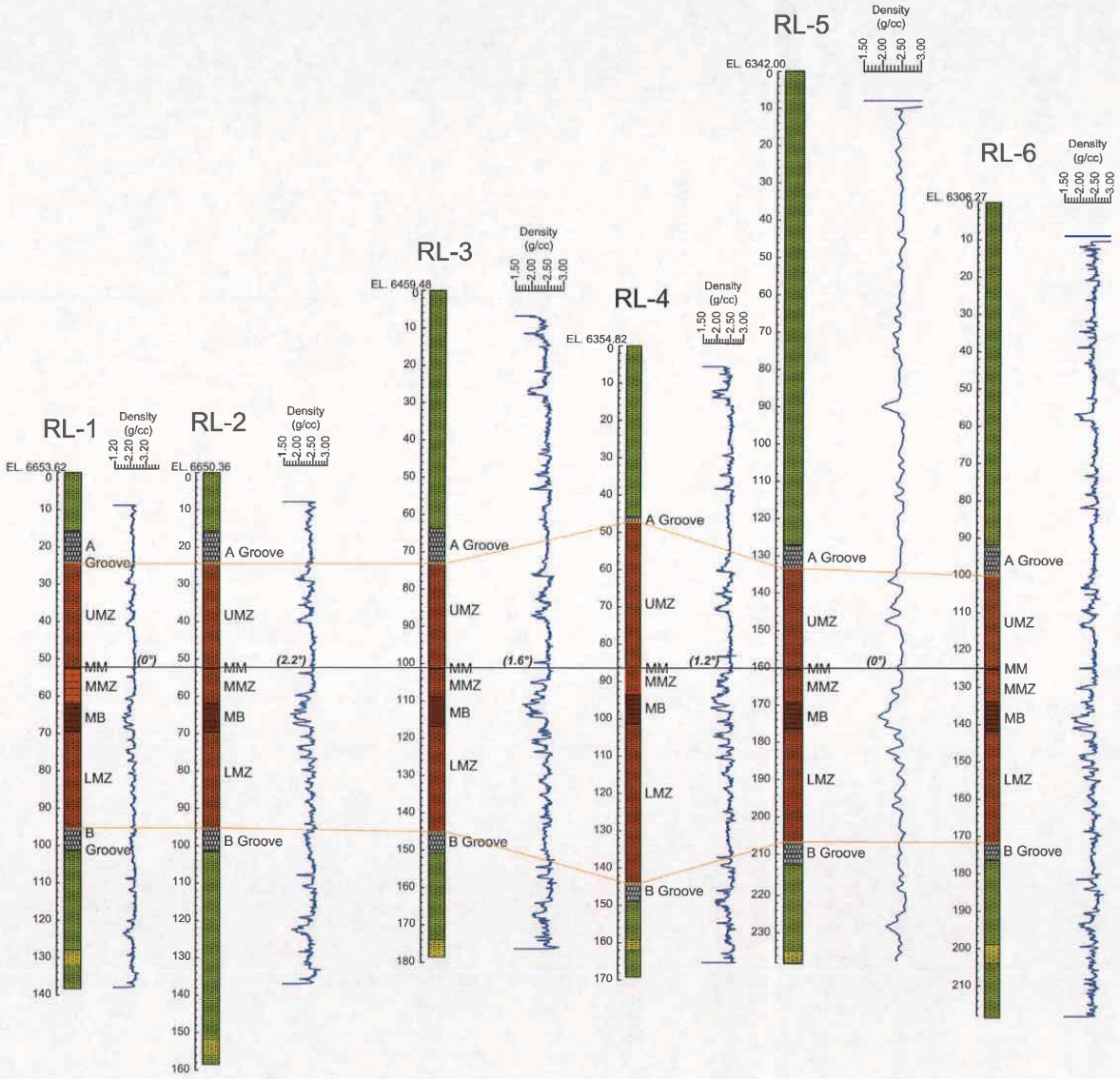
The B-Groove is easily identified in outcrop; however, its appearance in the subsurface is difficult to distinguish visibly. As a result, it is typically identified in the subsurface by geophysical logs or fisher assay data (Cashion, 1992).

Bulk density logs were run for each of the 6 core holes. Figure 6 is a cross section generally oriented north south that extends through 5 of the 6 core holes. Drill hole locations are shown on the Geologic Map (Figure 4). Each hole on the cross section is represented by a neutron density log showing the "picks" for the stratigraphic markers and beds as well as the ore zone to be mined. These markers and beds are correlated on the cross section. The datum for the cross section is mean sea level. The cross section shows the northward dip of the beds. The rock types present in all of holes are consistent and the dominant rock type is oil shale, as Figure 5 shows. The other rock types are mudstones which occur in the A-Groove and B-Groove horizons and elsewhere, thin silicified tuff horizons, most notably the Mahogany Marker, and a sandstone layer that is present beneath the zone to be mined.

The sandstone is cemented by calcium carbonate and is not porous. Water was encountered during drilling in one hole, RL-1, which is the southern-most hole drilled (Figure 6). Hole RL-1 was drilled at the head of a small draw and the water was encountered in fractures near the top of the hole. No water was encountered at depth in RL-1 or in any of the other holes. It should be noted that core holes are drilled with water as a circulation medium. Small quantities of water might not be observed; however, any significant water-bearing horizon would be recognized by an increase in circulation rate (return of water to the surface).

Regional ground water conditions and their relationship to the Southwest #1 project area are discussed further below.

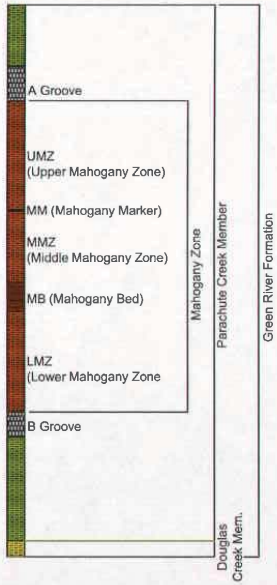
Table 1, below, shows summaries from the logs of oil and gas wells nearest to the Project Area that were used by Sprinkel (2009) to develop the "Interim Geologic Map of the Seep Ridge 30'x60' Quadrangle." Only the upper portions of the logs, from the surface through the regional Mesa Verde aquifer to the Dakota Sandstone, are shown. They place the Douglas Creek Member of the Green River Formation 780 to 1100 feet bgs and show the relative location of the Mahogany Zone within the Green River Formation. The Douglas Creek Member potentially contains the upper most aquifer in the Green River Formation in the eastern Uinta Basin.



Legend

- Shale/ Oil Shale
- Marlstone
- Volcanic Tuff
- Sandstone/ Mudstone

(2.2°) Apparent dip of Mahogany Marker between drill hole.



Cross Section developed by Norwest Corp

RED LEAF RESOURCES, INC.
Oile Schale Development

Figure 6
Geologic Cross Section
(Datum is Mahogany Marker)

JBR

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CP	12/21/2011

SCALE: Horizontal - NTS
Vertical - as shown

Table 1 Selected Oil and Gas Well Logs Near the Project Area

Well ID & Location	Formations	Unit Symbol	Top (feet bgs)	Thickness (feet)
Texaco Seep Ridge Unit #2				
SE1/4NE1/4 Sec 3, T14S, R22E API: 4304730135 Surface: 6834' AMSL	Parachute Creek Member, Green River Formation	Tgp	0	780
	Mahogany oil-shale zone, Green River Formation		731	
	Douglas Cr Member, Green River Form.	Tgd	780	691
	Green River-Wasatch transition zone	Tg-Tw	1471	451
	Wasatch Formation	Tw	1922	1511
	Upper Mesaverde Group	Kmv	3433	1487
	Sego Sandstone of Mesaverde Group	Kmv	4920	566
	Buck Tongue of Mancos Shale	Kmv	5486	54
	Castlegate Sandstone of Mesaverde Group	Kmv	5540	280
	Mancos Shale	Kms	5820	3400
	Frontier Formation	Kfd	9220	320
	Mowry Shale	Kfd	9540	30
	Dakota Sandstone	Kfd	9570	31
Hot Rod Oil Government Chorney B-NCT-1				
SE1/4SW1/4 Sec23, T13S, R22E API: 4304730115 Surface: 6624' AMSL	Parachute Creek Member, Green River Formation	Tgp	0	1120
	Mahogany oil-shale zone, Green River Formation		415	
	Douglas Cr Member, Green River Form.	Tgd	1120	995
	Green River-Wasatch Formations transition zone	Tg-Tw	2115	185
	Wasatch Formation	Tw	2300	1765
	Upper Mesaverde Group	Kmv	4065	1390
	Sego Sandstone of Mesaverde Group	Kmv	5455	515
	Buck Tongue of Mancos Shale	Kmv	5970	100
	Castlegate Sandstone of Mesaverde Group	Kmv	6070	280
	Mancos Shale	Kms	6350	3505

Well ID & Location	Formations	Unit Symbol	Top (feet bgs)	Thickness (feet)
	Frontier Formation	Kfd	9855	335
	Mowry Shale	Kfd	10190	30
	Dakota Sandstone	Kfd	10220	40

Source: Sprinkel 2009

10.3. Area Surface Water

Nearly all of the Project Area drains to Sweetwater Canyon Creek via Indian Ridge Canyon and its tributaries. A small portion at the north end of the Project Area drains to Klondike Canyon, which is another tributary of Sweetwater Canyon. Sweetwater Canyon Creek is tributary to Bitter Creek, which is a tributary of the White River. The confluence of Sweetwater Canyon Creek and Bitter Creek is approximately 3.3 miles northeast of the northeast corner of the RLR site. The confluence of Bitter Creek and the White River is approximately 20 miles north of the RLR site.

Annual rainfall is generally low for this region averaging 10 inches per year. The 10-year 24-hour storm event for the Project Area is 1.68 inches. (WRCC 2010)

The USGS briefly maintained a gaging station on Sweetwater Canyon Creek approximately 2 miles east of the Red Leaf site and upstream of Indian Ridge Canyon in T13S, R23E, Section 27 (Sweetwater Canyon Creek near Mouth near Watson, Utah) (Figure 3, Project Area). Drainage area for the station was 124 square miles. The gaging station was operated for four years between October 1974 and October 1978. During that period the average daily discharge was 0.089 cubic feet per second (cfs). It had zero average daily discharge for 82 percent of the period of record. Discharge periods were during spring runoff and following summer/fall storm events. The maximum discharge during these four years was 59 cfs on July 25, 1976; the average discharge for that day was 9.4 cfs, demonstrating the "flashy" nature of the stream. (USGS 2011)

The USGS maintained a gaging station on Bitter Creek approximately eight miles downstream of the Red Leaf site (Bitter Creek near Bonanza, Utah) for water years 1971 through 1989. During that period the annual average discharge ranged from 0.28 cfs in 1972 to 18.5 cfs in 1987, with the overall annual average for the period being 6.06 cfs. The maximum daily average recorded for the period was 150 cfs on September 5, 1982. Periods of no flow were common, and followed the same general hydrograph as Sweetwater Canyon Creek. (USGS 2011)

The Project Area slopes down to the east and Indian Ridge Canyon. It is dissected by numerous ephemeral drainages, and does not contain any perennial surface water sources. The USGS National Hydrography Dataset shows no springs in or near the Project Area (USGS 2010, JBR 2011). The ephemeral drainages that cross the area are typical of those found in this high-desert environment. Channels are incised in some reaches and essentially undefined in others, riparian vegetation is lacking,

and bed/bank sediment movement is evident. The runoff regime of these channels is controlled primarily by local summer thunderstorms that generate infrequent and short-lived, but often intense, flash floods.

10.4. Groundwater

10.4.1. Southern Uinta Basin Ground Water 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. However, BLM (2008) refers to the Parachute Creek and Douglas Creek members of the Green River Formation as potential aquifers locally within the Uinta Basin.

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). Based on Utah Division of Oil, Gas and Mining (DOGM) records of oil and gas wells near the Red Leaf project site, the top of the Mesa Verde Formation is between 3,000 and 4,000 feet below ground surface (as indicated for APIs 43-047-37336, 43-047-37283, 43-047-33488, 43-047-37523, 43-047-37522 and others (DOGM 2011). See Table 1, Selected Oil and Gas Well Logs Near the Project Area and Figure 4, Geologic Map.

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 between 1,000 mg/L and 3,000 mg/L total dissolved solids expected in the aquifer underlying the Red Leaf project (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. While the Green River Formation is generally considered an aquiclude in the southern part of the Basin, with low spring and well yields (Price and Miller 1975), the BLM (2008) considers both the Parachute Creek and Douglas Creek members as key aquifers locally in the Uinta Basin area.

10.5. Project Area Hydrogeology

The Green River and Wasatch Formations overlie the Mesa Verde Group in the project area (see Table 1), with the Parachute Creek Member of the Green River Formation being the surface bedrock formation found throughout the majority of the Red Leaf parcels (Figure 4). The Parachute Creek Member contains the Mahogany Oil Shale zone, from which RLR would extract its ore. The Douglas Creek Member underlies the Parachute Creek Member and is not exposed on the leases. Ground water from

the Douglas Creek aquifer discharges to stream channels in the southern Uinta Basin and to wells in the northern part of the Basin.

According to records on file with the Utah Division of Water Rights (2011), groundwater in the vicinity of the Red Leaf project has been encountered at depths shallower than those reported by Price and Miller (1975) or Freethey and Cordy (1991) for the Mesa Verde. Records of nearby water wells on file with the Utah DWR (2011) show the following:

1. A 455-foot well in T14S, R23E, NE¼ Section 6 was drilled and abandoned during year 2004 due to a lack of water;
2. A 1,312-foot-deep well drilled in 1978 had a static water level of 475 feet and produced at a rate of 9 gallons per minute (GPM) during a pump test; this well is in T14S, R22E, Section 2 (southwest of the Red Leaf parcels) and first encountered water at 890 feet;
3. A 900-foot well drilled in T13S, R23E, SE¼ Section 30 in 2010 (by RLR), hit water at 603 feet with a production rate of 1 GPM. A second formation at 830 feet yielded 15 GPM.

These ground water occurrences likely reflect localized, perched aquifers associated with lenses of permeable bedrock in the Douglas Creek Member of the Green River Formation. Alluvial deposits are minimal in the RLR parcels and are insufficient to meet the state definition of an aquifer. The Douglas Creek Member of the Green River Formation crops out in some of the deeper canyons in and near the Project Area (Sprinkel 2009).

The oil shale-rich-Parachute Creek Member behaves as an aquiclude inhibiting recharge of underlying horizons by infiltrating precipitation on the Red Leaf leases. Recharge to the underlying Douglas Creek Member from the surface on the leases themselves is therefore de minimus.. The recharge area for the Douglas Creek Member is the expansive outcrop area in the southern-most part of the Uinta Basin. From the recharge area, ground water flows to the north where it recharges the aquifer in the central part of the basin and discharges in the many stream channels that dissect the entire area (Holmes and Kimball, 1987). As the geologic map on Figure 4 shows, the Douglas Creek Member crops out in Indian Ridge Canyon immediately to the south of the Red Leaf lease blocks. The extensive area of outcropping Douglas Creek Member is located south of the Red Leaf leases (Sprinkel, 2009). However, the upper strata of the Douglas Creek Member in both Indian Ridge Canyon and the canyon to its south have been exposed on the canyon walls by erosion. As a result, any ground water moving to the north through the upper Douglas Creek would be intercepted by these canyons, preventing ground water flow from reaching the upper Douglas Creek Member beneath the Red Leaf leases. Any ground water flowing through the upper part of the Douglas Creek member would discharge at the outcrops on the south walls of these canyons. Holmes and Kimball (1987) reported no springs on the south canyon walls.

The B-Groove horizon is known to be a water-bearing horizon in the Piceance Creek Basin in northwestern Colorado where its lithology is comprised of sandstone, siltstone, some marlstone and lean oil shale (BLM, 2006). These lithologies along with fracturing result in sufficient transmissivity to enable the B Groove to behave as an aquifer, at least locally in the Piceance Creek Basin. At the White River mine in eastern Uintah County, the B-Groove is not mentioned as an aquifer in the Environmental Assessment (EA) performed for by the BLM for the Oil Shale Exploration Company's Research

Development and Design (RD&D) lease (BLM Environmental Assessment UT-080-06-280-EA). Presumably the dewatering activity necessary for reopening the mine would impact recharge to a B Groove aquifer and the impact would have been analyzed in the EA. It is reasonable to presume that the B Groove is not an aquifer at the White River Mine.

In contrast to the B Groove lithology in the Piceance Basin, the B-Groove horizon at the Red Leaf project area is described consistently in all 6 drill holes as being comprised of mudstone, brown- or blue-gray in color, lean (oil shale-poor), and weakly to strongly laminated. Only occasional short, vertical, closed fractures are noted in the core logs. A laminated mudstone would have no primary porosity or permeability and would tend not to preferentially develop secondary permeability through fracturing, as the rare occurrences of closed fractures indicates.

Maximum depth of the mine floor would not exceed 250 feet bgs, and the depth from the surface to the shallowest occurrence of ground water known is 600 at the Red Leaf water well; therefore the thickness of intervening Parachute Creek and Douglas Creek strata beneath the bottom of the open pit feet and the shallowest known ground water occurrence is no less than approximately 350 feet.

The oil and gas well logs used by Sprinkel (2009) that are nearest to the RLR site are shown in **Table 1** from the surface through the regional Mesa Verde aquifer and the Dakota sandstone. They are consistent with the three water wells described above in placing the Douglas Creek Member of the Green River Formation 780 to 1100 feet bgs.

10.6. Surface and Ground Water Quality

Table 2 shows selected water quality data from the USGS Sweetwater Canyon Creek gaging station during its four years of record, and Table 3 shows selected water quality data from the USGS Bitter Creek gaging station during its 18 years of record. They show dissolved solids concentrations increasing in the downstream direction.

Table 2 Selected Water Quality Data for the USGS Sweetwater Canyon Creek near Mouth near Watson, Utah Gaging Station, Water Years 1974-1977.

Parameter	# of Samples	Average	Minimum	Maximum
pH (SU)	9	8.2	8.0	8.5
Total Dissolved Solids (mg/L)	11	1,930	1,350	2,200
Total Dissolved Solids (tons/day)	8	2.7	0.52	10.6
Suspended Sediment (mg/L)	11	3,784	202	8,660

Parameter	# of Samples	Average	Minimum	Maximum
Specific Conductance (microsiemens/cm)	10	2,299	1,800	5,250

Table 3 Selected Water Quality Data for the USGS Bitter Creek near Bonanza, Utah Gaging Station, Water Years 1971-1989.

Parameter	# of Samples	Average	Minimum	Maximum
pH (SU)	41	8.1	7.4	8.6
Total Dissolved Solids (mg/L)	40	6,236.5	2,700	9,460
Total Dissolved Solids (tons/day)	33	24.3	0.22	103
Suspended Sediment (mg/L)	27	240.7	7	1,080
Specific Conductance (microsiemens/cm)	110	5,114[1]	1,540	>8,000

[1] Average does not include the nine instances recorded as >8,000 µS/cm

State-designated beneficial uses for the White River and its tributaries are 2B (secondary contact recreation), 3B (warm water fish and aquatic life), and 4 (agriculture). The latest 305(b) report to Congress (DWQ 2006) finds that the White River fully supports its designated 3B and 4 beneficial uses (2B was not assessed), and thus its water quality is not considered to be impaired.

Ground water quality for the southern part of the Douglas Creek member of the Green River Formation is described in Holmes and Kimball (1987) as follows:

> Water in the southern part of the aquifer most closely resembles the water from springs that discharge in canyon bottoms. This water is dominated by sulfate, bicarbonate, sodium, magnesium, or calcium as a result of reactions that take place in the recharge area. As the water moves downgradient in the aquifer, further reactions cause additional changes in the chemical quality. The dissolved-solids concentration increases from south to north in the aquifer. This change is in the direction of the flow path.

Table 4 is a summary of chemical quality of water in the Douglas Creek aquifer taken from Holmes and Kimball (1987).

Table 4 Summary of chemical quality of water in the Douglas Creek Aquifer

Variable	Southern part of the aquifer				Central aquifer mean value
	# of samples	Mean	Minimum	Maximum	
Water Temperature (°C)	4	19.1	16.5	22	25.5
Specific conductance (µS/cm)	4	1,070	940	1,300	1,670
pH (standard units)	3	8.2[1]	7.2	8.8	8.7[1]
		Milligrams per liter			
Alkalinity (as $CaCO_3$)	4	222	160	300	530
Hardness (as $CaCO_3$)	4	710	100	2,300	8.5
Calcium (as CA)	4	22	4.5	54	2.6
Magnesium (as Mg)	4	20	1.8	44	0.4
Sodium (as Na)	4	225	180	340	390
Potassium (as K)	4	0.8	0.6	1.0	0.9
Chloride (as Cl)	4	9.2	7.4	12	25
Sulfate (as SO_4)	4	365	270	470	300
Fluoride (as F)	4	0.3	0.2	0.5	2.4
Silica (as SiO_2)	4	11	8.1	17	14
Dissolved solids (calculated)	4	785	640	950	1,060
Nitrogen, ammonia (as N)	2	0.06	0.01	0.12	1.0
Nitrogen, nitrate (as N)	2	0.20	0.01	0.38	<0.01
		Micrograms per liter			
Boron (as B)	4	250	70	630	550
Iron (as Fe)	4	1,010	40	2,100	20
Manganese (as Mn)	4	28	10	60	10

[1] Geometric mean

Source: Holmes and Kimball 1987

11. Capsule Design Report

11.1. Capsule Construction Plan

The overall process description is described above in Section 6.0. This section is intended to describe only individual capsule construction.

11.2. Methods and Equipment

Capsule construction consists of several different elements. Each of the elements is listed below with a description of how each will be built. The current plan is to build two capsules every 120 days providing one capsule for processing every 60 days.

11.3. Capsule Stacking (with input from Hatch)

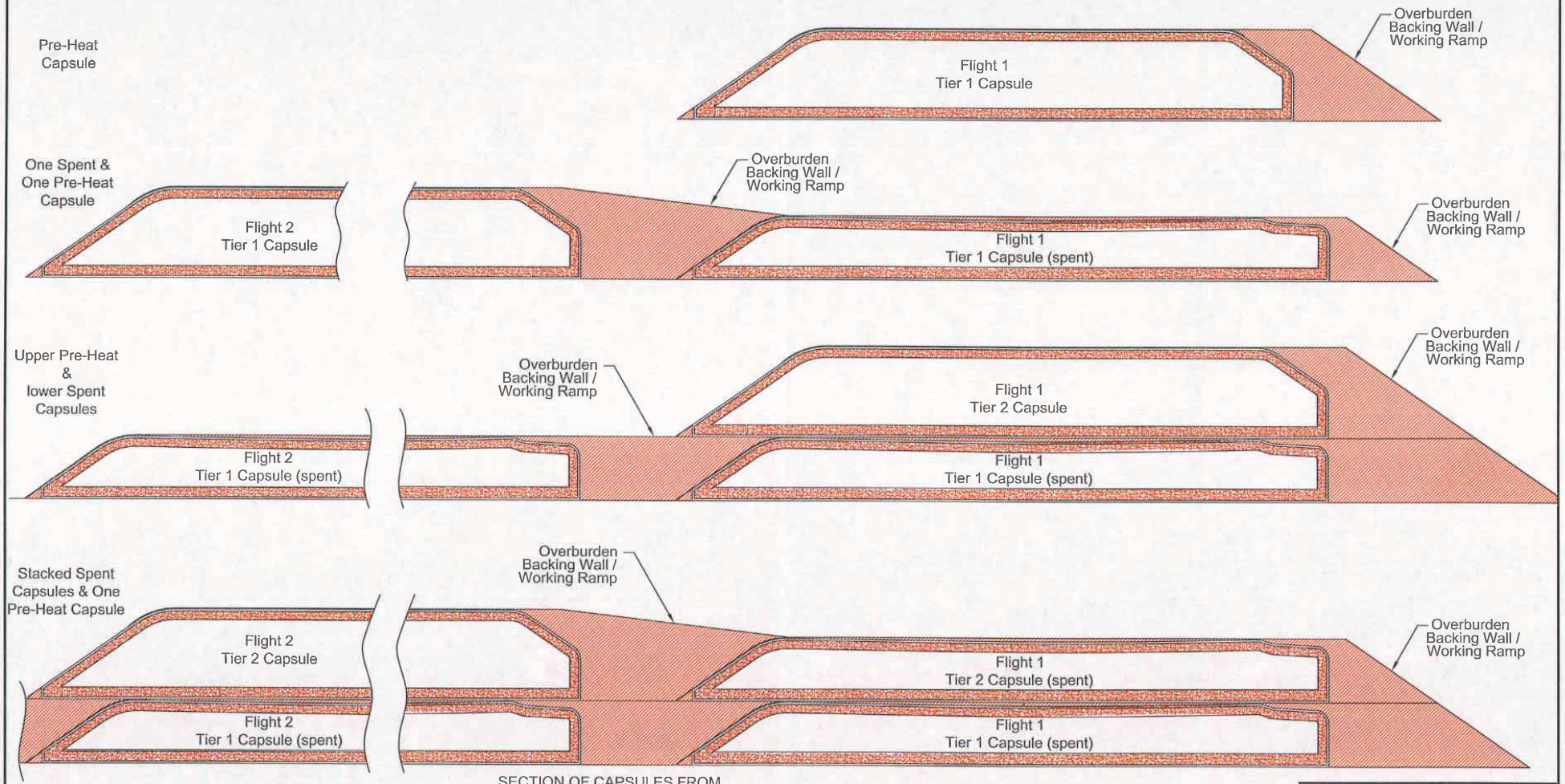
Selected steps in capsule construction and processing are illustrated on Figure 2 and on Figure 7 (2 sheets). The steps are further described below.

11.4. Capsule Floor and Walls

The capsule floor will be constructed with 3ft of compacted BAS covered by 13ft of gravel (2" x 3/8" crushed shale) with an oil collection pan embedded within the gravel. The floor of the mining horizon dips to the north at three degrees (Figure 2) and serves not only as the floor of the mining horizon, but also as the base upon which the production capsules will be constructed.

Constructing the floor of the capsule starts by creating the required drainage profile using dozers to contour the pit floor assuring that the natural grade is maintained and the required east-west drainage profile is achievable along the capsule floor and within the gravel. 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 compacting the capsule. The basal BAS layer for each capsule will be constructed using BAS manufactured on site with processed screened shale meeting the target design gradation, blended with 10%, #40 mesh bentonite clay product to be provided by Western Clay. The blended mixture will be moisture conditioned to a water content between optimum and +2 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 below in Section 12 describes the process 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 the results of this test fill work will so dictate.

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 East-West grade required for the oil drainage path through and out of the capsule.



SECTION OF CAPSULES FROM NORTH TO SOUTH (LOOKING EAST)

NOTE:
CAPSULE STACKING IS FOR REPRESENTATION ONLY. THE ACTUAL STACKING METHOD CAN BE FOUND ON OTHER DRAWINGS.

200 100 0 375

SCALE

ECOSHALE TECHNOLOGY | REDleaf RESOURCES

Figure 7 Sheet 1 of 2
Red Leaf Resources
Capsule Life Cycle
Sections for South to North

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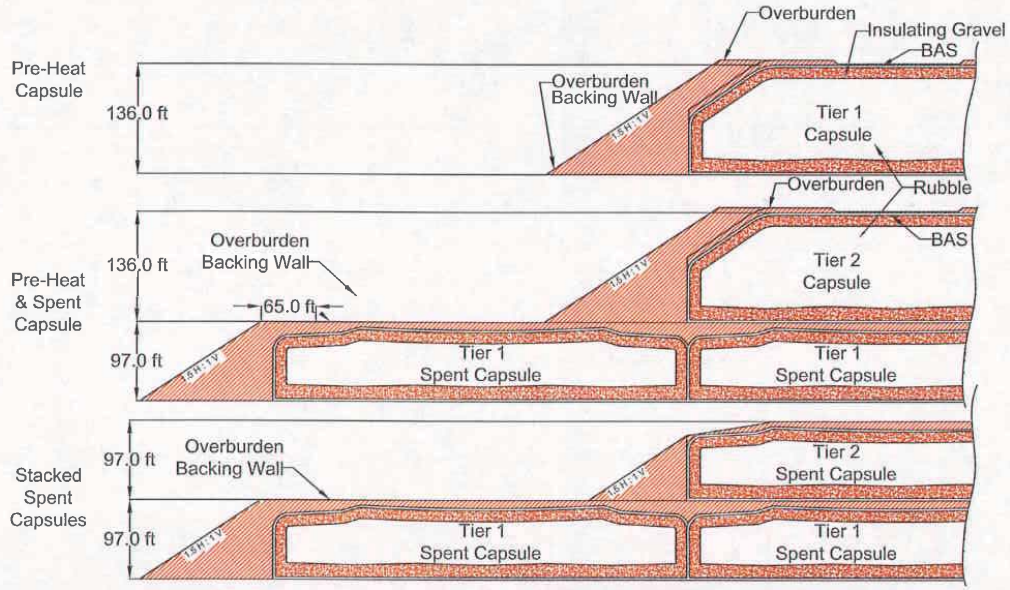

SECTION OF CAPSULES FROM
WEST TO EAST
(LOOKING NORTH OR SOUTH)

NOTE:
CAPSULE STACKING IS FOR REPRESENTATION ONLY. THE ACTUAL STACKING METHOD CAN BE FOUND ON OTHER DRAWINGS.

200 100 0 375

SCALE

Figure 7 Sheet 2 of 2
Red Leaf Resources
Capsule Life Cycle
Sections for West to East

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NORWEST CORPORATION

The oil collection pan is the next component of the floor to be built. The oil collection pan will be constructed from 18 to 20 gauge steel sheets with corrugations. Steel specifications are provided in Appendix D. The panels of the oil collection pan will be laid across the floor of the capsule with lapping joints over the corrugations 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 finished oil collection pan will be arranged to direct the oil flow into two channels that run south to north on either side of the center of the capsule and down the pit floor. Figure 8 illustrates the dual slope of the oil collection pan and the collection channels. The equipment used to place the pans will require use of forklifts and mine personnel handling the non-galvanized carbon steel gauge steel sheets directly to insure 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 each capsule.

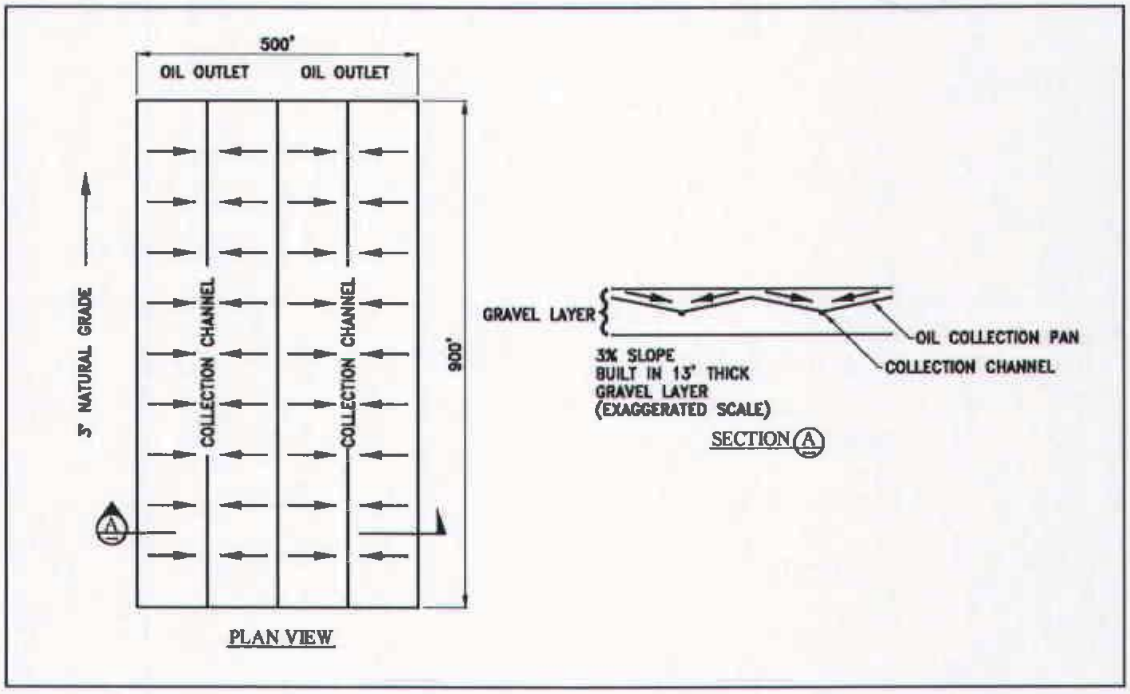


Figure 8 Capsule Floor Arrangement

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. The BAS perimeter wall will connect directly to the BAS floor to complete the encapsulation needed for the oil extraction process. The BAS wall will be 3ft thick and be placed with the same ejector bed articulated haul truck that was used to place the BAS on the capsule floor. This truck will be able to discharge to one side allowing the

Articulated Hauler Truck (AHT) to drive on the gravel and discharge the BAS outside of the delivery vehicle's wheel base.

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. Scrapers have been planned to place the gravel in the walls as the capsule develops above the floor level and will be used to compact the BAS in the walls. The scrapers will compact the BAS with the heavy wheel load they impart on the surface. To minimize degradation scrapers will not routinely drive on the rubble material. Additional compaction to meet the necessary compaction target will be conducted as dictated by test fill work if required.

Construction of vertical walls requires the placement of backing material. In areas where no future capsule is required the backing material needs to be placed 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. In areas where future capsules are planned, backing material must be placed or layered ahead of the capsule progression. Layer stacking of the backing material allows the placement of pipes in the next capsule. Placement of backing materials in the next capsule is illustrated in Figure 9. Rubble, gravel, BAS and backing walls needed to support the BAS/gravel walls must progress upwards at similar rates. To maximize the number of capsules that can be placed on the site, it will be necessary to build the adjoining area of the next capsule. The material placed in the next capsule will provide a resisting force, keeping the wall in position. The material placed in the adjoining capsule will need to be placed by layer stacking rather than allowing the material to cascade into place from above as in the last capsule in a flight of capsules. Layer stacking allow pipes to be placed in the adjoining capsule. In outlining capsules the backing wall can be built with cascade fill.

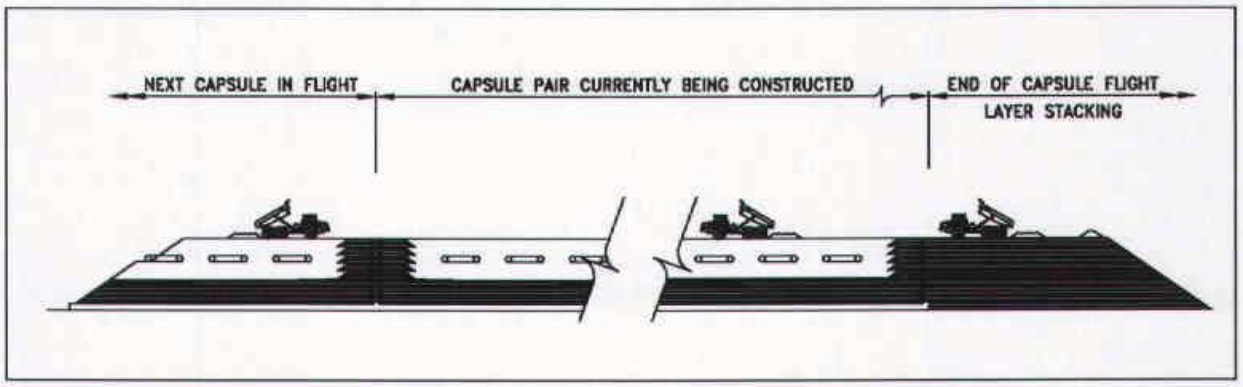


Figure 9 Layer Stacking

11.5. Placing Ore, Progressing the Walls and Laying Process Pipes

Rubble will be paced with standard AHT and dozers. In areas close to the wall, construction of the capsule will proceed in 1ft lifts. Small lifts minimize the use of BAS in wall construction by reducing the area being filled by the BAS. BAS use increases when the walls are created with higher lifts. This is due to

the void space created between the separation of the BAS and the gravel created with fill angles. Figure 10 illustrates how the BAS use increases with higher lifts. Outside the area affected by wall construction, the height of the rubble lifts can increase.

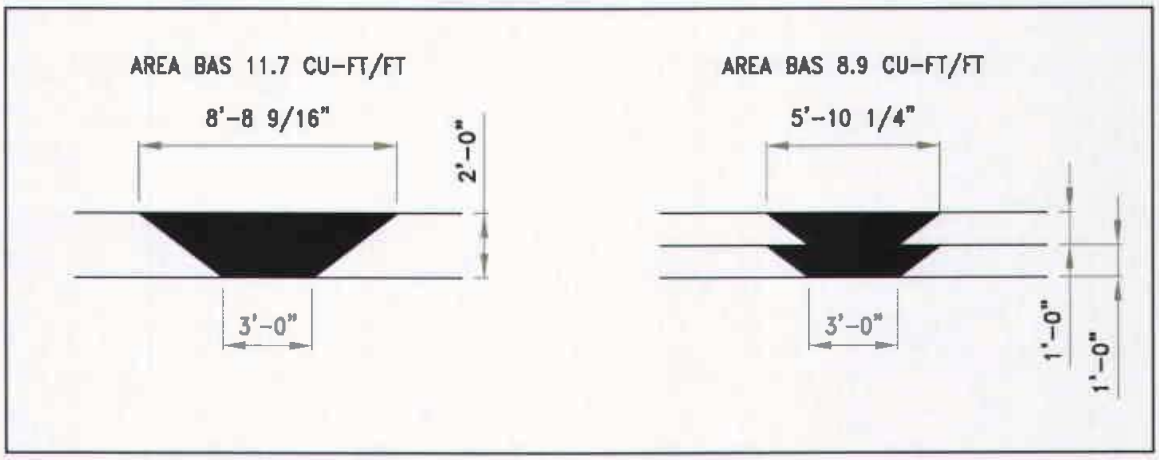


Figure 10 BAS Use Comparison Based on Lift

The wall between capsules will be created from BAS and gravel. Three of the four walls, the south end and both sides, are internally vertical and the fourth is built at the angle of repose. The wall constructed at the angle of repose is the north wall, and is where all the process equipment will tie into the capsule. The first layer of pipes will be placed as the ore placement continues, and when the level of ore has reached the required thickness. Pipes will be milled on the capsule while being placed in continuous runs from a mobile pipe rolling mill (MPRM). Pipes will be corrugated. Specification for the steel to be used in pipe milling are in Appendix D. Placement of rubble will continue while the pipes are placed. Layering of ore and placement of pipes will continue until the capsule is full. Internally at the north end of the capsule a manifold will be placed. The manifold ties all the layers of the heating pipes together and allows heated air to circulate through the pipe network. This manifold will be placed within the capsule in pre-fabricated sections allowing placement of the horizontal pipe runs to connect into the pipe network.

11.6. Process Wall 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.

11.7. Access Ramp

A pad and access ramp will be constructed along the south end of capsule flight. The pad and the access ramp will be constructed using traditional methods for earth structures that utilize haul trucks, graders, and compactors. After the first flight of capsules is complete, the ramps to the second and subsequent

flights will be built on the northern toe of the previous capsule flight. Building on the previous capsule's northern wall minimizes construction space and materials needed to build the ramp.

11.8. Capsule Finishing

The east and west margins of each capsule surface will be sloped (Figures 2, 7). The purpose of the slope is part of the capsule design that enables the upper BAS layer to remain intact and keep the capsules sealed when they settle 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 capsules.

11.9 Roof

Ore will be placed to the required depth after which 13 feet of gravel will be placed gravel over the rubble. Roads will be cut into the gravel to provide a road for the BAS trucks and compaction equipment.

After the BAS is placed, additional haul trucks and graders will cover the BAS with run of mine interburden/overburden material to a nominal depth of 2 feet, followed by placement of growth media (topsoil/topsoil substitute) in thicknesses of 6 to 12 inches.

11.10. Progression

Before the current capsule pair is completed construction of the floor of the next capsule pair will start and the capsule construction sequence will continue. Capsule progression is depicted in cross sections (Figures 2) and diagrammatically in NOI Figure 12 (Appendix A).

11.11. Material Handling Equipment

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

11.12. Capsule Stacking

Capsules will be stacked to provide sufficient retorting capacity for the ore to be mined. Capsule stacking is depicted in Figures 2 and 7. Figure 2 shows the relationship of the stacked capsules in a series of 3 cross sections. The sections are provided in 2 formats. The upper version shows the capsule rows and flights to scale with both pre and post-mining topography depicted. These sections include labeled slope angles for mine highwall, fill-slope, and capsule surface angles following reclamation. Also shown are the locations of all flights and capsules to scale, relative to the local topography. The lower part of the figure shows cross sections of the capsules in their configurations after the lower tier of capsules has collapsed. Note that capsule stacking takes place in the first 8 flights, but not the 9th flight. Note also the detail showing the BAS, gravel blanket, ore, upper gravel blanket and capping BAS with the overburden knuckle. Figure 7 shows the capsules and related earthwork construction more diagrammatically. Each of the 2 sheets depicts the progression of capsule construction beginning with a

completed first tier capsule, then to the post-heating, consolidated tier 1 capsule containing only spent shale and then to tier 2 capsule placement and finally consolidation. Each drawing calls out selected capsule-related components, notably backing walls and working ramps. The second sheet contains labeled sloped and height dimensions.

11.13. Capsule Consolidation

After capsule heating and oil recovery, the oil shale is expected to lose its strength, resulting in significant capsule settlement (consolidation). Capsules will be constructed to a height of approximately 136 feet; however, following consolidation the capsules will be reduced in height to approximately 97 feet. Information used to analyze capsule deformation includes material properties of gravel insulation, shale and BAS. Material properties were developed from laboratory testing, which included oven heating in the laboratory, and evaluating the conditions found in the pilot project.

11.13.1. BAS Integrity on Consolidation

11.13.1.1. Knuckle

One of purposes of the sloped upper edges of the capsule is to prevent shear of the BAS as consolidation occurs. Vertical BAS walls joining the horizontal upper BAS layer would not remain intact upon consolidation due to shear failure. 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. Figure2 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.

Several models were used to better understand the properties of individual components of the capsules. The particular models and certain input parameters are discussed below.

The information provided below on laboratory testing, pilot capsule investigation and modeling are high level summaries of separate investigations and reports.

11.13.2.1. Shale

The ANSYS "multi-linear elasticity" material model was used to approximate consolidation properties of rubblized shale at varying temperatures. Shale deformation can be suitably approximated using this model, although individual properties (particle strength degradations resulting from soil loss) cannot be captured by the model. This is acceptable as the roof design is driven by the total shale deformation, and the individual mechanisms are not impacting other capsule layers.

11.13.2.2. Gravel

In order to capture the material movement characteristics of gravel during subsidence, Drucker-Prager plasticity model was used. The volumetric characteristics from lab testing of the gravel layer during and

after shear failure is incorporated in the Drucker-Prager model. Similar to oil-shale model, hot/cold consolidation of the gravel layer is represented using a temperature-dependent elastic model based on material testing results.

11.13.2.3. BAS

Similar to gravel layer, a non-associative Drucker-Prager plasticity model with linear elastic properties is used for BAS in order to represent the soil shear failure. Material model parameters were determined based on the data from the pilot BAS mixture.

Results of the models conducted to date show that the capsules lose approximately 40-45' in total height after heating. The analysis results indicate that the proposed roof geometry provides a nearly flat post-subsidence capsule roof with no tensile cracking in the BAS layer. These results also show that the settling is not even across the heated capsule, and differential settling or subsidence of the highest to lowest point on the surface lowered by heating is approximately 6-7' across the dimension of the capsule. The gravel and BAS layers were not compromised even with the predicted subsidence that occurs after heating. The BAS layer is predicted to stay intact due to the heavy compression created by the knuckle design and surcharge load from the weight of the second tier capsule.

12. Construction Quality Control Plan

(This section was prepared for RLR by Intermountain Geotechnical and Environmental Services (IGES)

12.1. Bentonite Amended Shale (BAS) Quality Control

12.1.1. General

Quality of BAS placement, compaction and projected performance will be determined using field moisture density monitoring correlating to a suite of data developed on more rigorously evaluated test fill performance. The following discussions present approach for test fill preparation, performance monitoring and correlation development as the basis for this quality control approach.

12.1.2. Test Fill Development

A minimum of two test fills will be constructed using the same size and type of equipment proposed for capsule bottom liner and cap and BAS sidewalls. Each test pad will be constructed using BAS manufactured on site with processed screened shale meeting the target design gradation, blended with 10%, #40 mesh bentonite clay product to be provided by Western Clay. The blended mixture will be moisture conditioned to a water content between optimum and +2 percent and transported to the test fill site via truck. The size of each test fill will be approximately 20 ft. by 40 ft.

12.2. Bottom Liner Fill

BAS fill will then be placed on a prepared cleared surface of exposed shale and bladed to a maximum loose lift thickness of 18 inches as proposed for liner construction and compacted with successive passes of a compactor of equal size and type as proposed for actual cell construction. A minimum of 4 passes

will be applied uniformly over the fill. At the end of the 4th pass, a series of 8 nuclear density measurements will be performed and recorded. Two additional passes of the compactor will then be performed and an additional 8 nuclear density tests will be performed. A subsequent 2 passes and 8 additional density tests series will be performed as required to permit evaluation of the appropriate number of passes required to achieve the minimum 95% compaction for the 18 inch lift thickness.

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 protected with a temporary 6 inch lift of BAS until infiltration testing equipment is ready to be installed. Any delay in installation of SDRI testing equipment will require that the test fill be protected with 6 inches of uncompacted BAS fill.

12.3. Side Liner Fill

BAS fill will be placed on a prepared cleared surface of exposed shale and bladed to a maximum loose lift thickness of 12 inches as proposed for side liner construction and compacted with successive passes of a compactor of equal size and type as proposed for actual cell construction. A minimum of 4 passes will be applied uniformly over the fill. At the end of the 4th pass, a series of 8 nuclear density measurements will be performed and recorded. Two additional passes of the compactor will then be performed and an additional 8 nuclear density tests performed. A series of subsequent 2 passes and 8 density tests will be performed to permit evaluation of the appropriate number of passes required to achieve the required 95% compaction for the 12 inch lift thickness.

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 required 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 with a temporary 6 inch lift of BAS until infiltration testing equipment is ready to be installed.

12.4. Test Fill Evaluation

Hydraulic conductivity of each test fill will be evaluated in situ using a sealed double ring infiltrometer (SDRI). Testing will be performed in general accordance with ASTM D5093-02 (2008)[1] methods. Additionally, at the conclusion of the test relatively undisturbed 3-inch diameter tube samples of the test fill will be obtained for laboratory determination of hydraulic conductivity as a means of comparison of the test fill performance and projected future performance as a result of 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 compliment of index tests including Atterberg limits,

[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

grain-size and moisture and density will be performed on the tube specimens subjected to 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.

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.

12.5. Proposed Liner Testing Frequency

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

12.6. Bottom and Top

Field Moisture and Density measurement (ASTM D-6938 – 10) – one test/400 cy of liner or approximately every 10,000 sq. ft./lift.

12.7 .Side Walls

Field Moisture and Density measurement (ASTM D-6938 – 10) – one test/50 cy of liner or approximately every 270 ft. of wall/lift.

13. Ground Water Discharge Control Plan

The zero-discharge design of the process capsules has is described in detail in Section 11.0 and the plan for ensuring the design specifications for the BAS installation is described in Section 12.0 At the request of UDWQ staff, samples of spent shale were analyzed for leachable constituents, as described below.

13.1. Spent Shale Leachate Evaluation

Although the capsules are designed to prevent contact of meteoric water with spent shale within the capsules, leachability testing using the U.S. EPA's Synthetic Precipitate Leach Procedure (SPLP) was conducted on samples of spent shale. Samples were collected from recently generated spent shale derived from bench-scale testing. These samples represent spent shale with characteristics that would exist in the capsule soon after the capsule had begun to cool. Organic compounds and inorganic ions would tend to adsorb to soil particles over time; therefore, chemicals in the samples collected relatively soon after the recent bench test would tend to be less well adsorbed than they would after more residence time in the capsule. Stated differently, chemicals in the spent shale would tend to be more easily desorbed by infiltrating precipitation soon after processing is completed than they would after processing is complete and the capsules had been reclaimed.

Spent shale from the bench testing was 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 by a staff member of the engineering

firm IGES, a contractor to RLR. 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 (USEPA, 1998).[3] Method 1312 specifies 3 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 from West of the Mississippi is acidified to a pH of 5.0. Extraction Fluid #3 is filtered deionized water and it is use 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 insure 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 (TDS), major ions (Ca, Cl^-, F^-, K, Mg, Na, $SO_{4)}$, alkalinity, nitrate/nitrite (as N), oil and grease, Sr, and total organic carbon (TOC);
- Organic compounds: volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs);
- 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.

The entire laboratory report provided by AWAL is attached as Appendix E. The results for the general chemistry analyses are summarized in the following table;

[3] USEPA (1998). Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd ed.,draft IVA, U.S. Environmental Protection Agency, Office of Solid Waste: Washington, DC.

Table 5 General Chemistry

Sample Number	Lab	R11-122 210			Ground Water Quality Standard (note: N/S means no standard has been set)	Water Quality Standard for Bitter Creek and Tributaries 4-Day Average 1-hour Average
Parameter	Reporting Limit	#1	#2	#3		
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	≥500 mg/l l
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

The results of the metals analyses are shown in the table below. Note that only those metals with detectable quantities are shown in the table. Again, complete analytical results are shown in the attached lab report.

Table 6 Metals Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard (note: N/S means no standard has been set)	Water Quality Standard for Bitter Creek and Tributaries
Parameter	Reporting 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

As with the metals, only detectable quantities of VOCs and SVOCs are shown in the following two tables.

Table 7 VOCs Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard
Parameter	Reporting Limit	#1	#2	#3	(note: N/S means no standard has been set)
Acetone	0.0100	0.0195	0.0178	0.0152	N/S
Acrylonitrile	0.00500	0.0171	0.0134	0.0118	N/S

Table 8 SVOCs Detected by Lab Analysis

Sample Number	Lab	R11-122 210			Ground Water Quality Standard
Parameter	Reporting Limit	#1	#2	#3	(note: N/S means no standard has been set)
Benzoic acid	0.0200	0.0326	0.0354	0.0259	N/S

The preceding tables compare the detectable concentrations of ions and compounds identified in the spent shale by the previously described laboratory analysis to both Utah Ground Water Quality Standards and established Water Quality Standards for the Bitter Creek watershed, which would be the receiving water of any release to surface waters. The following excerpt from UAC R317-2.6, Standards of Quality for Waters of the State, Use Designations, indicates the applicable uses designated for Bitter Creek and its tributaries:

> 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 3A -- Protected for cold water species of game fish and other cold 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.

Water quality standards shown in the tables are those for Class 3A waters, which are the most stringent of the 3 use designations.

The analytical results for the 3 samples are consistent for almost all parameters analyzed, indicating that the spent shale is quite homogenous and that the samples analyzed are representative of the spent shale from the recent bench test. The results of the analyses found only 2 parameters that exceeded ground water quality standards: pH and antimony. Two parameters, pH and selenium, exceed the more water quality standards established for Class 3A-designated streams. The antimony and selenium results are less than twice the laboratory reporting limit, which makes the accuracy of the results questionable.

The volatile organic compounds, 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. The problem occurs because a given ion may not be exclusive to that compound, hence, a case of misidentification occurs. 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.

The single SVOC detected, benzoic acid, has no established water quality standard. 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 ground water or surface water in concentrations that would be detectable.

14. Reclamation and Closure Evaluation

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

14.1. 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 F contains the report prepared by Norwest describing the model setup, inputs, and results.

The modeling results demonstrated that the designed capsule cap and ET cover provides adequate control on infiltration into the capsules for the vegetated cover case using the design parameters. Even for 30 years of bare cover or very wet years the HELP model predicts minimal infiltration into the capsule for these extreme conditions.

15. Compliance Monitoring Plan

Monitoring of capsule performance and reclamation and closure performance will commence during construction of the capsules. Survey control will be used to monitor all aspects of capsule construction

including grade control on the pit floor and the progressive construction of the capsules until construction is complete. Survey control and visual observations will be used to monitor capsule consolidation. Observed results will be compared to modeled results and any anomalies or unexpected results will be investigated by either remote or direct means to ensure integrity of the BAS has not been compromised.

16. References

U.S. Bureau of Land Management, 2007, Environmental Assessment UT- 080 – 06 – 280, Oil Shale Research, Development and Demonstration (RD&D) Project White River Mine, Uintah County, Utah at http://www.blm.gov/pgdata/etc/medialib/blm/ut/vernal_fo/planning/white_river_oil_shale.Par.44590.File.dat/OSEC%20Oil%20Shale%20Final%20EA%20EA%20UT%20-%20080%20-%2006%20-%20280.pdf

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.

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.

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.

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

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.

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

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

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.

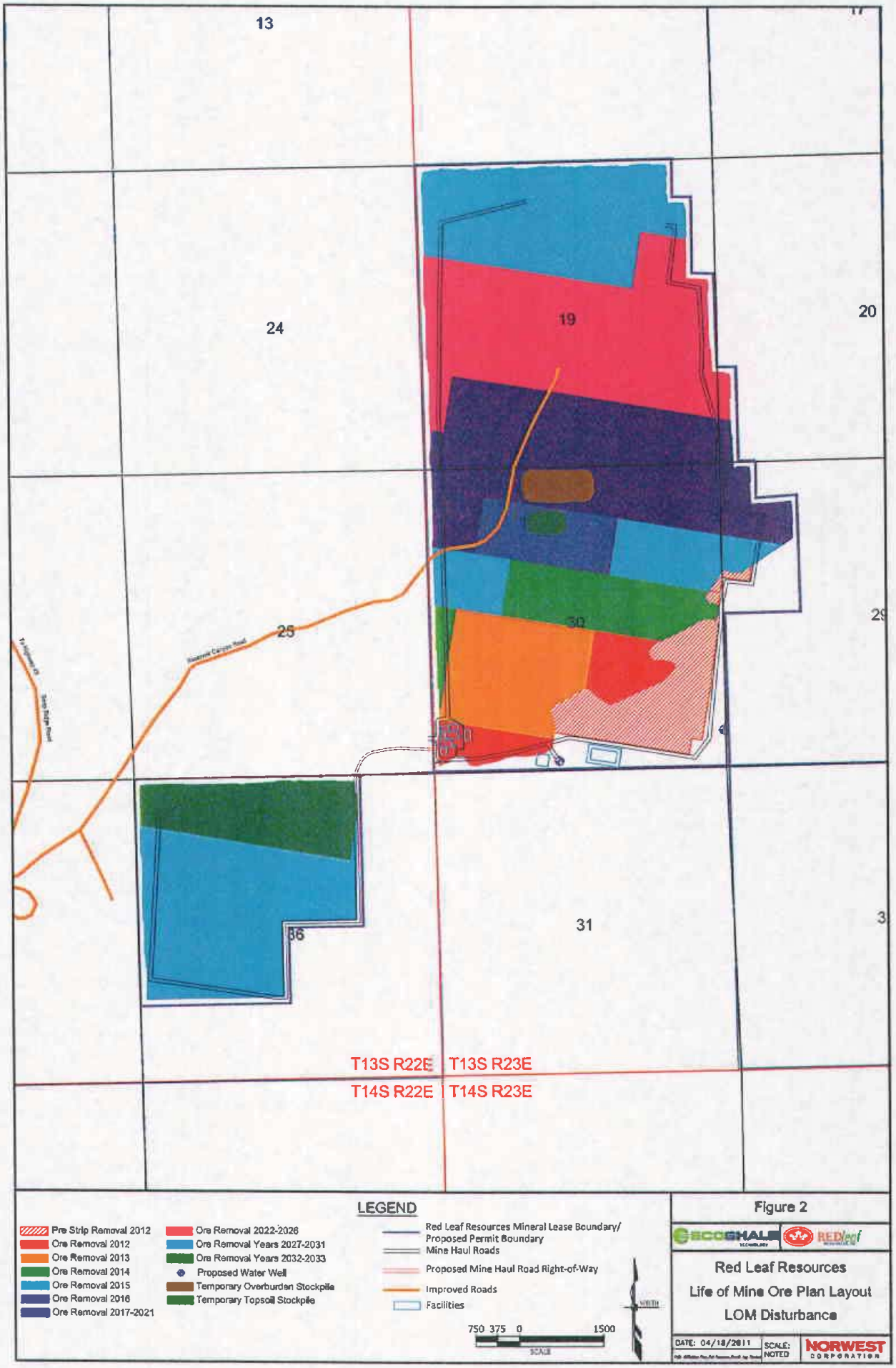
USGS. 2011. National Water Information System (NWIS) accessed online March 25, 2011 at http://waterdata.usgs.gov/nwis/nwisman/

USGS. 2010. Geographic information system (GIS) shape file 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.

Appendices

Appendix A

Selected Figures
from the
Utah Division of Oil, Gas and Mining
Notice of Intent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Ore Removal 2012
Ore Removal 2013
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Ore Removal 2015
Ore Removal 2016
Ore Removal 2017-2021
Ore Removal 2022-2026
Ore Removal Years 2027-2031
Ore Removal Years 2032-2033
Proposed Water Well
Temporary Overburden Stockpile
Temporary Topsoil Stockpile
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Mine Haul Roads
Proposed Mine Haul Road Right-of-Way
Improved Roads
Facilities
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Figure 2
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Life of Mine Ore Plan Layout
LOM Disturbance
DATE: 04/18/2011
SCALE: NOTED
NORWEST CORPORATION

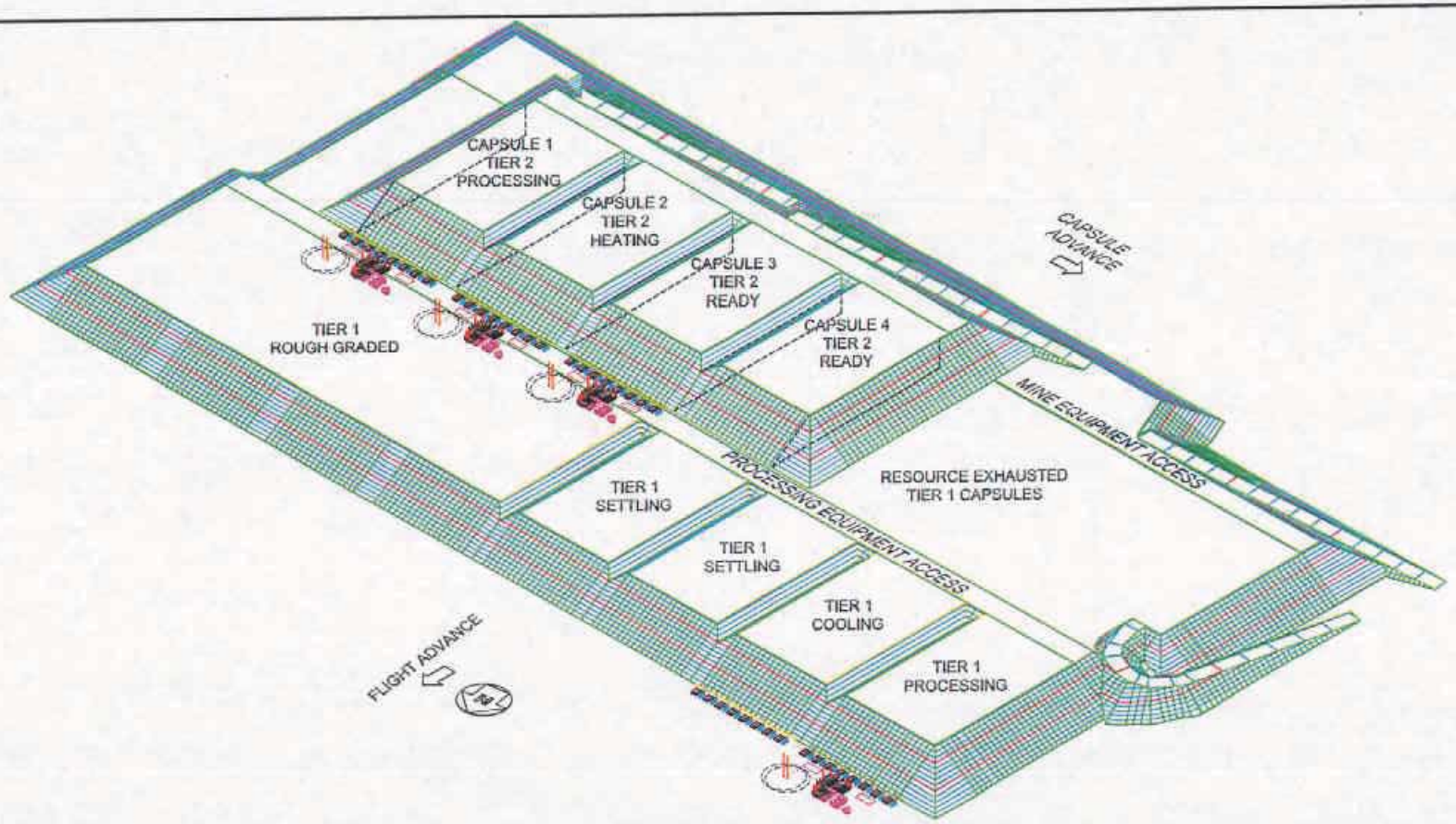


Figure 12

Conceptual Oil Shale Processing

Capsule Construction Progression Plan

DATE: 04/18/2011 SCALE: 1:200

NORWEST CORPORATION

Appendix B

Stacked Capsule Backing Wall
Stability Analysis

Norwest Corporation
April 21, 2011

NORWEST
CORPORATION

April 21, 2011

File #: 09-4573

Red Leaf Resources
200 W. Civic Center Dr.,
Suite 190
Sandy, UT 84070
USA

Attn: Mr. Shawn Packard

Dear Shawn;

Re: Stacked Capsule Backing Wall Stability Analysis

1 INTRODUCTION

This letter report presents the results of a preliminary analysis and provides recommendations to support the geotechnical design of the cell containment slopes for the capsules that will be constructed in the mined out area of Red Leaf's ECOSHALE Project in Uintah County, Utah.

2 SCOPE OF WORK

Norwest was asked to provide a geotechnical evaluation of the backing walls that will support the vertical walls of the BAS (bentonite amended soil) liner and provide containment of retorted oil shale material and associated by-products inside the capsules. It is understood that the backing walls will be constructed with surface overburden material and run-of-mine low grade shale that will be excavated by a combination of blasting and mechanical excavation during the development of the pit. In addition, the backing walls will need to satisfy long-term stability criteria related to reclamation since the capsules will be left in place following the retorting process to form permanent landforms.

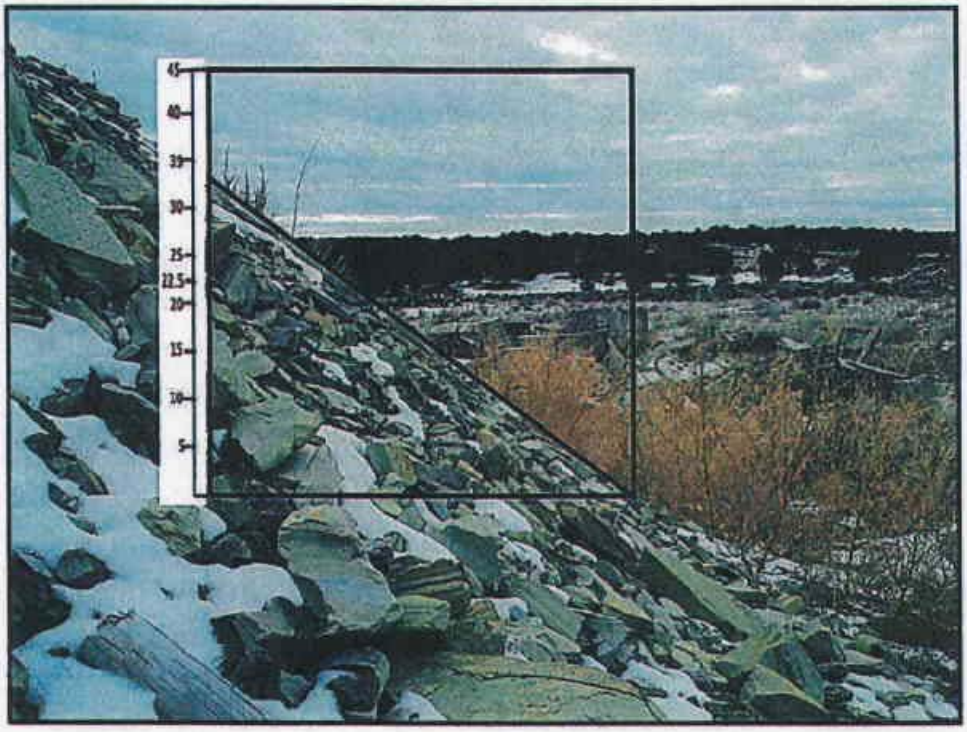
The scope of work involved a geotechnical analysis that was based on a stacked capsule configuration design presented to Norwest consisting of two 96 foot high capsules stacked on top of each other for a total backing wall height of 192 feet. The backing walls incorporate ramp designs to accommodate capsule construction equipment. A typical cross-section of the stacked capsule configuration can be seen in the stability output files presented in Appendix B.

3 MATERIAL PARAMETERS

The material parameters used in the stability analysis were selected based on site reconnaissance photos, data provided by Intermountain GeoEnvironmental Services Inc. (IGES), and Norwest's experience with compacted rockfill materials. Photos of loose, end-dumped shale materials representative of the typical

material that will be used to construct the backfill walls indicate an average angle of repose of about 35° (see Photo 1). The friction angle and cohesion used to model the surface material in the Red Leaf Cell Highwall Design by IGES were 36° and 50psf respectively. An additional strength assessment provided by IGES recommended strength parameters for the backing wall material over a range of normal stresses based on a literature review. The IGES assessment (see Appendix A) provided recommendations for compacted shale rockfill strength parameters for a range of loading conditions.

PHOTO 1
ANGLE OF REPOSE



The following material parameters were used to model the compacted backfill, oil shale, and bedrock units in the stability analysis of the capsule backing walls. Note that the BAS and insulating gravel units were not included in the preliminary backing wall stability analysis.

TABLE 1
STABILITY ANALYSIS MATERIAL PARAMETERS

Material Type	Unit Weight (pcf)	Friction Angle (°)	Cohesion (psf)
Compacted Backfill	130	40	0
Oil Shale	130	40	0
Pit Floor	Impenetrable Bedrock		

4 STABILITY ANALYSIS CRITERIA

The stability analysis criteria used to evaluate the stability of the backing walls is based on discussions with the state regulatory agency and the generally accepted standard of practice followed in the design of rockfill slopes. The minimum design safety factors used to evaluate the static and pseudo-static stability anslyses were 1.25 and 1.10 respectively. The horizontal seismic coefficients used in the pseudo-static analyses were selected based on regional data for Uintah County provided by the United States Geological Survey website. The pseudo-static stability analysis was evaluated for a 1 in 500 year event for operations and a 1 in 2,500 year event for long-term closure. A summary of the stability analysis minimum factor of safety criteria is presented in Table 2.

TABLE 2
SUMMARY OF STABILITY ANALYSIS CRITERIA

Analysis Type	Minimum Safety Factor
Static	1.25
Pseudo-static (1 in 500 year, k_h=0.04g)	1.10
Pseudo-static (1 in 2,500 year, k_h=0.12g)	1.10

5 STABILITY ANALYSIS

The stacked capsule backing wall stability analysis was performed on a model with two 1.5H:1V slopes and a total height of 192 feet (see sections in Appendix B). The piezometric surface was assumed to be the pit floor (i.e. the compacted backfill and oil shale materials are unsaturated). The results of the stacked capsule stability analysis satisfy the safety factor criteria and are summarized in Table 4. The stability analysis output files are presented in Appendix B. The values presented in the table represent the minimum safety factors associated with a failure surface that affects the entire height of the backing wall and the BAS liner system in the capsule.

TABLE 4
STABILITY ANALYSIS RESULTS

Analysis Type	Safety Factor
Static	2.00
Pseudo-static (1 in 500 year)	1.83
Pseudo-static (1 in 2,500 year)	1.56

6 CONCLUSIONS AND RECOMMENDATIONS

The results of the stability analysis show that the stacked capsule backing walls designed and constructed according the design configuration presented to Norwest will satisfy static and pseudo-static safety factor criteria. The following recommendations should be considered in the detailed design of the capsule backing walls:

- Backing wall material should be placed and compacted in lifts such that a minimum of 95% Standard Proctor Density is achieved.
- Backing wall slopes can be constructed at angle of repose but will require re-sloping to a 1.5H:1V slope angle in order to satisfy long-term safety factor criteria.
- Surface water that collects on the top of the capsules should be controlled and directed away from the crests of the backing walls to minimize erosion on the backing wall slopes.
- Ditches should be constructed at the toe of the backing wall slopes to ensure that the piezometric surface is maintained at the pit floor elevation.
- Further investigation work and lab testing should be carried out to determine the intact strength of the bedrock foundation and risk of planar bedding failures through potential weak layers affecting the stability of the backing walls and impacting the integrity of the BAS liner.
- The heat effects and pressure generated within the capsules during the retorting process should be evaluated to determine if they will adversely affect the stability of the backing walls and the integrity of the BAS liner.

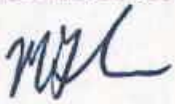
7 CLOSURE

All geotechnical information and results contained herein have been reviewed and interpreted by Michael Graham, PEng.

As mutual protection to Red Leaf Resources, the public and ourselves, this report and drawings are submitted for exclusive use of Red Leaf Resources. We specifically disclaim any responsibility for losses or damages incurred through the use of our work for a purpose other than as described in the report. Our reports and analysis should not be reproduced in whole or in part without our express written permission, other than as required in relation to this report.

Yours sincerely,

NORWEST CORPORATION



Michael Graham, PEng
Senior Geotechnical Engineer

Enclosures/Attachments

Appendix A	Summary Report: Data Review and Development of Rockfill Strength Parameters
Appendix B	Stability Analysis Output Files

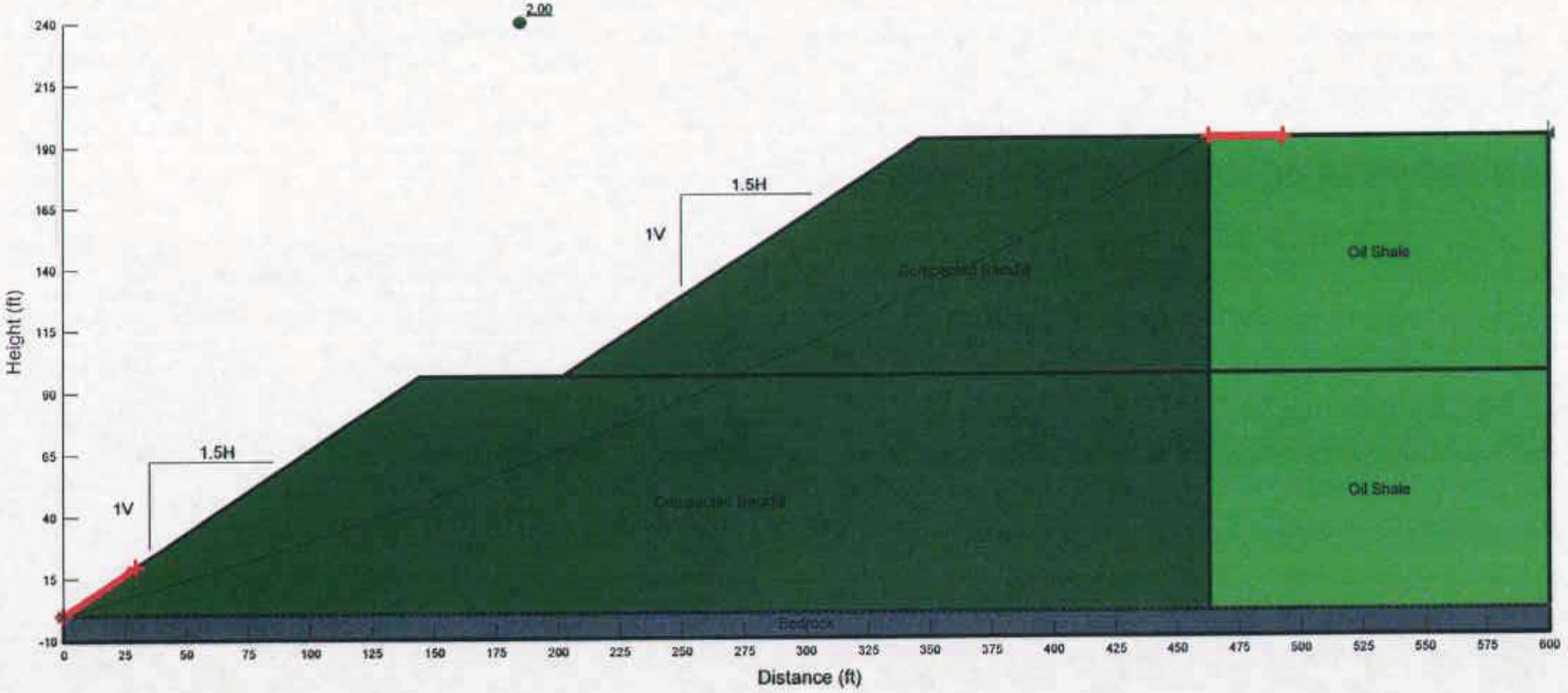
APPENDIX B

Stability Analysis Output Files

Red Leaf Ecoshale
Stacked.gsz
Static
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1

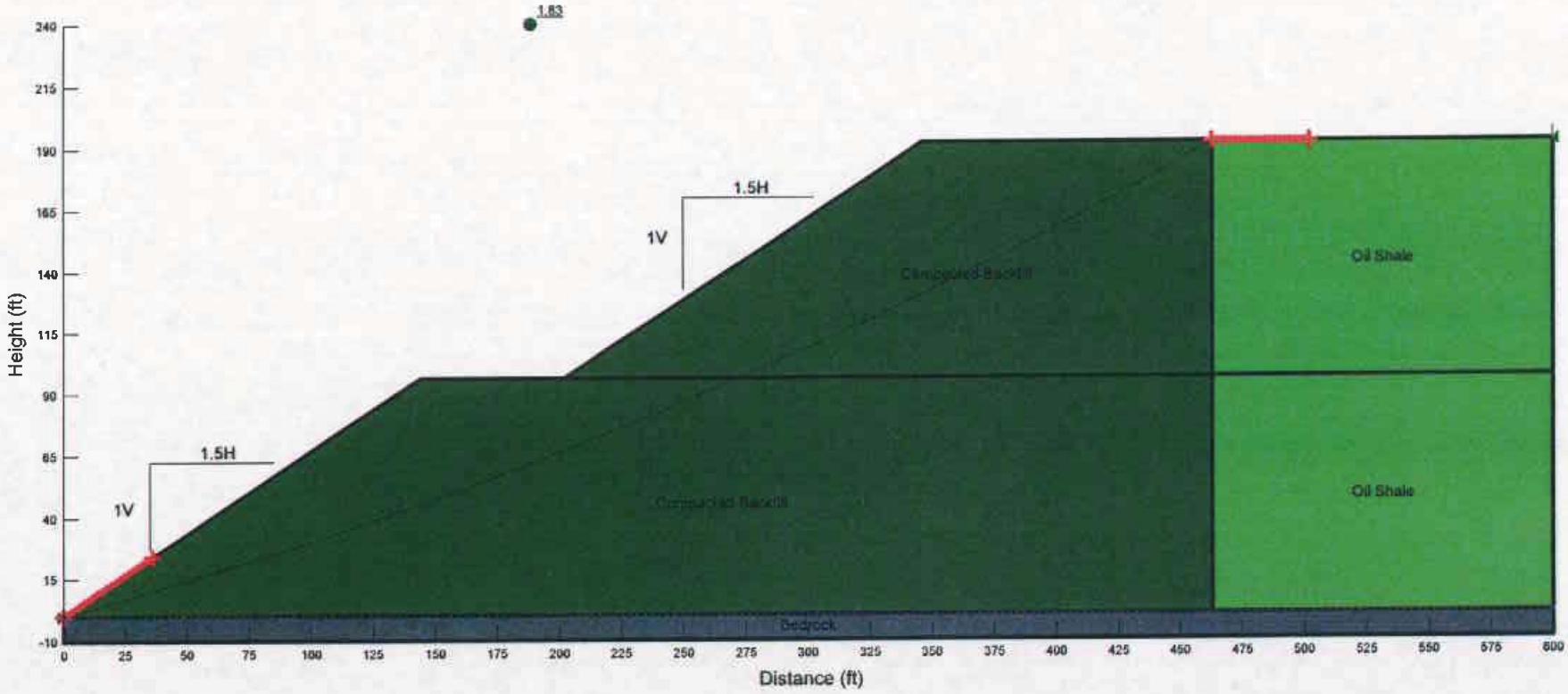


NORWEST

Red Leaf Ecoshale
Stacked.gsz
Pseudo-static_1/500
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0.04

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1

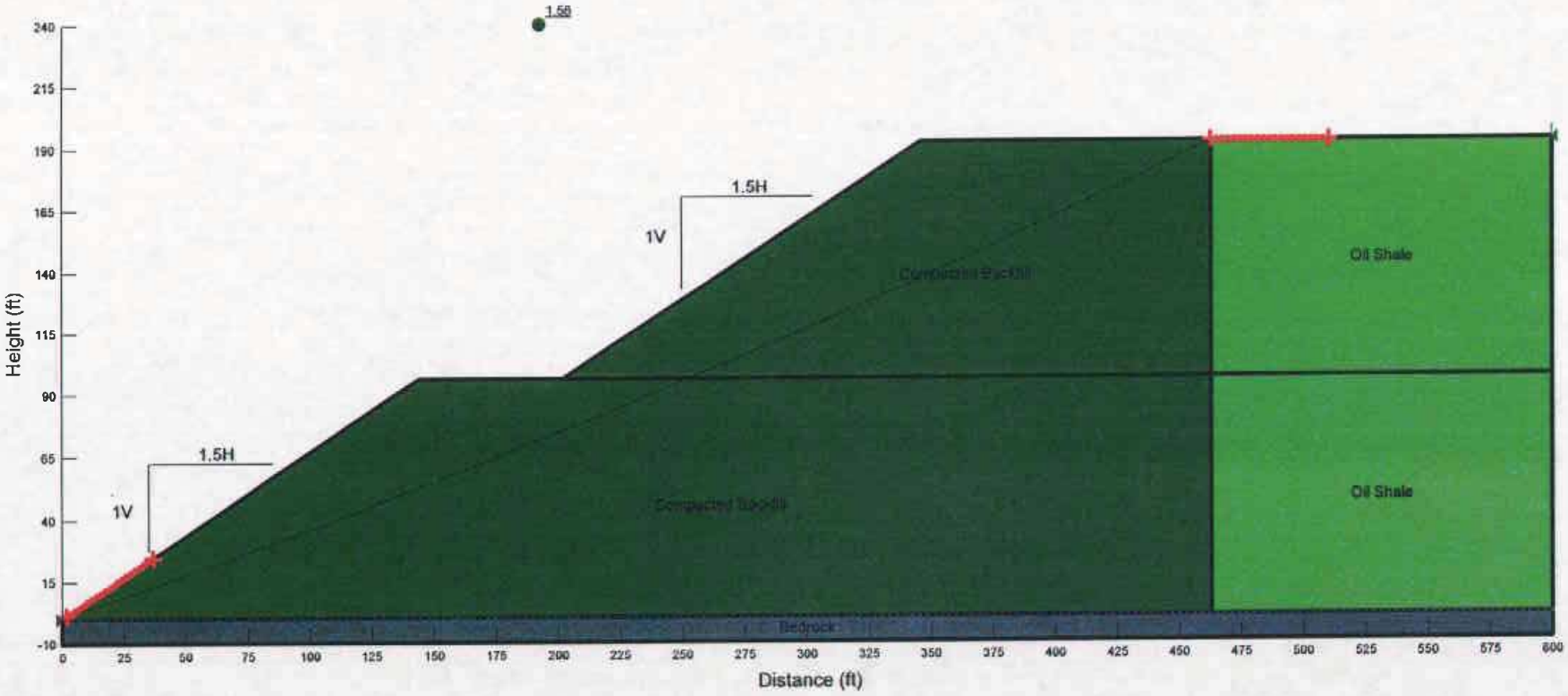


NORWEST

Red Leaf Ecoshale
Stacked.gsz
Pseudo-static_1/2500
I:\DATA\Salt Lake City Jobs\09-4573 Red Leaf\Engineering\SlopeW
21/04/2011

Spencer
Horz Seismic Load: 0.12

Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Oil Shale Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion: 0 psf Phi: 40 ° Phi-B: 0 ° Piezometric Line: 1



NORWEST

Appendix C

Operations and Reclamation Drainage Design Plan for Red Leaf Resources

Norwest Corporation
April 21, 2011

OPERATIONS AND RECLAMATION DRAINAGE DESIGN PLAN

RED LEAF RESOURCES

Submitted to:
RED LEAF RESOURCES

April 21, 2011

Norwest Corporation
950 So. Cherry St., Suite 800
Denver, Colorado 80246
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www.norwestcorp.com

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CORPORATION

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OPERATIONS AND RECLAMATION DRAINAGE PLAN
RED LEAF RESOURCES

Background

The Red Leaf Resources Eco Shale Mining Project uses heat to extract kerogen deposits from sedimentary shale deposits. The mining process consists of the simultaneous mining of the oil shale and the creation of the heating capsules. Upland clean water diversions and/or sumps and perimeter stormwater control will be installed initially, and then topsoil is salvaged and carefully stockpiled to be used during the reclamation phase. Once enough overburden is removed from the mine to create a capsule, a bentonite amended soil (BAS) liner is installed, followed by a metal liner above it to collect fluids and prevent seepage. The BAS is designed to stay intact throughout the heating and reclamation phase as described in greater detail in the NOI. This containment strategy prevents impacts to groundwater and the surrounding ecosystem. Collection pipes are placed along the bottom of the capsule. The mined material is placed above the collected pipes followed by a series of heating pipes to heat the material to extract the kerogen. The mined material and heating pipes will be 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 melt the kerogen into liquid which flows through the collection pipes to a central location to eventually undergo further processing.

A second layer of capsules will be constructed above the first layer, once cooling has occurred. Capsules are 500' wide by 900' long. The capsules will be reclaimed immediately once the kerogen liquid and gas deposits are extracted from the second layer. Reclamation will occur after 3.5 years of the beginning of operations, but drop to 2 years following the establishment of flights to the north that will accommodate access. The capsule reclamation and mining activities will occur simultaneously throughout the site. The water management plan includes a stormwater plan for initial reclamation, as well as one for final reclamation.

Soils and Vegetation

The soils on the site are generally classified as 55% Walknolls Mikim associated soils, which are well-drained silty loams and silty sands with a rated permeability of 2-6 in/hr (NRCS, 2003). This combination of soil type and permeability results in a B hydrologic soil type. Based on the vegetation surveys previously performed at the site, there is typically 80% vegetation cover consisting of pinyon and juniper or greasewood, sagebrush, and grass vegetation (JBR, 2010). This vegetation type and density results in a curve number of 75 for pinyon-juniper pre-mine watersheds and 86 for barren lands where topsoil salvage has occurred or reclaimed areas.

Design Storm Events

An estimated 10-year 24-hour storm event of 1.68 inches was used in the SEDCAD peak flow modeling for the pond and sump sizing. The 100-year 24-hour event is 2.54 inches (Bonnin, 2006), which was used in the calculations for the clean water diversions and the spillway design for ponds and sumps. The 100-year 60-day event of 6.17" was used to predict a worst case volume of storage for the two end-pit ponds (NOAA, 2011)..

Groundwater

A previous study by JBR Environmental Consultants has indicated a lack of groundwater that could affect inflow through the project area. Boreholes in the project area are typically dry to a depth greater than 900'; therefore, groundwater inflow was not factored into the calculations and design.

Operations Drainage Plan

A series of clean water diversions and sumps will be constructed to manage upland runoff from offsite tributaries at the western perimeter of the project site to prevent impacts to water resources and minimize erosion potential. Excavation is planned to first occur at the southwest corner of Section 30, T13S R23E and move north and east (Figures 2 and 3 of the NOI). Subsequent pits will be developed from east to west per the pit layout and ore removal timing map. Mining will continue north through Sections 30 and 19, and then operations will proceed from the south side of the lease in Section 36, T13S R22E **(see Figure 1).** The diversions and sumps necessary to protect each mining block will be constructed prior to any disturbance of that mining block. The diversions and sumps will be built in the order of the proposed mining sequence. **Table 1** lists the phasing of the diversion construction and the corresponding areas of protection.

The clean water diversions were modeled using the 100-year, 24-hour storm event of 2.54". The clean water diversion locations are shown on **Figure 1**, and design details for the worst case scenarios (largest contributing watersheds and steepest topography) are summarized in **Table 1**. The contributing watershed used in the analysis is shown on **Figure 1**. The design details for the diversions are shown on **Figure 4** and **Figure 5**. The diversions are typically triangular in shape with 4.5H:1V side slopes and 2-foot channel depths. The channel depth includes 0.5 feet of freeboard above peak flow. Some diversions on steep terrain (greater than 3%) are trapezoidal in shape with a 10-foot bottom width and 3H:1V side slopes. The different channel geometry is necessary to keep flow velocities below the limiting velocity of 5.5 feet per second. Select areas where the channel slope is greater than 5% may require armoring with angular rock, or pre-stabilization of a proposed vegetative channel with an erosion control product. As-built designs consisting of surveyed ditch profiles, representative cross-sections and hydraulics calculations will be submitted following construction. These will verify that design flows can be handled.

Due to the site topography, the diversions cannot convey all the runoff that would flow towards the mining pits. Areas that cannot be diverted require the use of ponds or sumps to contain runoff. The operational sumps are sized according the area of contributing watersheds and the 10-year 24-hour storm event. The sump locations and contributing watersheds are shown on **Figures 1** and **2**, and design details are listed in **Table 2**. The sumps are typically on-channel structures and will resemble a typical stock reservoir. The maximum height of a sump embankment will not exceed 10 feet in height and the maximum capacity will not exceed 20 acre-feet. An emergency spillway that is capable of safely conveying the peak flow during the 100-year, 24-hour storm with at least 1-foot of freeboard has been included in the design. The minimum spillway depth is 3 feet. The sumps have been designed to fully contain the runoff from the 10-year, 24-hour storm when the sump is empty. Therefore, water contained in the sump must be pumped or trucked to another location to provide the necessary operational containment. Norwest will submit as-built surveys to UDOGM within three months of the completion of construction.

Red Leaf plans to use the McCoy Reservoir #2 as highwall containment for Period 13. A 2011 survey found that the reservoir had 16.96 acre feet of capacity to the emergency spillway. The 10-year 24-hour runoff from the watershed contributing to this site is 8.03 acre feet. Red Leaf will utilize the reservoir for storage of operations water. The entire volume will be available for storage prior to its use as a sump to protect mining in Period 13.

The ponds (**Table 3**) were designed to handle the 10-year 24-hour storm event at a minimum and may be used for supplemental storage of operational ground water. Pond 1 has a capacity of 11.81 acre feet and is designed to retain 1.25 acre feet of water from the 10-year 24-hour storm. Pond 2 has a capacity of 2.17 acre feet and is designed to contain 0.35 acre feet for the 10-year 24-hour storm. Pond 3 has a capacity of 21.83 acre feet and

will contain 4.91acre feet of runoff for the 10-year 24-hour event. Operational staff will develop a strategy to identify the maximum storage level to ensure containment of the 10-year 24-hour storm. All three ponds have less than 20 acre feet of storage above grade, and Pond 3 utilizes excavated storage to achieve this objective. Red Leaf will submit as-built surveys to UDOGM within three months of the completion of construction.

During the reclamation phase, ponds and perimeter ditches will be constructed on site within the lease boundaries to control and contain runoff from the site after mining operations cease. The post-mine reclamation drainage plan is shown on **Figure 3**. The design details for the ponds are listed in **Table 3** and illustrated in **Figure 6**. Earthen ditches will collect runoff from the reclaimed areas and route it to down drains that are armored with angular rock. Four down drains on the west side of the larger mine area have been designed to collect water from existing drainages that will be mined-out. These ditches will be operational during mining operations and following the completion of mining. Sumps have been included at the bottom of each down drain for use during mining operations to prevent water from flowing into the open pit. In some cases, water will be conveyed through culverts to the sumps and designs are shown in **Table 4**. Reclamation will occur simultaneously to mining activities, which means that the operational drainage plan will be a combination of the designs included in **Figures 1** and **2**. For example, while Period 12 is being mined, CD-8 (**Figure 1**) will divert water from the west side of the pit to the north and away from the pit. Water from the reclaimed areas will be diverted through collection ditch CD-20s to Sump 20 (**Figure 2**).

Following the completion of mining, these sumps will be reclaimed and five reclamation ponds will be used to contain runoff waters and to provide water for stock and wildlife. The ponds will be inspected to ensure their storage and long-term stability prior to closure. Maintenance will be performed if necessary. The reclamation ditches and down drains will remain (**Figure 3**). Two in-pit ponds (Ponds 4 and 5) have been included at the northeast corner of the two mining areas, because these will be left as excavated areas

and water will naturally collect there. The adjacent highwall will be protected by a toe berm constructed with materials excavated for the ponds. The crest of the berm will be 5 feet above the modeled 100-year 60-day storm event of 6.17". The berm will have a 3H:1V outslope (**Figure 3**). The toe berm will be constructed in 6-inch horizontal lifts and compacted to 90% dry density. The berm adjacent to Pond 4 is 18 feet tall, and the berm adjacent to Pond 5 is 15 feet tall. The emergency spillway of the ponds outside the pit will be sized to safely pass the 100-year 24-hour storm event. Ponds will be constructed with 3:1 side slopes.

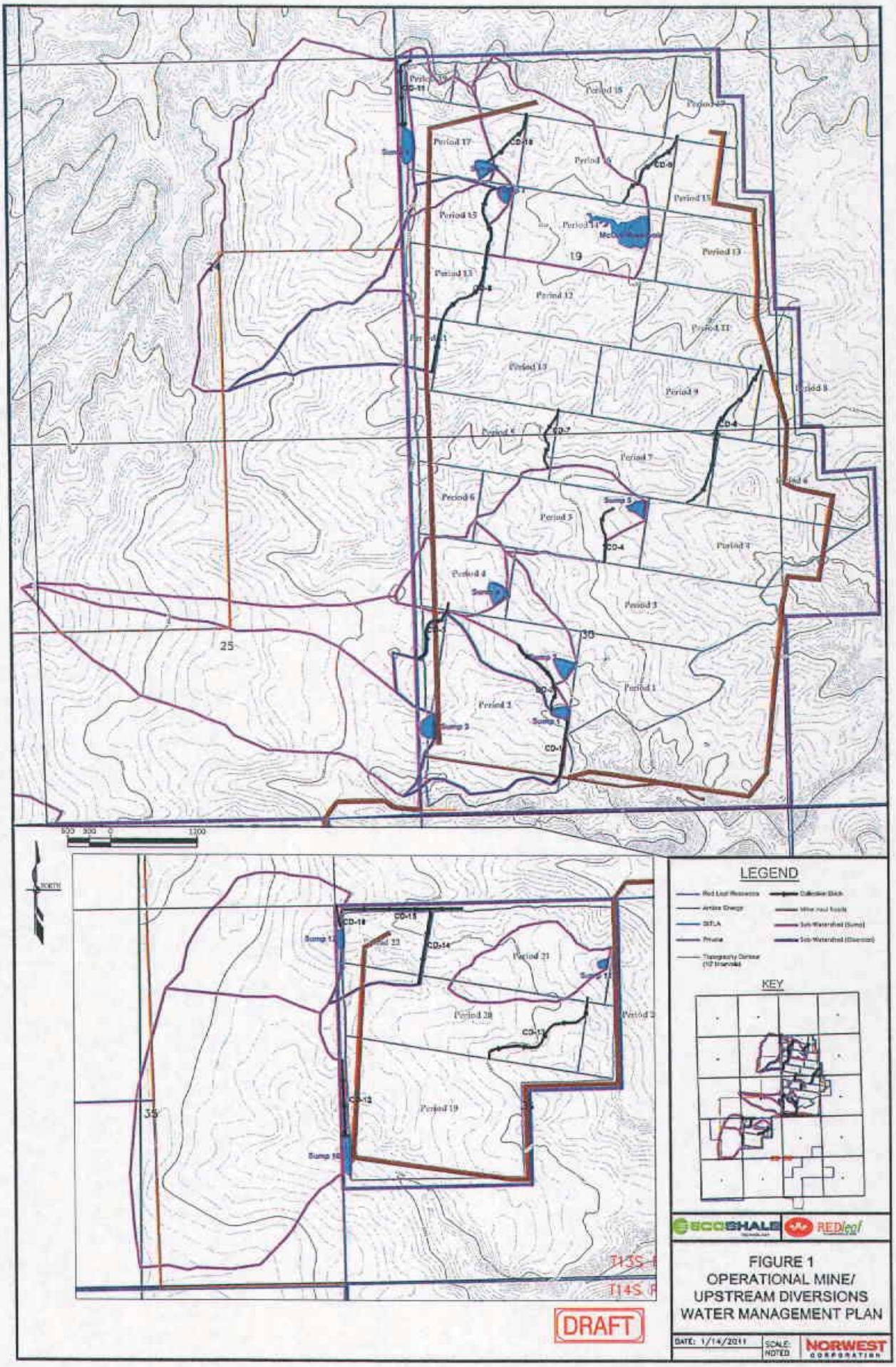
References

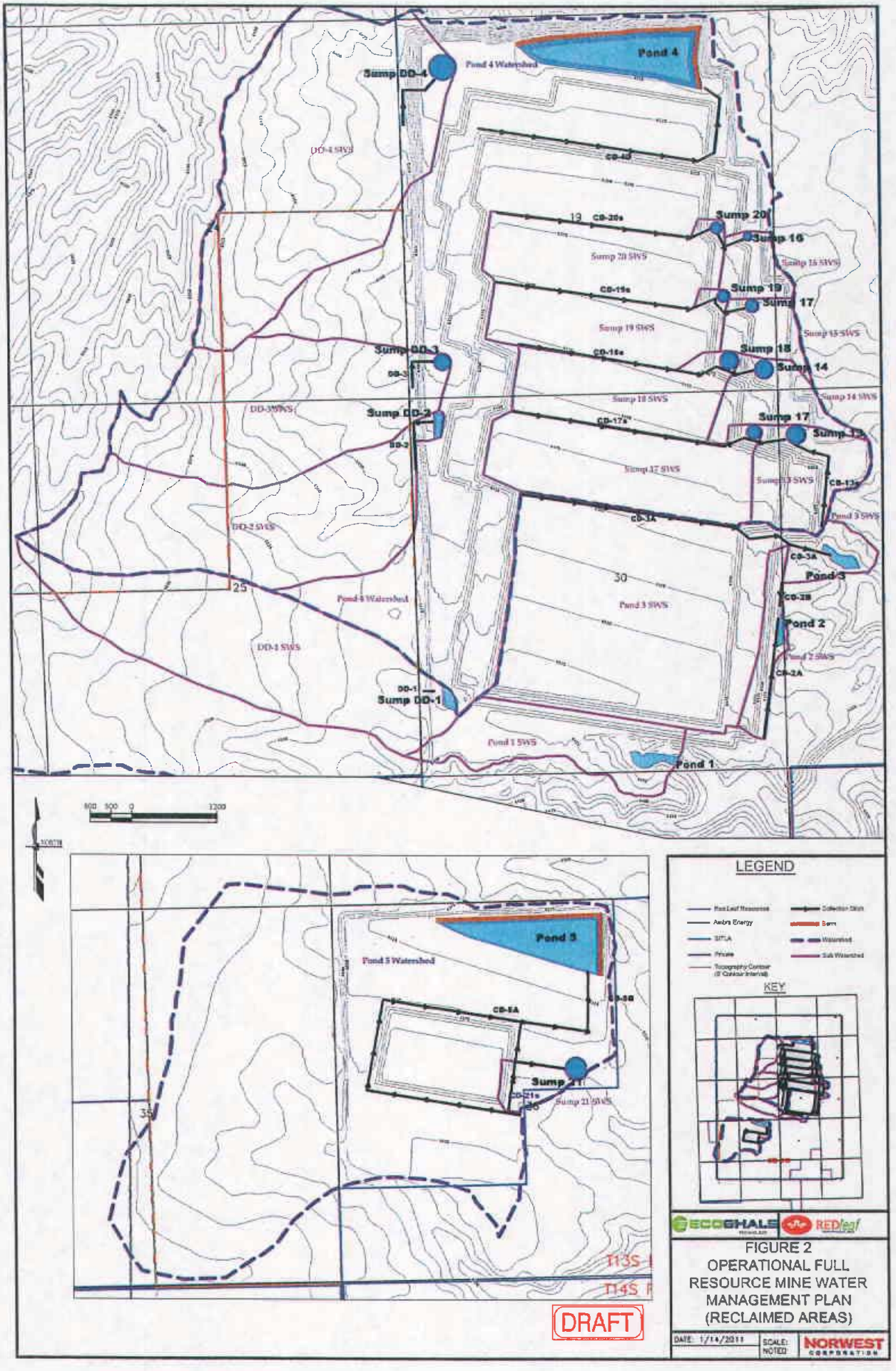
Bonnin, G.M., et.al. 2004 revised 2006. NOAA Atlas 14 Precipitation-Frequency Atlas of the United States Volume 1 Version 4.0: Semiarid Southwest (Arizona, Southeast California, Nevada, New Mexico, Utah). NOAA, National Weather Service, Silver Spring, Maryland. http://hdsc.nws.noaa.gov/hdsc/pfds/

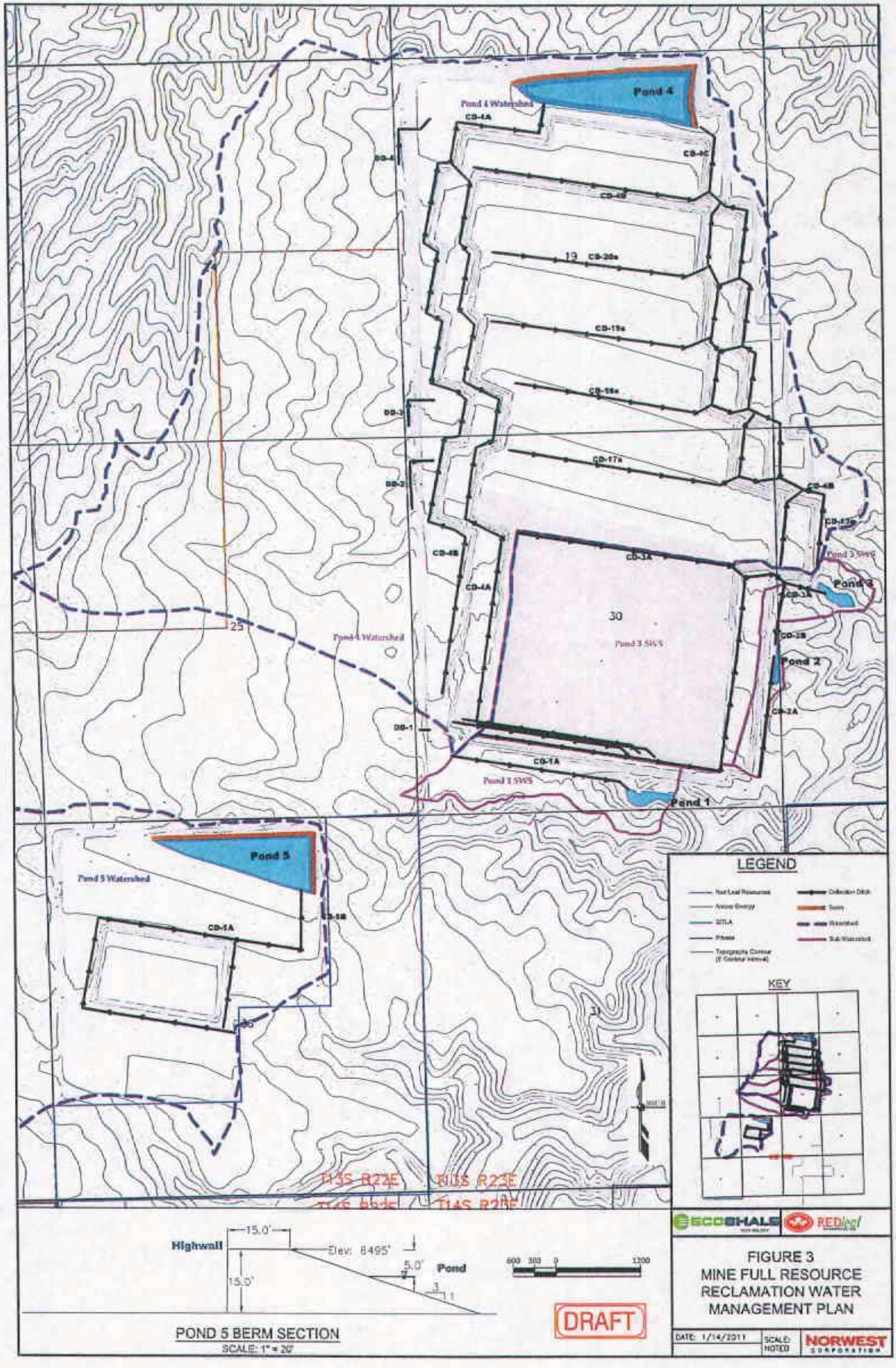
Natural Resource Conservation Service, United States Department of Agriculture, 2003 Soil Survey of Uintah Area, Utah – Parts of Daggett, Grand, and Uintah Counties, http://soildatamart.nrcs.usda.gov/Manuscripts/UT047/0/UT047.pdf, 2003.

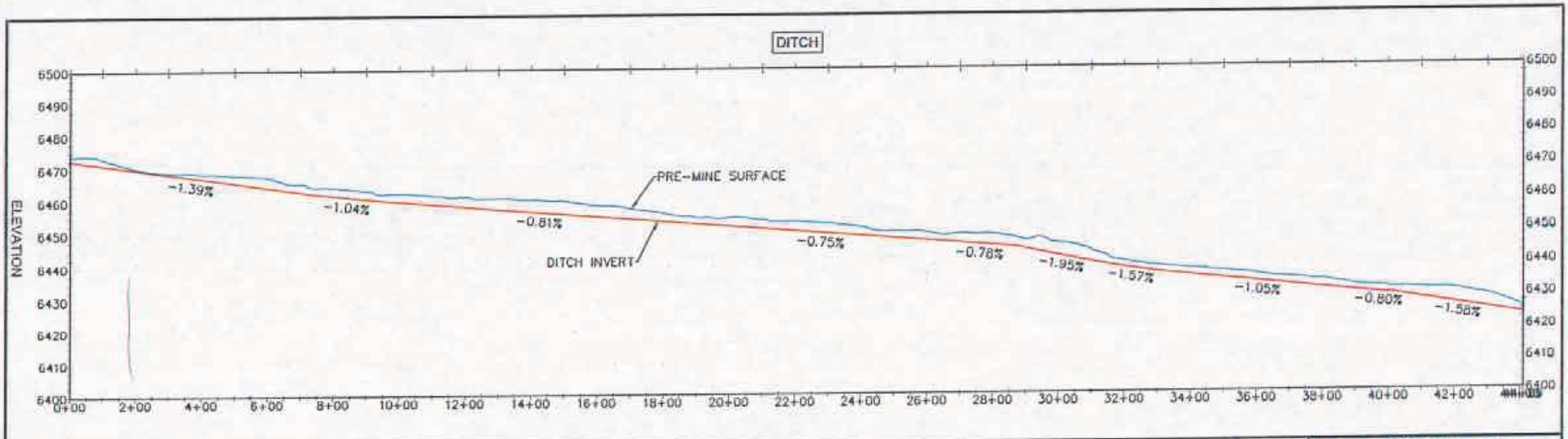
National Oceanic and Atmospheric Administration (NOAA) 2011. NOAA Atlas 14 Point Precipitation Frequency Estimates for Bonanza and Vernal Utah. Retrieved 4/12/11 from http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ut

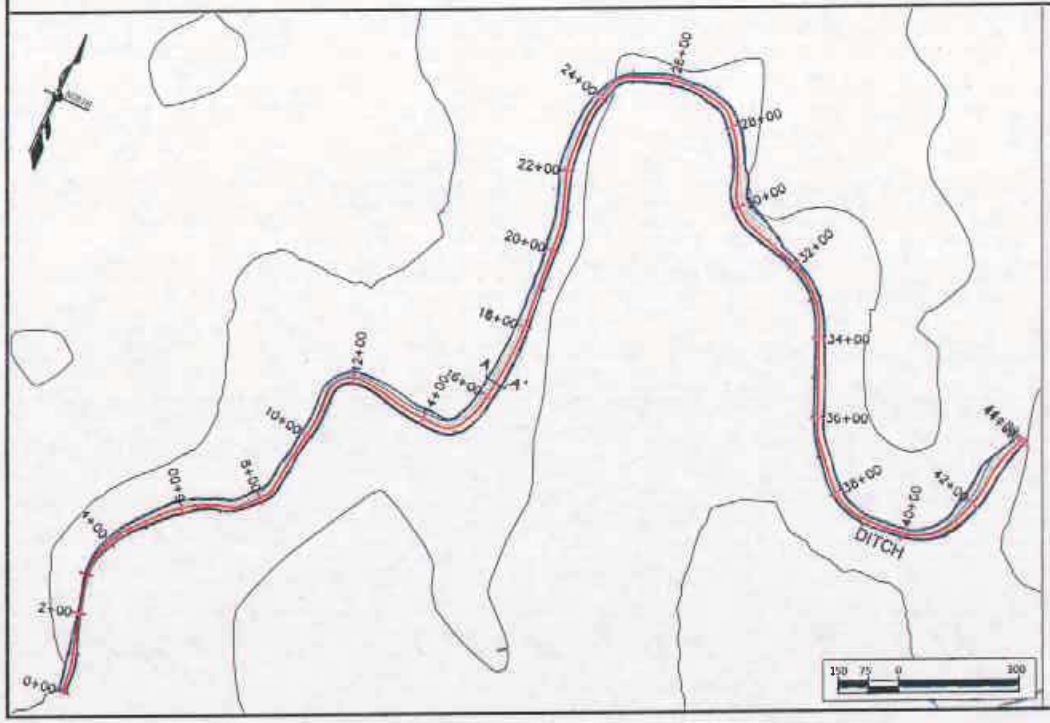
JBR Environmental Consultants, Inc., 2010, Red Leaf Project Area Vegetation Survey. Prepared by M. Sawyer.

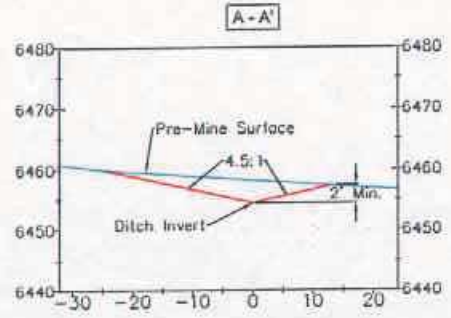

LEGEND
KEY
DRAFT
FIGURE 1
OPERATIONAL MINE/
UPSTREAM DIVERSIONS
WATER MANAGEMENT PLAN
DATE: 1/14/2011
SCALE: NOTED
NORWEST CORPORATION


Pond 4
Sump DD-4
Pond 4 Watershed
DD-4 SWS
CD-4S
Sump 20
Sump 16
Sump 19
Sump 17
Sump 15
Sump 18
Sump 14
Sump DD-3
Sump DD-2
Sump 17
Sump 13
Pond 3
Pond 2
Pond 1
Sump DD-1
Pond 5
Pond 5 Watershed
CD-5A
Sump 21
T13S
T14S
DRAFT
LEGEND
KEY
ECOGHALE
REDleaf
FIGURE 2
OPERATIONAL FULL RESOURCE MINE WATER MANAGEMENT PLAN (RECLAIMED AREAS)
DATE: 1/14/2011
SCALE: NOTED
NORWEST CORPORATION


Pond 4
Pond 4 Watershed
CD-4A
CD-4C
CD-4B
CD-20a
CD-19a
CD-18a
CD-17a
DD-4
DD-3
DD-2
DD-1
CD-4B
CD-4A
CD-3A
CD-3B
CD-2B
CD-2A
CD-1A
Pond 3 SWS
Pond 3
Pond 2
Pond 1 SWS
Pond 1
Pond 4 Watershed
Pond 3 SWS
19
30
25
31
Pond 5
Pond 5 Watershed
CD-5A
CD-5B
T13S R23E
T13S R23E
T14S R23E
LEGEND
KEY
Highwall
15.0'
Elev: 6495'
5.0'
Pond
15.0'
3
1
POND 5 BERM SECTION
SCALE: 1" = 20'
600 300 0 1200
DRAFT
FIGURE 3
MINE FULL RESOURCE
RECLAMATION WATER
MANAGEMENT PLAN
DATE: 1/14/2011
SCALE: NOTED
NORWEST CORPORATION







NOTES:

- CHANNEL SEGMENTS STEEPER THAN 5% MAY NEED TO BE ARMORED WITH RIP RAP.
- COLLECTION DITCHES AND ANY ASSOCIATED SUMPS ARE TO BE BUILT PRIOR TO ANY DISTURBANCE OF THE MINE BLOCK.
- DITCHES DISCHARGE TO SUMPS, PONDS, OR EXISTING DRAINAGES.

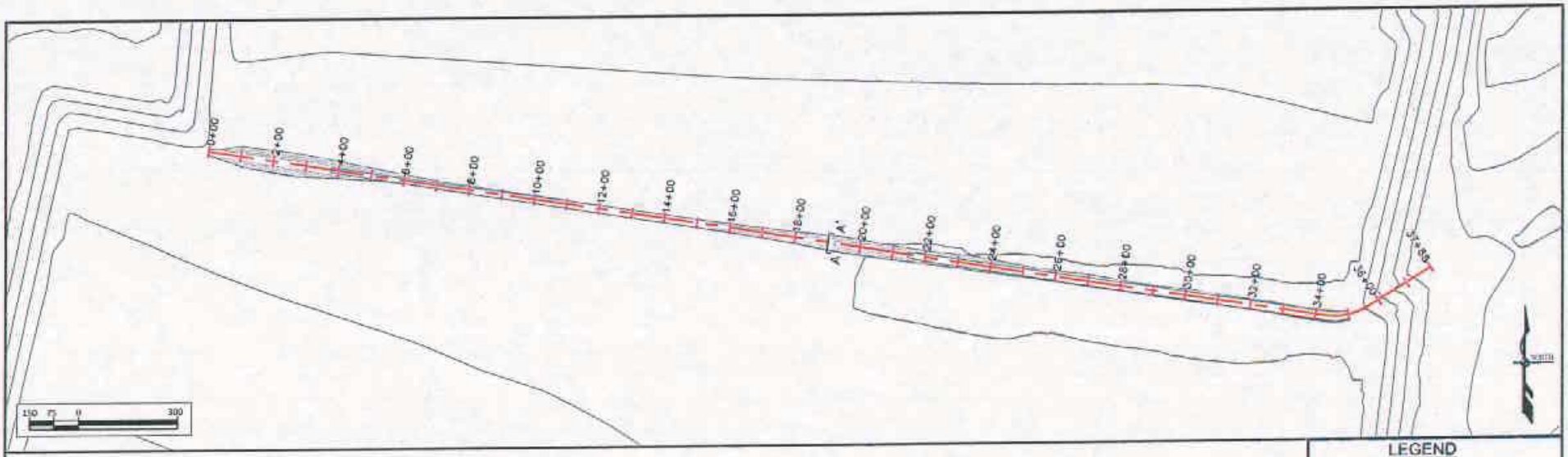
DRAFT

LEGEND

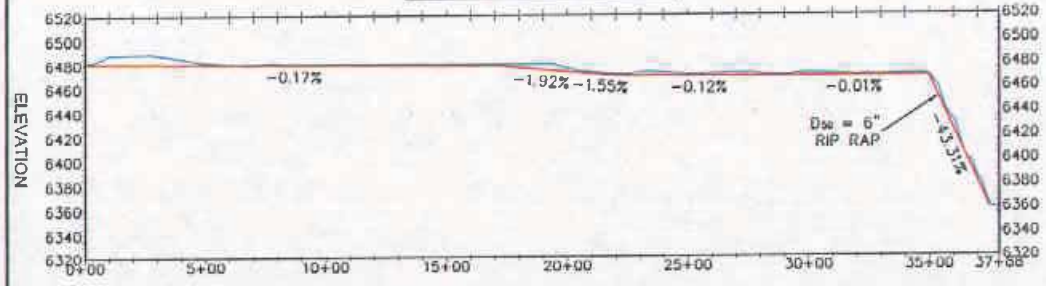
ECOSHALE | REDleaf

FIGURE 4
TYPICAL COLLECTION DITCH DESIGN

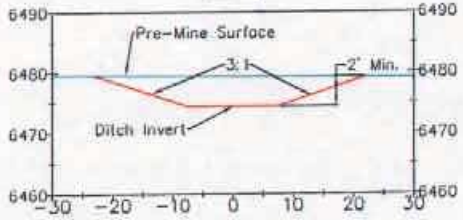
DATE: 10/29/2010 | SCALE: NOTED | NORWEST CORPORATION



POST MINE COLLECTION DITCH



A - A'



NOTES:

- CHANNEL SEGMENTS STEEPER THAN 5% MAY NEED TO BE ARMORED WITH RIP RAP.
- COLLECTION DITCHES AND ANY ASSOCIATED SUMPS ARE TO BE BUILT PRIOR TO ANY DISTURBANCE OF THE MINE BLOCK.
- DITCHES DISCHARGE TO SUMPS, PONDS, OR COLLECTION DITCHES.

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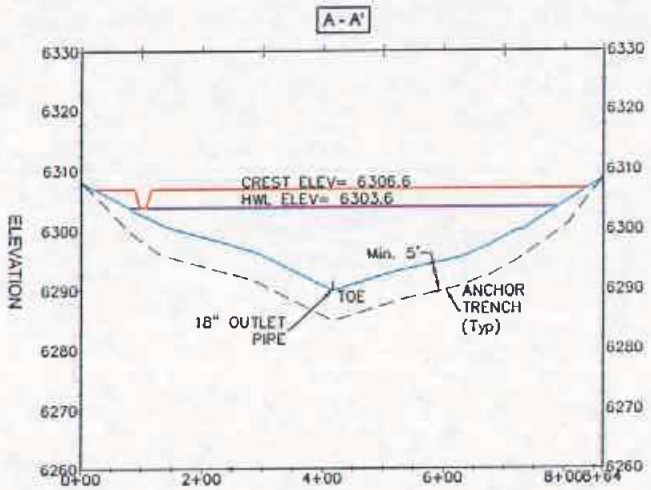
LEGEND

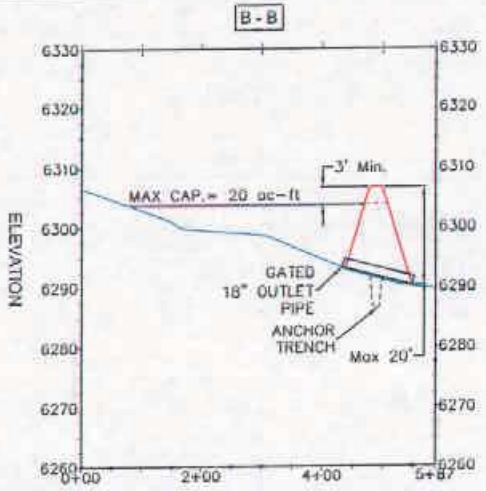
PRE-MINE SURFACE
DESIGN SURFACE

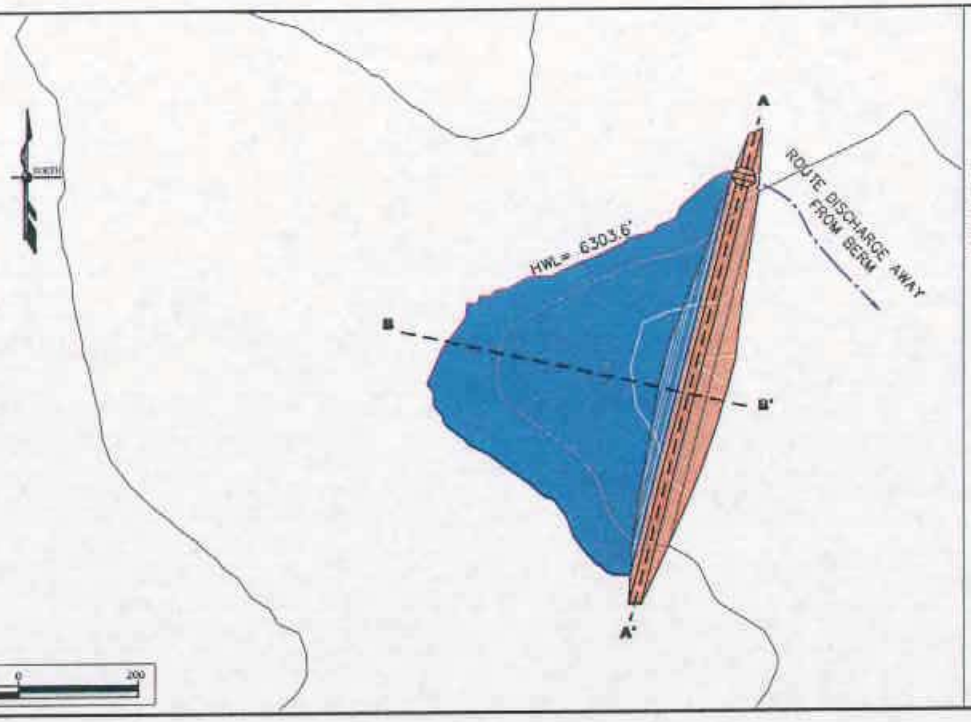
ECOSHALE | REDimat

FIGURE 5
TYPICAL RECLAMATION
DITCH DESIGN

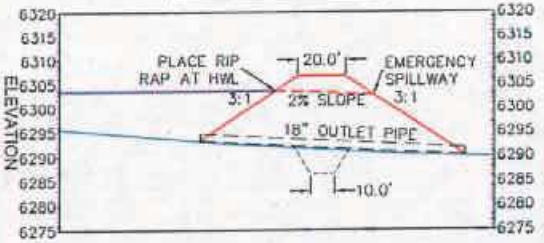
DATE: 10/29/2010 | SCALE: NOTED | NORWEST CORPORATION



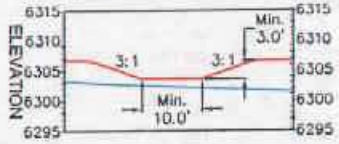




EMBANKMENT SECTION



EMERGENCY SPILLWAY



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LEGEND

FIGURE 6
TYPICAL POND / SUMP DESIGN

DATE: 10/29/2010 SCALE: NOTED NORWEST CORPORATION

Table 1: Collection Ditches (Mining Phase)

Ditch	Protected Area	Length	Top Elev.	Bottom Elev.	Elevation Change	Slope %
CD-1	Period 1	908	6450	6390	60	6.61
CD-2	Period 1	1149	6425	6390	35	3.05
CD-3	Period 2	1196	6480	6475	5	0.42
CD-4	Period 4	1237	6390	6370	20	1.62
CD-5	REMOVED					
CD-6	Period 6, 8	2638	6360	6280	80	3.03
CD-7	Period 7	923	6415	6385	30	3.25
CD-8	Periods 10, 12, 14	2365	6380	6310	70	2.96
CD-9	Period 15	1476	6300	6290	10	0.68
CD-10	Period 16	996	6360	6320	40	4.02
CD-11	Period 17	1177	6420	6360	60	5.10
CD-12	Period 19	1298	6685	6620	65	5.01
CD-13	Period 19	2277	6600	6580	20	0.88
CD-14	Period 21	1306	6660	6585	75	5.74
CD-15	Period 21	2005	6635	6570	65	3.24
CD-16	Period 22	415	6640	6630	10	2.41

Worst Case Design Scenario: 100-year 24-hour storm event (2.54")

Ditch **CD-8** **Largest Contributing Watershed**

Name	Mine Periods in Use	SWS Area (ac)	Peak Flow (cfs)	Shape	Bottom Width	Side Slopes	Flow Depth	Freeboard	Channel Depth	Velocity (fps)
Ditch CD-8	10,12,14	95.05	27	Trapezoidal	10	3H:1V	0.49	0.5	0.99	4.75

Ditch **CD-1** **Slope: 6.6%**

Name	Mine Periods in Use	SWS Area (ac)	Peak Flow (cfs)	Shape	Bottom Width	Side Slopes	Flow Depth	Freeboard	Channel Depth	Velocity (fps)
Ditch CD-1	1	1.35	1.07	Tri	-	4.5H:1V	0.27	0.5	0.77	3.29
	Assumed CD-3 and Sump 3 were in place									
Ditch CD-14	21	69.89	16.59	Trapezoidal	10	3H:1V	0.3	0.5	0.8	5.05

Table 2: Operational Sumps (Mining Phase)

Name	SWS Area (ac)	Runoff (ac-ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac-ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump 1	90.90	1.74	3H:1V	10	0.36	3.38	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 1
Sump 2	23.88	0.46	3H:1V	10	1.11	6.34	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 1
Sump 3	155.67	2.98	3H:1V	10	1.04	5.88	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 2
Sump 4	32.19	0.62	3H:1V	10	1.23	7.13	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Periods 2 and 3
Sump 5	50.13	0.96	3H:1V	10	0.82	4.46	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 4
McCoy Reservoir	419.06	8.03	3H:1V	10	4.33	16.96	0	2	4	2	Trapezoidal, 10' wide, 3:1 sideslopes	Period 13
Sump 7	31.33	0.60	3H:1V	10	0.73	4.01	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 14
Sump 8	268.07	5.14	3H:1V	10	0.98	5.51	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Periods 14 and 15
Sump 9	223.76	4.29	3H:1V	10	1.47	8.40	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 17
Sump 10	226.19	4.34	3H:1V	10	1.17	5.40	0	12	15	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 19
Sump 11	37.75	0.72	3H:1V	10	0.31	1.47	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 20
Sump 12	79.53	1.52	3H:1V	10	0.13	2.02	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Period 22
Sump 13	140.49	2.69	3H:1V	10	1.20	7.09	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 14	94.20	1.81	3H:1V	10	1.22	7.23	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 15	74.22	1.42	3H:1V	10	0.59	3.23	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

Table 2: Operational Sumps (Mining Phase)

Name	SWS Area (ac)	Runoff (ac ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac-ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump 16	89.65	1.72	3H:1V	10	0.24	1.97	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 17	96.15	1.84	3H:1V	10	0.65	3.77	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 18	66.09	1.27	3H:1V	10	1.06	6.18	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 19	65.14	1.25	3H:1V	10	0.48	2.56	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 20	74.78	1.43	3H:1V	10	0.48	2.54	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump 21	13.78	0.26	3H:1V	10	1.59	9.60	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-1	173.23	3.32	3H:1V	10	0.80	4.33	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-2	176.31	3.38	3H:1V	10	0.74	3.79	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-3	159.83	3.06	3H:1V	10	0.49	4.88	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-4	245.86	4.71	3H:1V	10	1.43	13.77	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

Table 3: Ponds (Reclamation)

Name	SWS Area (ac.)	10-Yr 24-Hr Runoff (ac-ft.)	100-Yr 24-Hr Runoff (ac-ft.)	100-Yr 60-Day Runoff (ac-ft)	Slopes	Height (ft.)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Bottom Area (sq. ft.)	HWL Area (sq. ft.)	Bottom Area (ac.)	HWL Area (ac.)	Capacity (ac-ft.)	Spillway
Pond 1	64.99102	1.245661	3.41	24.21	3H:1V	12	0	10	12	2	54698	98246	1.26	2.26	11.81	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 2	18.42	0.353065	0.97	6.86	3H:1V	10	0	7	10	3	5574	23437	0.13	0.54	2.17	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 3	256.13	4.909112	13.45	95.41	3H:1V	20	0	18	20	2	24166.67	88158	0.55	2.02	21.83	Trapezoidal, 10' wide, 3:1 sideslopes
Pond 4	1543.10	29.57615	81.01	506.74	3H:1V	25	0	25	25	Below Grade Excavation	823049	1244739	18.89	28.58	589.22	None
Pond 5	613.86	11.76571	32.23	197.25	3H:1V	10	0	10	10	Below Grade Excavation	832645.87	990698	19.11	22.74	209.03	None

Table 4: Downdrain Sumps, Culvert and Downdrain Designs (Reclamation Phase)

Name	SWS Area (ac)	Runoff (ac-ft)	Slopes	Height (ft)	HWL Area (ac)	Capacity (ac-ft)	Toe Elev (ft.)	HWL Elev (ft.)	Crest Elev (ft.)	Freeboard (ft.)	Spillway	Mine Period Protected
Sump DD-1	173.23	3.32	3H:1V	10	0.80	4.33	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-2	177.46	3.40	3H:1V	10	0.73	3.79	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-3	160.49	3.08	3H:1V	10	0.49	5.22	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine
Sump DD-4	247.01	4.73	3H:1V	10	2.22	13.75	0	7	10	3	Trapezoidal, 10' wide, 3:1 sideslopes	Post-Mine

		Road Culvert				Downdrain Pipe				
Name	SWS Area (ac)	Min. Diameter (in.)	Length (ft)	Pipe Slope	Peak Discharge (cfs)	Min. Diameter (in.)	Length (ft)	Pipe Slope	Peak Discharge (cfs)	Mine Period Protected
DD-1	173.23	30	65	1%	24.24	30	134	26%	24	Post-Mine
DD-2	177.46	42	65	1%	47.97	42	103	78%	47.45	Post-Mine
DD-3	160.49	42	65	2%	44.73	42	136	65.7	43.88	Post-Mine
DD-4	247.01	NA	NA	NA	NA	75.8	230	87	75.8	Post-Mine

Appendix D

Steel Specifications

Collection Pan
and
Capsule Piping

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	---	---	---

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.

Appendix E

SPLP Leachate Analysis

American West Analytical
Laboratories

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

John Wallace
IGES
4153 South Commerce Drive
Salt Lake City, UT 84107
TEL: (801) 270-9400

RE: Red Leaf ECOSHALE / 01109-013

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,

Approved by: 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'

Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

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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: 1110545-001
Client Sample ID: R11-122 #1
Collection Date: 10/27/2011 0930h
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 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.

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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.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

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

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

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	[1]@
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.
[1] - 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.

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Laboratory Director
Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

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

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.

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Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

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

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.

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QA Officer

ORGANIC ANALYTICAL REPORT

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	

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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	

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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	

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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**	

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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
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.

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ORGANIC ANALYTICAL REPORT

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

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	

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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	

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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	

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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**	

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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
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.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

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	

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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	

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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	

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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**	

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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
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.

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Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

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	

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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	

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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
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	

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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
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.

ORGANIC ANALYTICAL REPORT

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

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	

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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
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	

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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	

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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
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.

ORGANIC ANALYTICAL REPORT

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

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	

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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
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	

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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	

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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
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.

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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

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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

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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

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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

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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

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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

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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: 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

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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

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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

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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.

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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

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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 because 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.

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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.

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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.

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QC SUMMARY REPORT

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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

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QC SUMMARY REPORT

Client: IGES
Lab Set ID: 1110545
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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

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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

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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

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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	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

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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

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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

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Client: IGES
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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

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QC SUMMARY REPORT

Client: IGES
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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

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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

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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

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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	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

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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

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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

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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

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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.

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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

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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	I	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

I - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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.

American West Analytical Laboratories

REVISED 10/31/11 TOC's sent out

WORK ORDER Summary

Work Order: **1110545**

Page 1 of 3 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.;

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

Client: IGES

Work Order: 1110545

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

Client: IGES

Work Order: 1110545

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
Page 1 of 3 10/28/2011

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.;

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

Work Order: **1110545**

Client: IGES

 10/28/2011

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	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								
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						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

Work Order: 1110545

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 Red Leaf Ecosmile

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	COMMENTS
R11-122 #1	10/27/11 0930		1	SEE ATTACHED MEMO	1 2 2+ 3 3+ 4	
R11-122 #2	10/27/11 0935		1			
R11-122 #3	10/27/11 0940		1			

EMAIL RESULTS TO Jim Hatch Camp per memo

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered
Notes:

2 Ambient or (Chilled)
Notes: on ice

3 Temperature 1.9°

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:

Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME: John F. Wallace	Time: 1246	PRINT NAME: Elma Hayward	Time: 1346

Special Instructions:

Memo

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
- Miscellaneous: Nitrate + nitrite, ~~fluorine~~ Fluoride 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 F

Reclamation Cover Performance Modeling (HELP)

RECLAMATION COVER PERFORMANCE MODELING

RED LEAF RESOURCES

Submitted to:
RED LEAF RESOURCES

November 7, 2011

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

RECLAMATION COVER PERFORMANCE MONITORING
RED LEAF RESOURCES

Background

The Red Leaf Resources Eco Shale Mining Project uses heat to extract kerogen deposits from sedimentary shale deposits. The mining process consists of the simultaneous mining of the oil shale and the creation of the heating capsules. Once enough overburden is removed from the mine to create a capsule, an impermeable liner is placed on the bottom of the capsule to prevent impacts to groundwater and the surrounding ecosystem. Collection pipes are placed along the bottom of the capsule. The mined material is placed above the collected pipes, followed by a series of heating pipes to heat the material to extract the kerogen. The mined material and heating pipes will be 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 melt the kerogen into liquid which flows through the collection pipes to a central location to eventually undergo further processing.

A second layer of capsules will be constructed on top of the first layer, once cooling has occurred. Capsules are 500' wide by 900' long. The capsules will be reclaimed immediately once the kerogen liquid and gas deposits are extracted from the second layer, and the capsules have cooled and settled. The capsule reclamation and mining activities will occur simultaneously throughout the site. The final cover on the capsules consists of a low permeability bentonite amended soil (BAS) cap overlain by a layer of overburden and 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 or being removed by evapotranspiration (ET) from the vegetated cover.

The performance of the designed cap 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 cap was modeled as designed, with the cap design being described more fully in the application. This text 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.

Closed Capsule Size and Description

The closed capsules are 500' wide and 900' long with a surface area of approximately 10.3 acres. The capsules are independently closed so the modeling evaluation was for a representative single capsule. Each capsule has 8 layers with the upper three being the BAS cap, overburden layer, and growth layer. The 8 layers are shown on Table 1.

Table 1. Model Layers

Model Layer	Represents	Thickness (feet)	Notes
1	topsoil	1	Top 12 inches of stripped material. Scarified to alleviate compaction
2	overburden layer	2	Stripped material from 12 to 36 inches below topsoil in areas where vegetation is dominated by grasses and shrubs
3	BAS cap	3	Low permeability cap
4	gravel insulation layer	13	High permeability
5	spent ore layer	61	Spent oil shale
6	gravel insulation layer	13	High permeability
7	Steel Plate	0.01	Oil collection system
8	BAS liner	3	Low permeability liner

The capsules have a cap, sides, and liner consisting of BAS with an in situ permeability of $1x10^{-7}$ cm/sec or less. Model layers 3 and 8 are of this material. The gravel insulation layers will be higher conductivity material. The spent oil shale is represented with a

[1] Available at http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill

moderate conductivity material. The BAS cap will be covered and protected with at least a 2 ft thick layer of overburden material from the site which is model layer 2. The overburden will be overlain by a 1 ft thick layer of soil which is model layer 1.

The overburden and soil will be gathered during the stripping portion of site preparation with the soil being the top 12 inches and primarily a silty loam. The overburden will be a lift of up to 2 feet of suitable cover (subsoil and overburden) below the soil where the vegetation is dominated by grasses and shrubs. 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.

Site Weather Data

The water budget for the capsule cap is strongly influenced by the weather regime and growing season at the site. Four types of weather data are required:

a. Evapotranspiration
b. Precipitation
c. Temperature
d. Solar Radiation

There are a number of cities with weather data available in the HELP model. The nearest cities to the site are Grand Junction, CO, Salt Lake City UT, Pocatello ID, and Lander, WY. 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. There is a 15 year history of weather data for the Upper Sand Wash RAWS meteorological station located approximately 5.2 miles NW (at N 39° 42' 49" West 109° 26' 46" with and elevation of 6,300 ft) from the site with a similar altitude and topography as the Red Leaf site (Hatch, 2010). This 15-year history was used with the synthetic weather generator to generate the input weather data from the HELP model.

The data analysis period of reference data from this site is 15 years from June 1, 1995, to June 30, 2010. Site specific data for precipitation, elevation, temperature, relative humidity, and latitude were used in the generation of the synthetic data sets. Site specific parameters and default parameters for the four cities are shown in Tables 2 through 4.

Table 2. General Parameters

Parameter	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO	Lander, WY
Latitude	39.66	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

Table 3. Mean Monthly Precipitation (inches)

Month	Red Leaf 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

Month	Red Leaf Site	Pocatello, Idaho	Salt Lake City, Utah	Grand Junction, CO
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. Red Leaf site data from Upper Sand Wash station

Table 4. Mean Monthly Temperature (Fahrenheit)

Month	Red Leaf 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. Red Leaf site data from Upper Sand Wash station

Evapotranspiration

Site specific values for evapotranspiration shown in Table 2 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 and 18 inches for the bare soil case, based on the silty loam nature of the topsoil. The maximum leaf area index was set to zero for the bare soil case and 1.6 for the reclaimed case. The 1.6 represents a mixture of poor and fair grass stands and is suggested by the HELP model based on the shorter growing season.

Precipitation

The site has approximately 9 inches of precipitation yearly with the largest amounts of precipitation occurring in August through October. The closest match for the precipitation volumes and pattern of lower winter precipitation and higher precipitation in late summer is Grand Junction, Colorado as shown in Table 3. 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.

Site specific values of mean monthly precipitation were used with the Grand Junction, CO coefficients to generate 30 years of daily precipitation. Table 5 compares the synthetic mean monthly precipitation to the site data.

Table 5. Mean Monthly Precipitation – Site and Model

Month	Red Leaf Site	HELP
January	0.3	0.27
February	0.4	0.37
March	0.6	0.57
April	0.9	0.99
May	0.6	0.57
June	0.8	0.75
July	0.7	0.65
August	1.3	1.31
September	1.6	1.35
October	1.1	1.29
November	0.4	0.53
December	0.3	0.26
Total	9.0	8.91

Temperature

The nearest match for temperature is Pocatello, ID with cold winters and maximum mean monthly temperatures in the low 70s during the summer as shown in Table 4. Site specific values of mean monthly temperature were used with the Pocatello, ID coefficients to generate 30 years of daily temperatures.

Solar Radiation

The site specific latitude was used with the Pocatello, ID coefficient to generate 30 years of daily solar radiation values.

Capsule Layers and Parameters

The capsule cap has three 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. This is summarized in Table 6.

The soil and overburden are silty loam from the site and the soil from 1 to 3 feet below the ground surface as noted in the capsule description section. For modeling purposes these were represented as silty sands with the overburden layer being less permeable than the soil. 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 6. Model Parameters

Model Layer	Represents	Thickness (feet)	Soil Texture		Total Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Initial Soil Water Content (vol/vol)	Saturated Hydraulic Conductivity (cm/sec)
			Number	Description					
1	topsoil	1	5	silty sand	0.457	0.131	0.058	0.109	1.0×10^{-3}
2	overburden layer	2	6	silty sand	0.453	0.190	0.085	0.092	7.2×10^{-4}
3	BAS cap	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}
4	gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
5	spent ore layer	61	10	clayey silt	0.398	0.244	0.136	0.136	1.2×10^{-4}
6	gravel insulation layer	13	21	gravel	0.397	0.032	0.013	0.032	3.0×10^{-1}
7	steel plate	0.01	35	simulated as a membrane liner	0.000	0.000	0.000	0.000	1.0×10^{-13}
8	BAS liner	3	16	barrier soil	0.427	0.418	0.367	0.427	1.0×10^{-7}

Model Execution

The HELP model was run for 30 years for a variety of climatic, soil, and design data to examine the potential cap performance for a range of potential conditions. The base model simulation was for a vegetated landfill cap as designed. This model was run using synthetic data sets described previously.

Sensitivity model runs were then conducted for:

1. Bare landfill (non-vegetated)
2. Increased precipitation to 150% of historical.
3. Lower Leaf Area Index (LAI)

Model Results

The model output is summarized in Table 7. 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 7. Model Results

Scenario	Average Annual Totals (inches) for Years 1 through 30				
	Precip	Runoff	ET	Percolation through Layer 3	Average Head on Layer 3
Base Reclaimed Case	8.90	0.000	8.860	0.006	0.001
Non-vegetated Case	8.90	0.071	8.468	0.263	0.293
Increased Precipitation (150%)	13.37	0.016	13.128	0.158	0.242
Lower LAI (1.2)	8.90	0.000	8.861	0.007	0.001

1. Model input and output files available on request

The average annual totals for percolation through the BAS liner and average head on the liner are shown in Table 7 for the modeled scenarios. This shows minimal head on the top of Layer 3 and percolation through layer 3 of less than 0.01 inches per year for the base vegetated case. The bare cover allowed 0.34 inches of infiltration per year with the unrealistic assumption that the vegetation was not established at the site for 30 years. A 50% increase in mean monthly precipitation for the vegetated cover predicted infiltration of 0.16 inches per year. The infiltration is a function of the precipitation and average head on layer 3. These vary over time with over half of the years having an average head of 0.000 inches on layer 3. This simulation shows the ability of the cover to handle much wetter years than average. The vegetated cover with a lower LAI showed very similar performance to the base case.

Based on these model results, the designed capsule cap and ET cover provides adequate control on infiltration into the capsules for the vegetated cover case using the design parameters. Even for 30 years of bare cover or very wet years the HELP model predicts minimal infiltration into the capsule for these extreme conditions.

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