Red Leaf Comment Response Figures and Attachments

Figures

1. Site Location Figure from the Permit Application (Figure 1)

2. Oil shale and oil sand deposits in the Eastern Uinta Basin

3 Natural Gas and Crude Oil Fields in the Eastern Uinta Basin

4. Generalized Stratigraphic Column Showing Relationship of Mahogany Zone and Douglas Creek Member

5. Plot of Recharge observed during Red Leaf and DWQ Oct. 16 Sampling Event

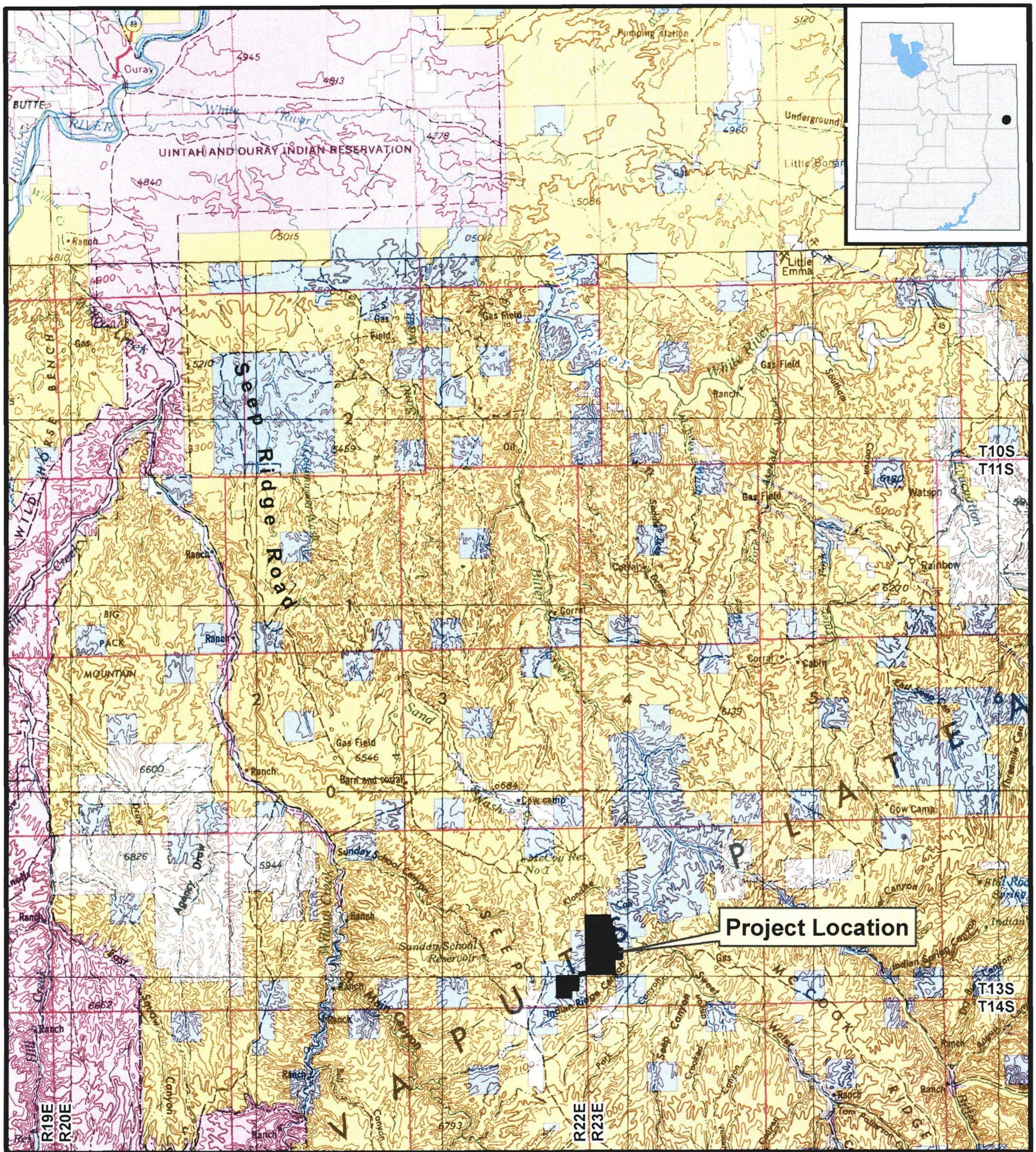
6. Final EPS reclamation depiction showing sampling points and regarding and runoff features

Attachment A November 7, 2013 Norwest Corp. RL-1 through RL-6 Core Review

Attachment B July 11, 2012 DWQ Memo by Mark Novak "Field Reconnaissance of Rocks Underlying the site of Proposed Southwest #1 Mine"

Attachment C May 30, 2013 Tech Memo from R.J. Bayer to Jay Vance on "Assessment of the Capacity of the EPS Capsule for absorption and Retention of HELP-predicted Infiltration"

Attachment D November 6, 2013 Tech Memo from R.J. Bayer to Jay Vance on "Supplemental Information Regarding Seeps and Springs"



Legend

- Project Area

Land Ownership

- BLM
- State
- Private
- Tribal Lands - The Uintah & Ouray Reservation

4 0 4 Miles

N

RED LEAF RESOURCES, INC.
Southwest #1 Project

FIGURE 1
LOCATION MAP

JBR

DRAWN BY	DATE DRAWN
CP	06/01/2011
SCALE	1:300,000

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

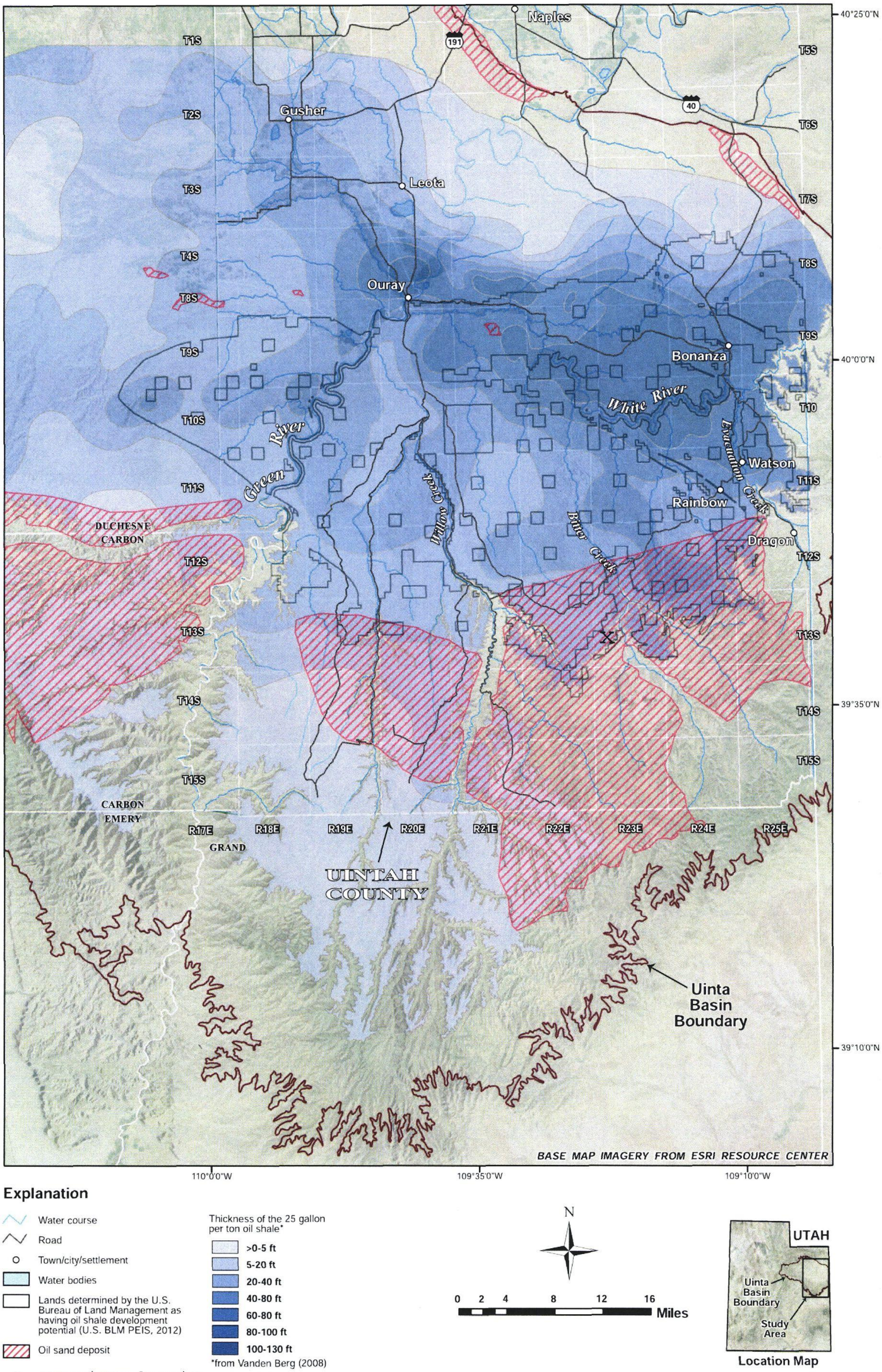


Figure 2. Oil shale and oil sand deposits in the eastern Uinta Basin.

Adapted from UGS open file report 595

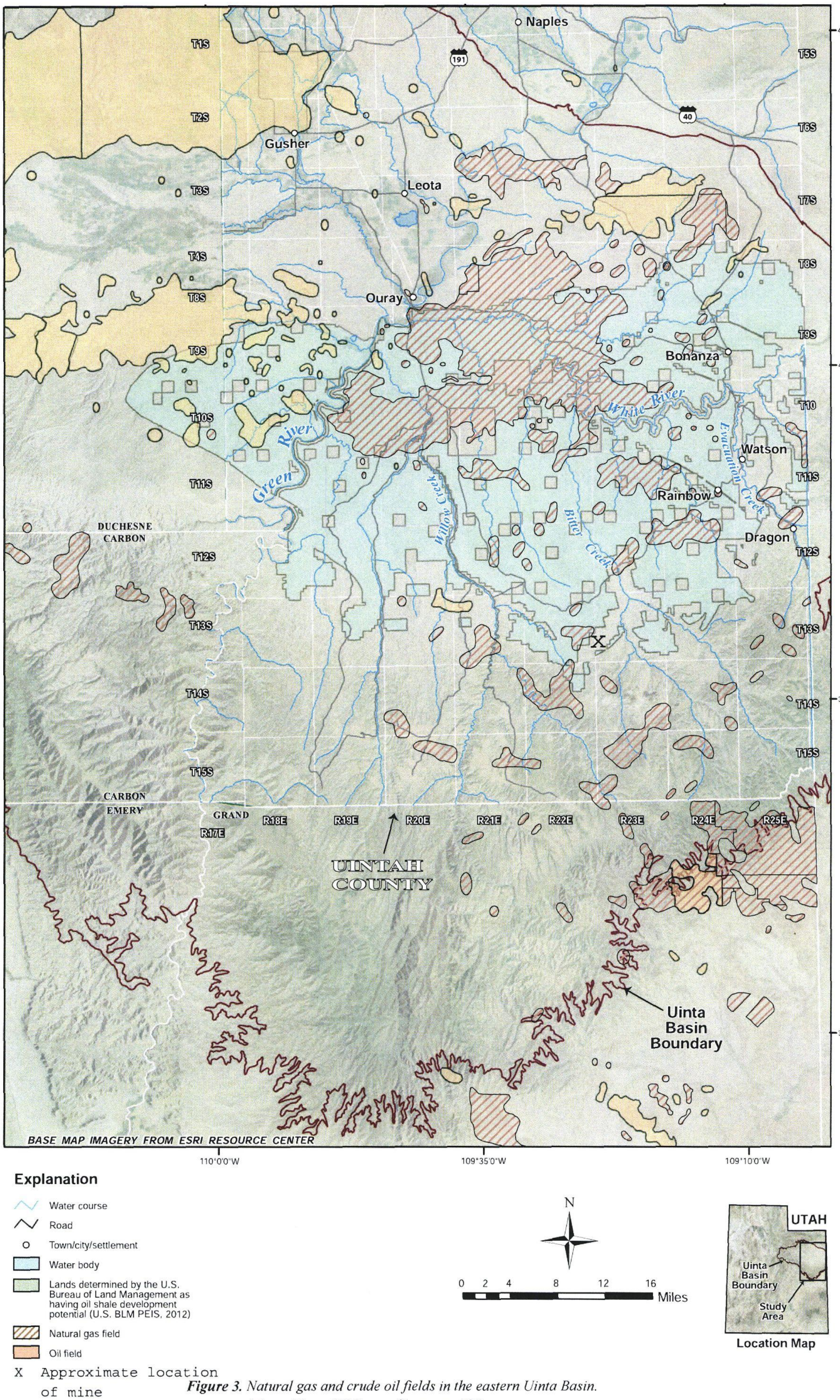


Figure 3. Natural gas and crude oil fields in the eastern Uinta Basin. Adapted from UGS open file report 595

~~Figure 3~~

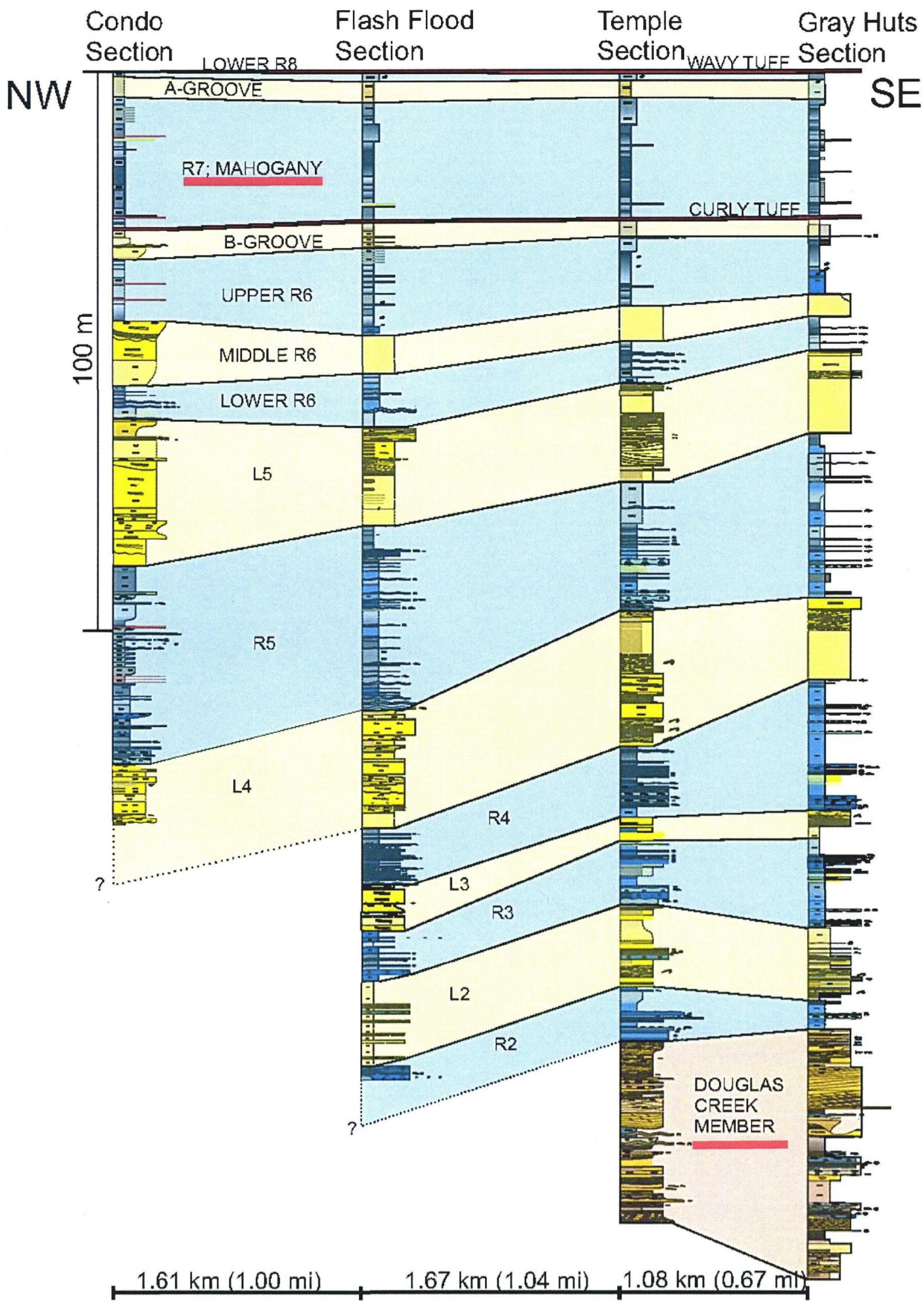


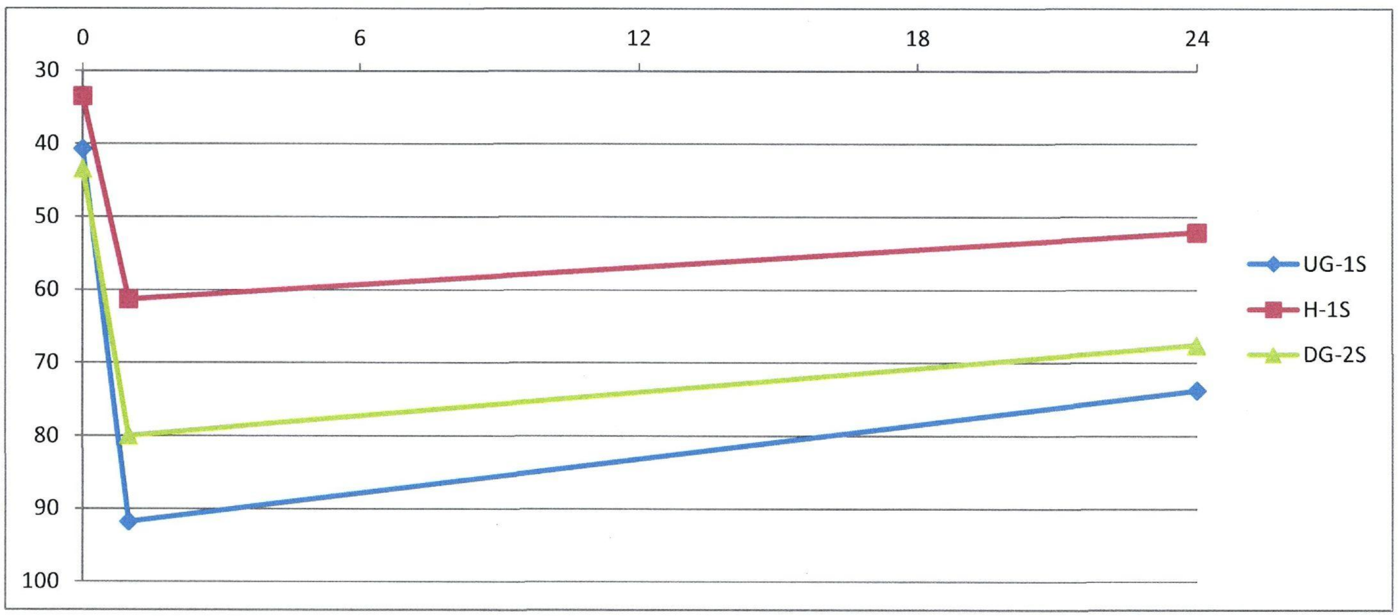
Figure 4. Generalized Stratigraphic Column Showing Relationship of Mahogany Zone and Douglas Creek Member (after Morgan Rosenburg, U. of Utah)

Figure 5

Recharge Observed during sampling event with DWQ on October 16, 2013

Well	Measured* depth to well bottom	Measured depth to water 15-Oct-13	Estimated depth after purge	Measured depth to water 16-Oct-13
UG-1S	94.3	40.7	91.8	73.8
H-1S	63.78	33.51	61.28	52.1
DG-2S	82.44	43.39	79.94	67.56

Recharge observed (casing volume)	Recharge rate observed
11.8 gallons of recharge within ~24 hrs	0.49 gallons per hour (approx.)
6.0 gallons of recharge within ~24 hrs	0.25 gallons per hour (approx.)
8.1 gallons of recharge within ~24 hrs	0.34 gallons per hour (approx.)



* Depth measurements made from marked datum location on the casing

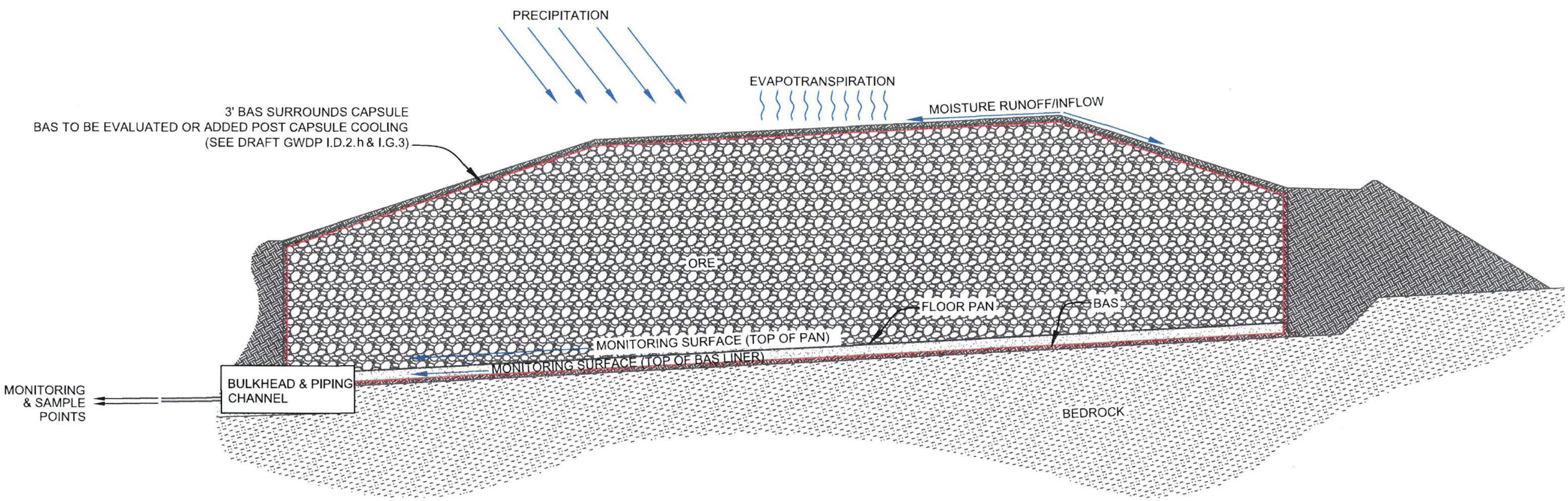


Figure 6. Final EPS Reclamation Depiction Showing Sampling Points and Precipitation Effects

Attachment A

November 7, 2013
Norwest Corp. RL-1 through RL-6
Core Review

Dan H.

NORWEST
CORPORATION

Steven B. Kerr
Project Manager Geologic Services

November 7, 2013

File No. 187-29

Mr. Jay K. Vance, P.E.
Manager, Environmental and Permitting
Red Leaf Resources, Inc.
Suite 200
10808 S. River Front Parkway
South Jordan, UT 84095

Subject: RL-1 through RL-6 Core Review

Dear Mr. Vance:

Six RL core holes were drilled in June of 2010. Norwest Corporation (Norwest) provided technical oversight to the drilling program, including the geologic logging of the core. The Norwest geologist noted the occurrence of a minor sandstone unit that occurs between 14 and 53 feet (ft) below the base of the Mahogany Zone near the bottom of each hole. The geologic logs note a medium to coarse-grained quartz-rich sandstone ranging from 2.9 to 4.6ft in thickness, with a dusky red-brown to gray-brown color. The logs also note occasional thin interbeds of marlstone and siltstone. One of the logs, RL-4, notes a strong odor of hydrocarbons at the time of logging. In five of the six holes, oil shale occurs below the sandstone unit. Drill hole RL-3 terminated in the sandstone. It should be noted that the term oil shale, as it is applied to rocks in the Green River Formation, is actually dolomitic marlstone enriched with varying amounts of kerogen. The thin-bedded nature of the rock along with the dark-colored "varves" of kerogen gives the appearance of shale.

Following Norwest's standard procedures, all core was logged at the drill site. All measurements and lithologic descriptions are made while the core is still in the core tray. Core is depth marked and striped for orientation while still in the tray and photographed on one-foot intervals. After all of these steps, upon completion of the logging and photography, the core is placed into core sleeves to retard oxidation and moisture loss then placed into standard cardboard core boxes for storage and transport.

Norwest was asked by Red Leaf Resources, Inc. (RLR) to review the geologic logs and re-examine the sandstone interval in the drill core for the six RL drill holes. On November 5, 2013, Norwest geologists Steven Kerr and Pete Doumit re-examined core for the sandstone intervals in holes RL-1, RL-4, and RL-6. In addition, Norwest retrieved and reviewed the geologic logs, geophysical logs, and core photos for all six RL holes.

The core intervals containing the sandstone for the three holes remains as fully intact core that has not been cut, sampled, or assayed as it occurs well below the established RLR ore horizon. The core was found to be still sealed in the original polyethylene core sleeves and core boxes that it was placed in soon after its collection from core drilling. The core is in excellent condition.

Norwest's re-examination of the core confirmed the measurements and descriptions made in the geologic log. It should be noted that the drilling and logging conducted in the field was mainly focused on characterizing the Mahogany Zone oil shale. From our re-examination of the core, we have provided some additional details and insights to the character of the sandstone unit that were not included in the original logging:

- The dusky red-brown color noted in the geology log is attributed to bitumen saturation (tar sand). The bitumen saturation varies from very strong to nonexistent in all holes. Bitumen saturation is confined to the medium to coarse-grained sandstone intervals and does not affect the occasional thin interbeds of marlstone within the sandstone.
- The sandstone is a carbonate-cemented sandstone. There is a weak to moderate reaction when tested with 10% HCl solution. Bitumen appears to retard the acid reaction plus the carbonate composition in Parachute Creek Member rocks are predominantly dolomitic.
- There are numerous veinlets and stringers of white secondary calcite within the sandstone sequence. These appear to be post-diagenetic or late-diagenetic in origin.
- The base of the sandstone interval is marked by a 3 to 4-inch interval of oil shale rip-up clasts with white secondary calcite infilling around the clasts.

- Oil shale occurs directly below the sandstone interval. The oil shale directly below the sandstone is very similar to the oil shale in the lower portions of the Mahogany Zone and elsewhere in the Parachute Creek Member. It is a light to medium greenish-gray to brownish gray dolomitic marlstone with thin discrete bands of kerogen enrichment. Kerogen enrichment is weak to moderate in the oil shale sequence below the sandstone through the remaining core interval (to the bottom of the hole).

All of these characteristics can be clearly seen in the sequence of core photos from RL-4 that are presented in the attached Figure 1 of this letter.

In conclusion, Norwest believes the thin sandstone unit that was encountered below the Mahogany Zone in drill holes RL-1 through RL-6 as well as the underlying oil shale sequences are part of the lower Parachute Creek Member. In addition, the fact that the unit is thin, bitumen-saturated, and carbonate-cemented precludes the availability for the unit to be considered an aquifer to any realistic degree.

Sincerely,

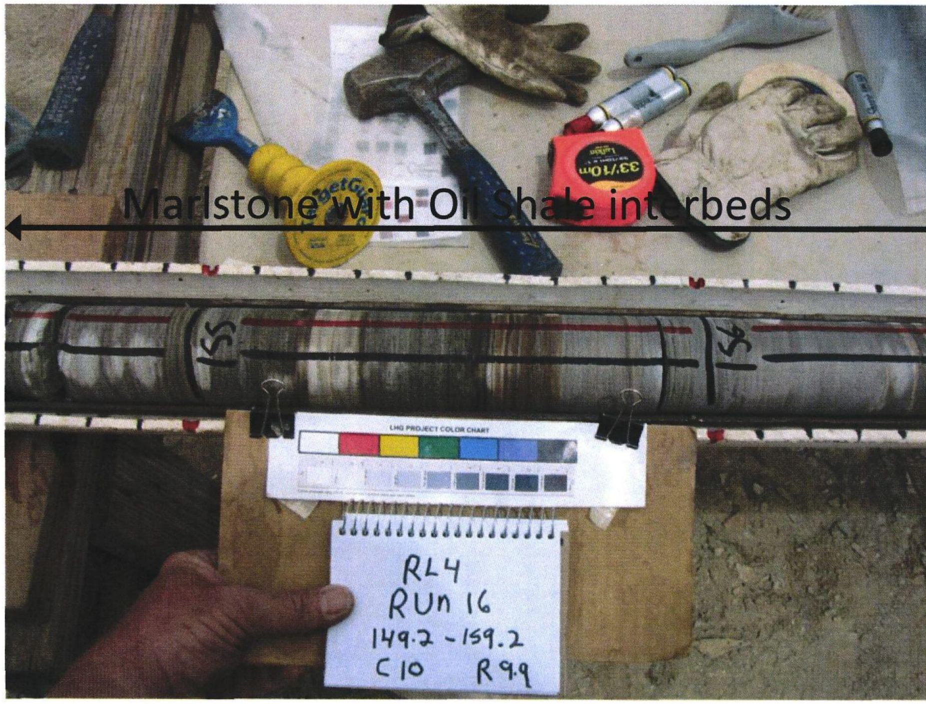
NORWEST CORPORATION

LICENSED PROFESSIONAL GEOLOGIST
No. 5557442
STEVEN B. KERR
STATE OF UTAH

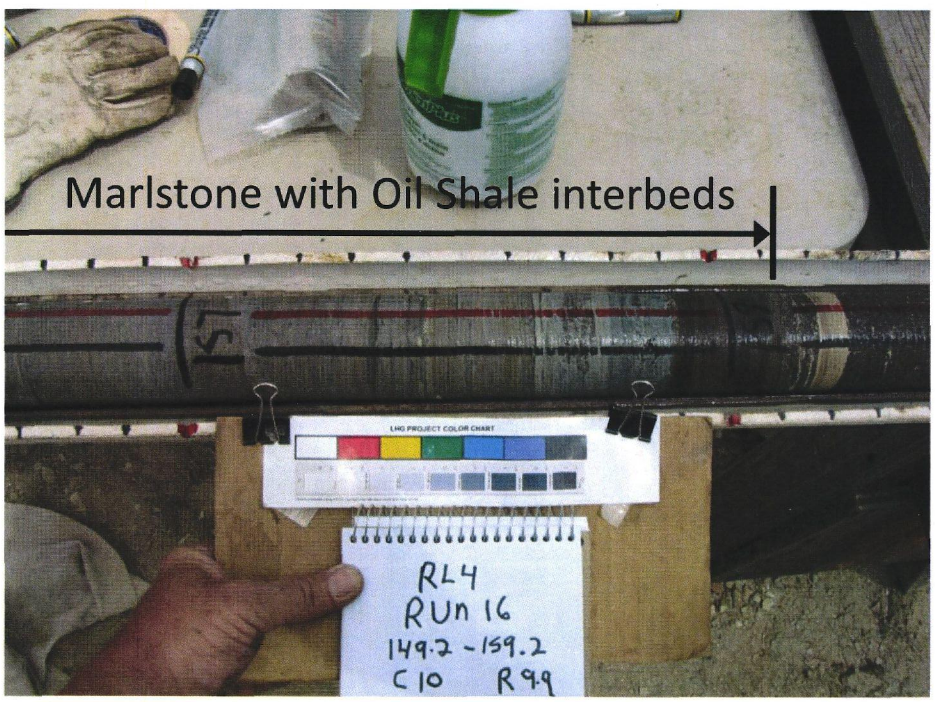
Steven B. Kerr, PG
Project Manager Geologic Services

Attachments

RL-4 Tar Sand
158.1’ – 161.9’

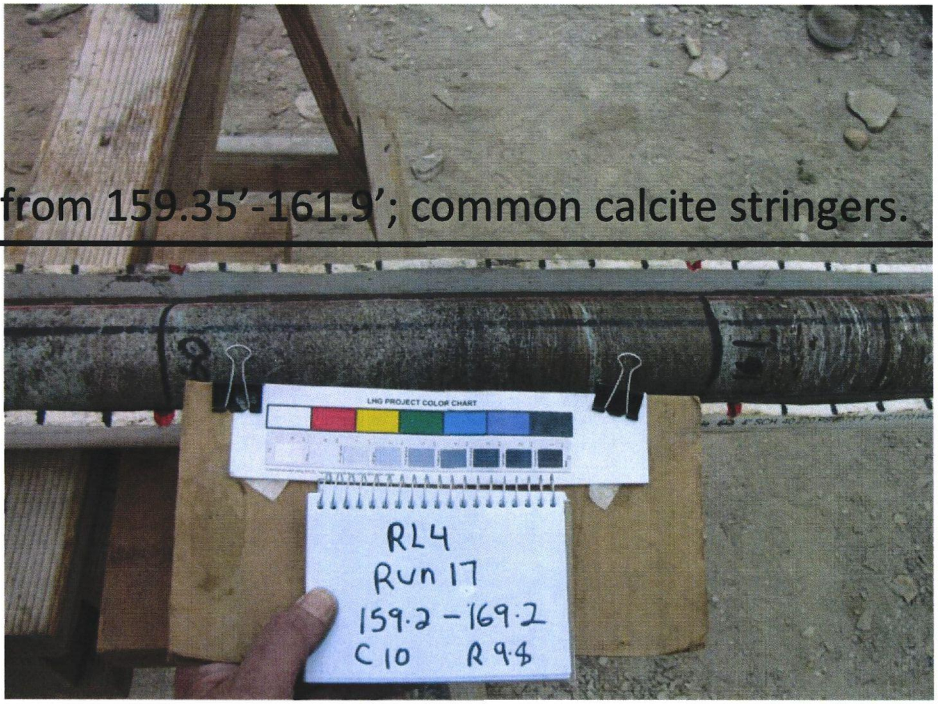

Marlstone with Oil Shale interbeds
155
RL4
RUn 16
149.2 - 159.2
C10 R9.9

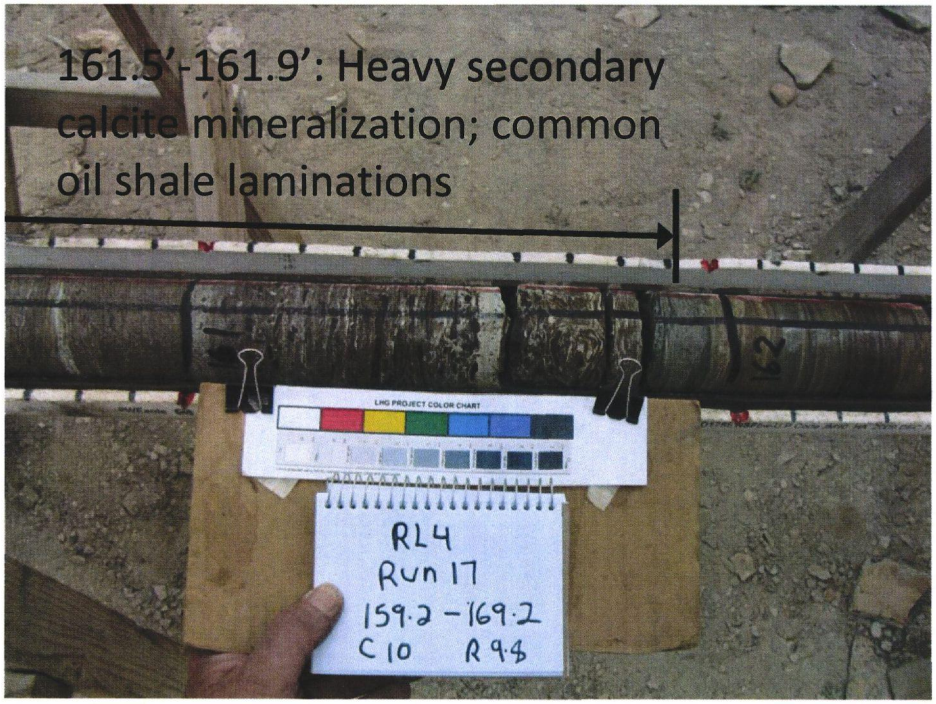

Marlstone with Oil Shale interbeds
RL4
RUn 16
149.2 - 159.2
C10 R9.9


Marlstone with Oil Shale interbeds
157
RL4
RUn 16
149.2 - 159.2
C10 R9.9


Top of Tar Sand at 158.1'.
Strongly bitumen-saturated
from 158.1'-159.35'.
RL4
RUn 16
149.2 - 159.2
C10 R9.9


Moderately-saturated with bitumen from 159.35'-161.9'; common calcite stringers.
RL4
Run 17
159.2 - 169.2
C10 R9.8


RL4
Run 17
159.2 - 169.2
C10 R9.8


161.5'-161.9': Heavy secondary calcite mineralization; common oil shale laminations
RL4
Run 17
159.2 - 169.2
C10 R9.8


Base of Tar Sand at 161.9'. Oil Shale below.
RL4
Run 17
159.2 - 169.2
C10 R9.8


Oil Shale with Marlstone interbeds
LHG PROJECT COLOR CHART
RL4
Run 17
159.2 - 169.2
C10 R9.8


Oil Shale with Marlstone interbeds
LHG PROJECT COLOR CHART
RL4
Run 17
159.2 - 169.2
C10 R9.8


Oil Shale with Marlstone interbeds
LHG PROJECT COLOR CHART
RL4
Run 17
159.2 - 169.2
C10 R9.8


Oil Shale with Marlstone interbeds
LHG PROJECT COLOR CHART
RL4
Run 17
159.2 - 169.2
C10 R9.8

Attachment B

July 11, 2012
DWQ Memo by Mark Novak
"Field Reconnaissance of Rocks Underlying the site of Proposed Southwest #1 Mine"

State of Utah
GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

MEMORANDUM

TO: Red Leaf Resources ground water discharge permit file

FROM: Mark Novak

DATE: July 11, 2012

SUBJECT: Field Reconnaissance of Rocks Underlying the Site of Proposed Southwest #1 Mine

Comments: Mike Vandenberg of the Utah Geological Survey, Rob Herbert and I examined rocks that stratigraphically underlie the Mahogany Zone oil shales at the site of Red Leaf Resources' proposed Southwest #1 Mine in Section 30, T. 13 S., R .23 E., SLBM, Uintah County, Utah. All rocks exposed in this area are contained in the Tertiary Green River Formation.

A generalized stratigraphic column of the proposed mine area is shown in Figure 1 (Figure 5 from Red Leaf's ground water discharge permit application). Planned production from the mine is entirely oil shales of the Mahogany Zone, contained in a stratigraphic thickness of approximately 70 feet. Approximate locations of the photos described below are shown on Figure 2 (from Figure 1 of Red Leaf's Notice of Intent to Commence Large Mining Operations). The strata near the Mahogany Marker (a volcanic ash horizon within the Mahogany Zone) are exposed near Red Leaf's current test facility, shown in Photo 1. Oil shale in this horizon is a hard, competent fine-grained rock with minor fracturing. The ponded water shown in Photo 1 has been there since the excavation was made about a year ago, and has not seeped into the underlying rock.

We examined the rocks underlying the Mahogany Zone, exposed to the east of Red Leaf's test facility, to evaluate their potential to contain aquifers or to transmit water downwards from the future mined area. The green line on Figure 2 represents the Mahogany Bed outcrop, the richest oil shale unit within the Mahogany Zone. Rock strata in this area dip 1 to 3 degrees to the north.

At the base of the Mahogany Zone is a stratum referred to as the B Groove. The outcrop of this unit that we examined is shown in Photo 2. At this site the B Groove strata consist of thinly laminated and fissile dolomitic mudstone. Some vertical fractures are present

The B Groove strata are underlain by oil shale as shown in photo 3. No significant fracturing is seen in these strata at this location. Photo 4 shows black organic-rich oil shale on freshly-exposed surfaces, contrasting with the white weathered surface.

195 North 1460 West • Salt Lake City, UT
Mailing Address: P.O. Box 144870 • Salt Lake City, UT 84114-4870
Telephone (801) 536-4300 • Fax (801) 536-4301 • T.D.D. (801) 536-4414
www.deq.utah.gov

Photo 5 shows the first thin, sandy carbonate bed encountered below the B Groove and the shales and oil shales that underlie it. This unit is identified as the top of the Douglas Creek Member of the Green River Formation in Red Leaf's documents (prepared by JBR Environmental Consultants). The boundary between the Parachute Creek Member and the Douglas Creek Member is transitional, however, and JBR's interpretation may differ from others in the literature.

The sandy carbonate strata (tan-colored rocks at the top of the outcrop in Photo 4) are thinly bedded and well-cemented. Fracturing seems to be isolated in certain zones less than 10 feet thick, as opposed to extensive deep vertical fractures. The sandy carbonate is underlain by shale and oil shale (light-colored underlying strata).

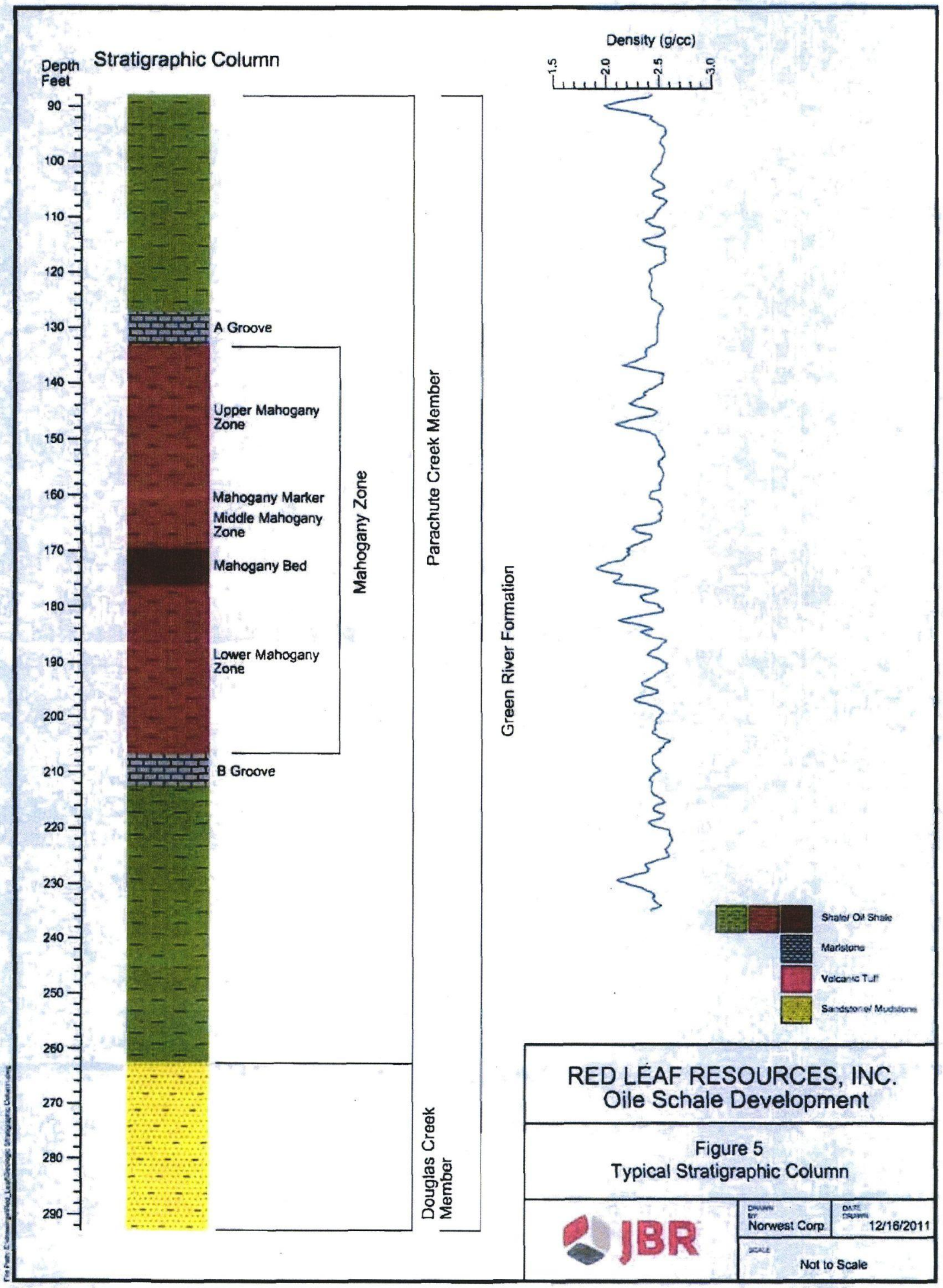
Interpretation

Examination of the strata underlying the Mahogany Zone shows that they are predominantly fine-grained sedimentary rocks with very low permeability. The presence of hydrocarbons immediately below the rock's thin weathered surface indicates that water does not penetrate these fine-grained rocks very deeply. Fracturing is not extensive nor interconnected enough to enhance secondary permeability.

As shown in Photo 5, the boundary between the Parachute Creek and Douglas Creek Members of the Green River Formation is transitional. The "sands" of the transition zone (starting in the R-6 rich oil shale zone, roughly 50 to 60 feet below the Mahogany Zone) start as thin (less than 3 feet thick) sandy carbonates with very low permeability interbedded with low-permeability shales and oil shales. With increasing depth (450 to 600 feet below the Mahogany Zone), these "sandy" units consist of more sand and less carbonate, increasing their permeability and porosity and their potential to hold water. They also thicken with depth. Any aquifers in the Douglas Creek Member underlying the mine site are hydraulically isolated from water originating as precipitation falling on the future mine workings by the underlying low-permeability shales and rocks of the transition zone.

Oil shale and shale in the Parachute Creek Member originated as fine-grained sediments deposited in a deep-lake environment, referred to as the profundal facies. Because these sediments were deposited far from the ancient lake shore in a deep-water, low-energy environment, there will not be significant lateral variation in their composition in areas where they are present, such as the proposed mine site. Therefore, low-permeability shales should underlie the Mahogany Zone across the entire mine site. In contrast, sediments that formed the Douglas Creek Member were deposited in shallow-water, near-shore environments such as beaches, lagoons, stream channels and flood plains, referred to as the littoral facies, and individual sandstone and shale units may be of limited lateral extent.

Figure 1



Depth Feet
Stratigraphic Column
Density (g/cc)
1.5
2.0
2.5
3.0
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
Douglas Creek Member
Green River Formation
Shale/ Oil Shale
Marlstone
Volcanic Tuff
Sandstone/ Mudstone
RED LEAF RESOURCES, INC.
Oile Schale Development
Figure 5
Typical Stratigraphic Column
JBR
Norwest Corp.
12/16/2011
Not to Scale

Figure 2. Approximate Locations of Photos

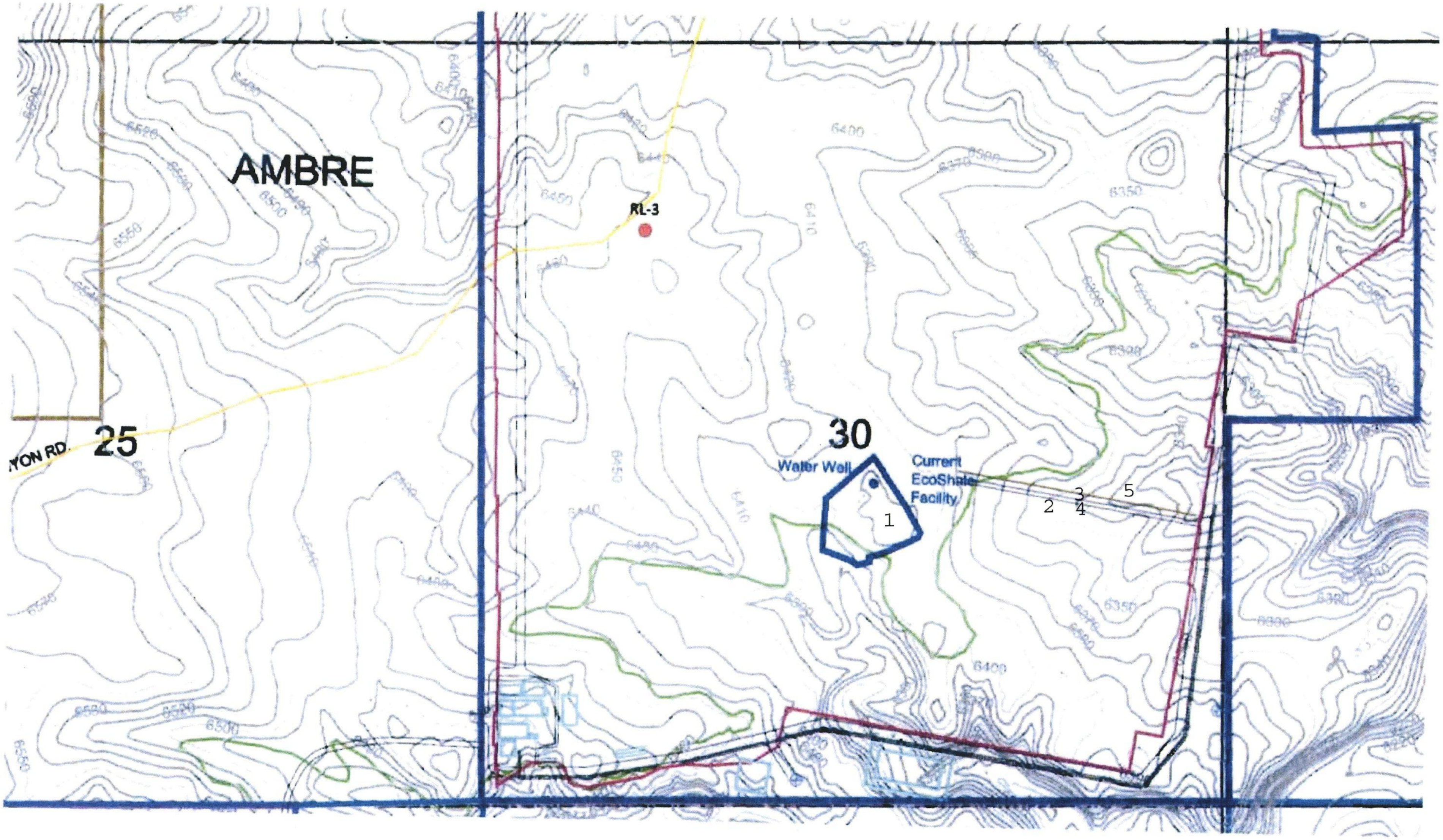



Photo 1

Photo 2


Photo 3


Photo 4

Photo 5

Attachment C

May 30, 2013
Tech Memo from R.J. Bayer to Jay Vance on
"Assessment of the Capacity of the EPS Capsule for absorption and Retention of HELP-predicted Infiltration"

Robert J. Bayer, Professional Geologist, LC.
8842 Shady Meadow Drive
Sandy, UT 84093
Email: bob@rjbayerpgeo.com
O: 801-561-4286
C: 801-560-9709

TECHNICAL MEMORANDUM

To: Jay Vance

From: R. J. Bayer

Date: May 30, 2013

Project: Red Leaf Resources

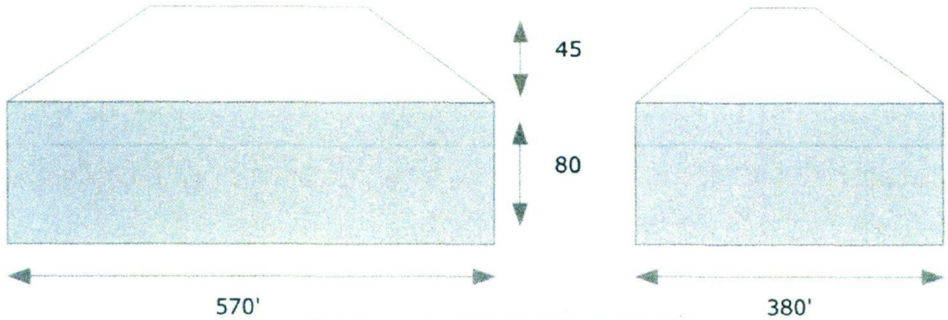
Subject: Assessment of the Capacity of the EPS Capsule for Absorption and Retention of HELP-predicted Infiltration

At the request of Mark Novak with the Utah Division of Water Quality, I have estimated the capacity of the EPS capsule to retain water predicted to infiltrate on an annual basis by the Hydrologic Evaluation of Landfill Performance (HELP) model. The model was run by Norwest Corporation for the commercial-scale production capsules, included within Red Leaf Resource's (RLR) Notice of Intent (NOI) to Commence Large Mining Operations at Seep Ridge approved by the Utah Division of Oil Gas and Mining (DOGM). All roof design alternatives for the EPS capsule include the 3-foot BAS layer with the same design properties (compacted in lifts to a permeability of $\leq 1 \times 10^{-7}$ cm/sec) for purposes of infiltration prevention, as does the BAS roof for the commercial-scale capsules approved by DOGM.

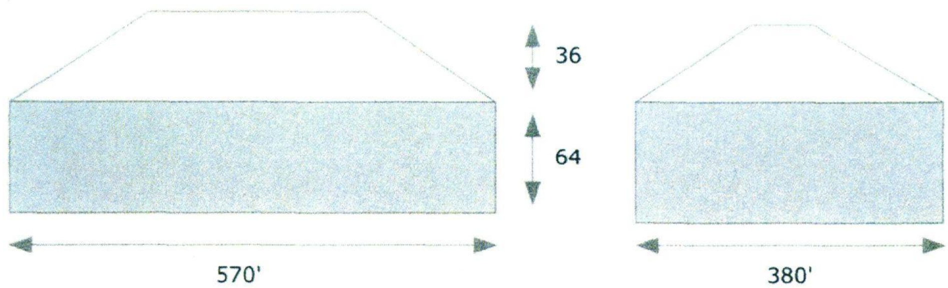
The EPS capsule has a design height of from 65 feet at the margins to 90 feet at the center. In cross section the basal part is rectangular with dimensions of 380 feet by 570 feet by 65 feet high. The upper part of the capsule has a trapezoidal cross section with a height of 25 feet.

Following settlement as the result of volume loss during heating and petroleum product removal, the height of the capsule is anticipated to be reduced by 20 percent. This settlement estimate is somewhat less than was anticipated when the DOGM was submitted and is based on new data and additional design and modeling that has occurred since the NOI was submitted to DOGM in 2011.

The schematics below shows the EPS capsule in long and cross sections both at full construction height and after settlement.



EPS Capsule Long and Cross Section
Constructed Dimensions (not to scale)
Thicknesses show ore only



EPS Capsule Long and Cross Section
Settled Dimensions (not to scale)
Thicknesses show ore only

At total volume reduction of 20% would follow the predicted decrease in capsule height. The Norwest HELP model evaluation predicted that the upper BAS roof layer would allow 0.16 inches (0.13 feet) of meteoric water infiltrate through it annually.

The approach to assessing the time required for the entire EPS capsule to reach field capacity had 2 components: 1) selection of a field capacity assumption for the capsule based on the lowest value available from the literature reviewed, 1 inch per foot of material (Ward and Trimble, 2003); 2) the absorptive capacity of the spent shale as determined by laboratory testing done at RLR's laboratory, which was measured at 11.3 percent. Absorption of infiltrating water in the spent shale is presumed to occur gradually and to be substantially complete by the time field capacity is reached.

The field capacity assumed was for sand. The texture of the spent shale following collapse is anticipated to consist of a somewhat graded mixture of grains from coarse sand to cobble-size or larger. Although the literature does not appear to contain data on field capacity for such a material, the selected field capacity of 1 inch per foot of material (0.083 percent) is believed to be a reasonable and conservative estimate based on scientific judgment.

The laboratory-measured absorptive capacity of the soil was reduced by 10 percent (to 10.2 percent) in order to be conservative. Because of the slow rate of infiltration and the unsaturated flow that will occur over the variably sized particle surfaces in the spent shale, absorption is anticipated to be effective in retaining infiltrating water.

A highly conservative estimate of the time over which field capacity would be reached in the EPS capsule was made considering <u>only</u> the lower rectangular, post-settlement part of the capsule. The following additional assumptions were applied:

- Settled ore thickness for the rectangular part of the capsule is 64 feet:
- Only the capacity of the ore itself to retain water has been considered;
- Absorption rate is equal to infiltration rate through roof BAS;
- The capacity of the upper trapezoidal part of the capsule to retain water was not considered.

The assumptions for field capacity (10 percent) and absorptive capacity (of the spent shale 0.083 percent) discussed above were also applied.

The time necessary for only the lower part of the EPS capsule to reach field capacity was calculated as follows.

Water retention capacity, X (ft) = (adjusted absorption capacity + field capacity) x capsule thickness (ft)

Or

X = (10.2% + 8.3%) x 64 = 11.84 ft.

At 0.13 feet per year of infiltration and 11.84 feet of retention capacity:

0.13 ft/yr x 11.84 ft = 911 years

Attachment D

November 6, 2013
Tech Memo from R.J. Bayer to Jay Vance on
"Supplemental Information Regarding Seeps and Springs"

Robert J. Bayer, Professional Geologist, LC.
8842 Shady Meadow Drive
Sandy, UT 84093
Email (temporary) rjbayer826@gmail.com

TECHNICAL MEMORANDUM

To: Jay Vance

From: R. J. Bayer

Date: November 6, 2013

Project: Red Leaf Resources Southwest #1 Project

Subject: Supplemental Information Regarding Seeps and Springs

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This memo is intended to describe the origin of the seeps and springs identified by JBR Environmental Consultants, Inc. (JBR) in two surveys carried out in the fall of 2012 and the spring of 2013. The survey boundary was established by me and I provided oversight for both surveys. I visited the seeps and springs in Klondike Canyon in May 2013 during the second of the two surveys. This memo is intended to address questions brought by Living Rivers regarding the origin of the seeps and springs.

The JBR Seep and Spring reports state that the springs occur in the Parachute Creek Member; however, this statement refers to the bedrock formation in which or over which the springs or seeps occur. The Ground Water Discharge Permit Application (GWDPA), on page 23 states the following:

> The observed geological occurrence of the single spring and most seeps was discharging or potentially discharging stream bed material, which was comprised of alluvium, residuum or both.

This statement is based on my observations during the May 2013 survey. I visited the observed seeps and springs in Klondike Canyon and the above statement is based on those observations. The "aquifer" from which the Klondike Canyon seeps and springs discharge is the alluvial and residuum fill in the canyon bottoms. Klondike Canyon is part of a large, incised watershed as shown on the on USGS topographic maps and maps provided in the GWDPA. The springs observed in the canyon discharge from alluvial deposits on the canyon floor at places where alluvium has been scoured, bedrock is exposed, and temporary surface flow occurs in the stream bed. After alluvium again fills the channel downstream, flow resumes in the subsurface.

The seeps and springs in Reservoir Canyon discharge from alluvium as do those in Klondike Canyon. The smaller watershed area of Reservoir Canyon is unusual for the area. The upper main channel and all tributaries to the canyon contain thick (up to 10 or more feet) deposits of very porous and permeable unconsolidated sediments that are likely of aeolian and alluvial origin. Channel development in these sediment-filled drainages is intermittent and most flow has to be subsurface probably along the underlying bedrock surface. Examining the USGS topo sheet (Bates Knolls 7.5 minute) one notes that unlike tributaries in all of the adjacent watersheds, these tributary drainages are not incised. Having examined these drainages, I have observed that their channel morphology is predominantly broad swales with occasional gully formation resulting from down-cutting in these thick unconsolidated deposits. Bedrock exposures in these tributary drainages are limited in the upper most reaches where the unconsolidated sediments occur. These porous sediments undoubtedly collect most of the precipitation that falls in the watershed area and store it, allowing it to release slowly as seeps or springs from the alluvial fill in the lower reach of Reservoir Canyon.