

STATE OF UTAH  
DEPARTMENT OF ENVIRONMENTAL QUALITY  
DIVISION OF WATER QUALITY  
SALT LAKE CITY, UTAH 84114-4870

**Ground Water Discharge Permit  
Permit No. UGW470002**

In compliance with the provisions of the Utah Water Quality Act, title 19, Chapter 5, Utah Code Annotated 1953, as amended, the Act,

**Red Leaf Resources, Inc.  
10808 River Front Parkway, Suite 200  
South Jordan, Utah 84095-5956**

is granted a Ground Water Quality Discharge Permit for the operation of an oil shale mine and an Early Production System capsule for extraction of hydrocarbons in Uintah County, Utah.

The facility is located in the SE ¼ of Section 30, T. 13 S., R. 23 E., Salt Lake Base and Meridian.

This permit is based on representations made by the permittee and other information contained in the administrative record. It is the responsibility of the permittee to read and understand all provisions of this permit.

The facility shall be constructed and operated in accordance with the conditions set forth in the ground water discharge permit and the construction permit of \_\_\_\_\_, 2013 and the Utah Ground Water Quality Protection Rules (UAC R317-6).

This permit shall become effective on \_\_\_\_\_, 2013.

The permit and authorization to operate shall expire on \_\_\_\_\_, 2018.

\_\_\_\_\_  
Walter L. Baker, P.E.  
Director

**I. SPECIFIC PERMIT CONDITIONS**

**A. Ground Water Classification**

Based on available data, the uppermost ground water underlying the mine site is Class IV (R317-6-3(3.7) Total Dissolved Solids (TDS) greater than 10,000 mg/L). Ground water in the Douglas Creek aquifer encountered by Red Leaf Resources' water supply well, originating from depths of 600 to 800 feet below ground surface, is Class II (R317-6-3(3.5) TDS greater than 500, but less than 3,000 mg/L).

**B. Background Ground Water Quality**

Ground water quality in saturated zones contained in rocks within and above the oil shales of the Mahogany Zone, the ore zone for this mine, is shown in analyses listed in Appendix F of Red Leaf Resources' March, 2013 ground water discharge application (DWQ-2013-002069). Ground water quality in the deeper Douglas Creek aquifer tapped by Red Leaf Resources' water supply well is shown in the Driller's Log and Water Analysis, DWQ-2013-002069.

**C. Ground Water Protection Levels**

Ground water monitoring is not feasible at this site due to the very low permeability of the shales that underlie it, therefore ground water protection levels will not be established for this permit. Compliance with the Ground Water Quality Protection Regulations will be demonstrated by source monitoring. The monitoring requirements specified in Part I(E) below will allow DWQ to determine if any potential discharge to subsurface or waters of the State may result from large-scale production at the mine.

**D. Best Available Technology (BAT) Standard**

1. Authorized Construction

Construction for this phase of the project will consist of one Early Production System (EPS) capsule using a preliminary Eco-Shale capsule design, of approximately 75% the size of capsules planned for eventual commercial production. Red Leaf also intends to use this EPS capsule to evaluate design features related to waste containment. Information gained from studies of technical, economic and environmental aspects of this EPS capsule will be used to develop a final design for the production capsules. Red Leaf shall apply for a major modification of this permit, and report the results of studies on the EPS capsule related to ground water protection, to obtain DWQ approval for the construction of production capsules.

2. Design and Construction

The authorized facilities will be constructed in accordance with the engineering design plans and specifications approved by the Construction Permit issued by the Director.

Capsule construction elements include:

- a. Subgrade preparation: Overburden and ore will be removed from the mine pit area to prepare a bedrock surface as a foundation for the capsule. The prepared surface will slope towards fluid collection points on the north side of the capsule. Six channels will be dug into bedrock on the north side of the capsule to conduct heating and product piping from the capsule to the adjacent facilities for heating, product condensing and storage, and to allow pipe penetrations through the lower liner of the capsule by means of a bulkhead installed over the tunnel, beneath the lower liner and insulating layer of the capsule. The channels will be covered with precast concrete slabs.
- b. Lower liner: A layer of bentonite-amended shale (BAS) will be placed on the bedrock surface and compacted to construct a liner with saturated hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec or less, with a thickness of three feet. (All other BAS liners in the capsule will be constructed to this standard.) A flexible membrane liner (FML) may be installed above the BAS liner to insure recoverability of the product and prevent loss of liquid product to the lower BAS liner. BAS floor dimensions for the EPS capsule will be approximately 385 feet by 695 feet; production capsules are anticipated to have dimensions of 500 by 900 feet. A layer of well-graded 1-inch minus road-base material will be placed on top of the BAS liner.
- c. Lower liner penetrations: Vertical penetrations containing the heating and product recovery piping will be installed through a reinforced steel bulkhead at the base of the lower liner. The BAS liner will overlap the bulkhead creating a seal.
- d. Liquids collection pan: A steel liquids-collection pan will be installed on top of engineered, insulating fill overlying the BAS. The steel pan will direct the liberated petroleum liquids to a collection system and prevent loss of oil to the underlying liner or to the environment. The pan is sloped northward to direct liquids to a collection trough and from there to vertical delivery pipes that penetrate the lower liner through the bulkhead on the north side of the capsule. The pipes then lead out of the capsule area through the six covered channels cut into the bedrock.

- e. Insulating “rind”: an additional layer of appropriately-sized gravel derived from mine overburden and interburden or other earthen material that meets the necessary insulating/thermal barrier requirements will be placed on top of the metal pan to insulate the BAS liner from heat used to retort the shale. As the capsule is constructed, this layer and the BAS liner will be placed vertically to enclose the ore on the sides, and the insulating layer and BAS liner will also be placed on top of the ore to completely enclose it.
  
- f. Main capsule construction: 100 to 160 feet of run-of-mine oil shale ore will be stacked on top of the insulating layer. At the same time the ore is placed, insulating layers and a BAS liner will be installed vertically along the sides of the ore, connected with these same layers at the bottom of the capsule. All sides of the EPS capsule will be buttressed by engineered fill, placed at a slope of 1.5H:1V. Corrugated heating pipes will be placed within the stacked ore, and vapor recovery pipes will be installed in the upper part of the capsule. These pipes will enter and exit the capsule through the bulkheads installed through the lower BAS liner. A FML may be installed along the capsule sides for product containment but will not be incorporated into the BAS side wall.
  
- f. Capsule top layers: Significant compaction of the oil shale ore is anticipated both during placement and retorting. To accommodate this compaction and maintain integrity of the upper BAS liner, the upper portion of the capsule will be designed to have a pitched cover surface. An insulating layer will be placed over the upper surface of the ore, connected to the side insulating layers to complete the “rind” surrounding the stacked ore. A top BAS liner will be constructed over the insulating layer and will be joined to the vertical side BAS liners with a sloped “knuckle” structure. The top BAS liner will be covered with 4 to 15 feet of overburden/interburden material to maintain compressive stress on the liner. This surface will be covered with 6 to 12 inches of topsoil or a topsoil substitute to begin reclamation.
  
- g. Functional equivalent top layer design: Because Red Leaf intends to evaluate different designs by construction of the EPS capsule, in lieu of or in addition to the use for BAS for the operational cover layer, a FML may be used to prevent infiltration of precipitation-derived water and containment of product during operations. If the membrane is used alone, a 3-foot BAS cap will be installed over the capsule surface following settlement and cooling. The cap will meet the standards for compaction and permeability established for the other BAS layers in the capsule.

## E. Compliance Monitoring Requirements

Beginning six months after shutdown of retorting operations in the EPS capsule, Red Leaf will monitor drainage from the metal collection pan, the top of the lower BAS liner, and the six tunnels that lead to the liner penetration bulkheads semi-annually for water or liquid hydrocarbons discharging from the capsule. If any water is found in quantities large enough to obtain a sample for analysis, Red Leaf shall sample this water and analyze it for the contaminants of concern for surface water quality listed below, petroleum-related parameters listed in Part I.F, and any other constituents that may be identified by DWQ following the SPLP analysis of spent shale required in Part I.G.2, below. Required analyses for additional compounds identified by SPLP analysis of the spent shale will be specified by DWQ after review of analytical results. Results from these analyses shall be reported to DWQ.

Liquid hydrocarbons draining from the metal collection pan may not be discharged to the environment. If water discharges from the pan it must be contained until a disposal method is approved by DWQ. Analyses required in this section are intended to help DWQ determine appropriate disposal methods for any water that may discharge from the capsule.

Surface water parameters:

TDS	Nitrate	pH
Total Phosphorus	Boron	Temperature
Arsenic	Selenium	

This permit does not authorize discharge of waters impacted by surface or subsurface operations to surface water or place any materials where there is probable cause to believe it will cause pollution.

## F. Reporting Requirements

Red Leaf will notify DWQ of the date when heating pipes in the EPS capsule are shut down. Six months from that date and continuing on a semi-annual schedule for the term of this permit, Red Leaf will begin monitoring for the presence of liquid hydrocarbons and water discharging from the pipes that drain the metal liquids collection pan, the top of the lower BAS liner, and the weep holes installed in the six tunnels leading to the liner penetration bulkheads. Beginning six months after shut down of heating, Red Leaf shall report any quantities of water draining from these points during the preceding six-month period. Beginning one year after shut down of heating, Red Leaf shall report the quantities of liquid hydrocarbons draining from these points during the previous six-month period.

If water drains from any of these points in a quantity large enough to obtain a sample for analysis, Red Leaf shall analyze it for parameters of concern for surface water listed in Part I.E, above, as well as the petroleum parameters benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), Total Petroleum Hydrocarbons- Gasoline Range Organics (TPH-GRO), Total Petroleum Hydrocarbons- Diesel Range Organics (TPH-DRO) and Total Recoverable Petroleum Hydrocarbons (TRPH). Analysis for additional parameters may be required by DWQ following SPLP analysis of spent shale required in Part I.G.2, below.

Reports shall be submitted semi-annually to DWQ within 90 days of the date of observation of the pipes draining the liquids collection pan.

## **G. Compliance Schedule**

### **1. Sampling and Analysis Plan**

No later than the date that heating pipes in the capsule are shut down, Red Leaf shall submit for DWQ approval a Sampling and Analysis Plan for monitoring drainage from the liquids collection pan as required by this permit. The plan will list locations to be monitored and sampled, methods to determine the quantities of liquid hydrocarbons and water that have drained from the pan in the six month period prior to monitoring events, sampling procedures and analytical methods to be used for the parameters required by this permit. Analytical methods must have detection limits less than or equal to the ground water standards in Table 1 of UAC R317-6-2.

### **2. Analysis of Spent Shale and Waste Rock**

After closure and sufficient cooling of the EPS capsule, Red Leaf shall obtain representative samples of the spent shale (including residual hydrocarbons) and also of the waste rock that will be left in place underneath the layer of topsoil or other growth medium used for final site reclamation. The samples shall be used for the Synthetic Precipitation Leaching Procedure extraction, and the extract analyzed for the following parameters:

General Chemistry: pH, total dissolved solids (TDS), major ions (Na, K, Mg, Ca, Cl, SO<sub>4</sub>, alkalinity), F, Sr, OH, nitrate+nitrite (as N), total organic carbon;

Metals from Table 1 of UAC R317-6: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium and zinc; and

Petroleum-related parameters: benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), total petroleum hydrocarbons- gasoline range organics (TPH-GRO), total petroleum hydrocarbons- diesel range organics (TPH-DRO) and total recoverable petroleum hydrocarbons (TRPH).

Red Leaf shall submit a plan for conducting this study for DWQ approval at least 90 days before the anticipated start of the study. Results of these SPLP analyses must be reported in Red Leaf's application to revise this permit.

### **3. Evaluation of Upper BAS Liner Performance and Hydrologic Properties of Spent Shale**

Following closure of the EPS capsule, Red Leaf shall evaluate the saturated hydraulic conductivity of the upper BAS liner. If sections of the liner were designed or constructed differently, hydraulic conductivity should be evaluated for each section of the liner. If a section of the liner has BAS that was installed before retorting and capsule compaction, hydraulic conductivity shall be evaluated in a place on the liner that has undergone the most mechanical strain during compaction. Red Leaf shall also evaluate the hydrologic properties of the spent shale from the EPS capsule, particularly field capacity and initial

moisture content. Using values for hydrologic properties measured on the closed EPS capsule, Red Leaf shall model water flow through all sections of the upper liner into the capsule using the Hydrologic Evaluation of Landfill Performance model or a similar model. Red Leaf shall also evaluate the quantity of water that would be needed to bring the EPS capsule's content to field capacity, and estimate the time this would take.

Red Leaf must specify the liner design to be used for production capsules, and perform similar modeling as required for the EPS capsule to estimate the quantity of water and time needed to bring a production capsule's contents to field capacity, assuming similar hydrologic properties of the materials.

Red Leaf shall submit a plan for conducting this study for DWQ approval at least 90 days before the anticipated start of the study. Results of this study must be reported in Red Leaf's application to revise this permit.

4. Reclamation Plan

Incorporating information from studies of the EPS capsule as required in Parts I.G.2 and I.G.3, above, Red Leaf shall propose reclamation plans for the EPS capsule and for future capsules for commercial production that are protective of ground water quality according to the provisions of UAC R317-6, and also protective of other waters of the state. This reclamation plan shall be included as part of Red Leaf's application to modify this permit.

**H. Requirement to Modify Permit Before Going into Production**

Prior to full scale production and operation Red Leaf shall modify the existing permit based on the results and reports provided from the EPS. The permit modification will be subject to the public notice and comment requirements of R317-6-6(6.5), a minimum of 30 days to comment on the permit modification and notice in a newspaper.

## **II. MONITORING, RECORDING AND REPORTING REQUIREMENTS**

### **A. Representative Sampling**

Samples taken in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity.

### **B. Analytical Procedures**

Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3.L, unless other test procedures have been specified in this permit.

### **C. Penalties for Tampering**

The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

### **D. Reporting of Monitoring Results**

Monitoring results obtained during each reporting period specified in the permit, shall be submitted to the Director, Utah Division of Water Quality at the following address no later than the 15th day of the month following the completed reporting period:

State of Utah  
Division of Water Quality  
P.O. Box 144870  
Salt Lake City, Utah 84114-4870  
Attention: Ground Water Protection Section

### **E. Compliance Schedules**

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

### **F. Additional Monitoring by the Permittee**

If the permittee monitors any pollutant more frequently than required by this permit, using approved test procedures as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

### **G. Records Contents**

Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

**H. Retention of Records**

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

**I. Twenty-four Hour Notice of Noncompliance Reporting**

1. The permittee shall verbally report any noncompliance which may endanger public health or the environment as soon as possible, but no later than 24 hours from the time the permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24 hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 536-4300, during normal business hours (Monday through Thursday 7:00 am - 6:00 pm Mountain Time).
2. A written submission shall also be provided to the Director within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:
  - a. A description of the noncompliance and its cause;
  - b. The period of noncompliance, including exact dates and times;
  - c. The estimated time noncompliance is expected to continue if it has not been corrected; and,
  - d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.
3. Reports shall be submitted to the addresses in Part II.D, Reporting of Monitoring Results.

**J. Other Noncompliance Reporting**

Instances of noncompliance not required to be reported within 24 hours, shall be reported at the time that monitoring reports for Part II.D are submitted.

**K. Inspection and Entry**

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,
4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

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**III. COMPLIANCE RESPONSIBILITIES**

**A. Duty to Comply**

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

**B. Penalties for Violations of Permit Conditions**

The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed \$10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding \$25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding \$50,000 per day. Nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

**C. Need to Halt or Reduce Activity not a Defense**

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

**D. Duty to Mitigate**

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

**E. Proper Operation and Maintenance**

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

#### **IV. GENERAL REQUIREMENTS**

##### **A. Planned Changes**

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

##### **B. Anticipated Noncompliance**

The permittee shall give advance notice of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

##### **C. Permit Actions**

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

##### **D. Duty to Reapply**

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this permit.

##### **E. Duty to Provide Information**

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

##### **F. Other Information**

When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Director, it shall promptly submit such facts or information.

##### **G. Signatory Requirements**

All applications, reports or information submitted to the Director shall be signed and certified.

1. All permit applications shall be signed as follows:
  - a. For a corporation: by a responsible corporate officer;
  - b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.
  - c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
  - a. The authorization is made in writing by a person described above and submitted to the Director, and,
  - b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)
3. Changes to Authorization. If an authorization under Part IV.G.2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part IV.G.2 must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.
4. Certification. Any person signing a document under this section shall make the following certification:

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

**H. Penalties for Falsification of Reports**

The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

**I. Availability of Reports**

Except for data determined to be confidential by the permittee, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Director. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

**J. Property Rights**

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

**K. Severability**

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

**L. Transfers**

This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date;
2. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,
3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

**M. State Laws**

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by Section 19-5-117 of the Act.

**N. Reopener Provision**

This permit may be reopened and modified (following proper administrative procedures) to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. If new ground water standards are adopted by the Board, the permit may be reopened and modified to extend the terms of the permit or to include pollutants covered by new standards. The permittee may apply for a variance under the conditions outlined in R317-6-6.4.D.
2. If alternative compliance mechanisms are required.
3. If subsequent ground water monitoring data reveals the background water quality values in Part I Table 1 are not accurate.