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ABBREVIATIONS AND ACRONYMS

$[UO_2(CO_3)_2]^{-2}$	uranyl dicarbonate ion
$[UO_2(CO_3)_3]^{-4}$	uranyl tricarbonate ion
°F	degrees Fahrenheit
BLM	Bureau of Land Management
DOT	Department of Transportation
EPA	Environmental Protection Agency
ft	feet
ft bgs	feet below ground surface
FWS	Fish and Wildlife Service
g/L	grams per liter
gpm	gallons per minute
GPS	Global Positioning System
HDPE	high-density polyethylene
ISR	In Situ Recovery
LC ISR, LLC	Lost Creek ISR, LLC
LQD	Land Quality Division
MIT	mechanical integrity test
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
Permit Area	Lost Creek Permit Area
Plant	Lost Creek Plant
PPE	personal protective equipment
ppm	parts per million
Project	Lost Creek Project
psi	pounds per square inch
psig	pound-force per square inch gauge
RO	reverse osmosis
RWP	Radiation Work Permit
SDR	standard dimension ratio
SOP	standard operating procedure
SWPPP	Storm Water Pollution Prevention Plan
U_3O_8	uranium oxide
UCL	Upper Control Limit
UIC	Underground Injection Control
US	United States
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WSEO	Wyoming State Engineer's Office
WQD	Water Quality Division
WYPDES	Wyoming Pollution Discharge Elimination System

OPERATIONS PLAN

Lost Creek ISR, LLC (LC ISR, LLC) has prepared this Operations Plan (OP) for the Wyoming Department of Environmental Quality (WDEQ) in support of a permit to conduct In Situ Recovery (ISR) of uranium in Sweetwater County, Wyoming. The Lost Creek Project (Project) will use existing ISR technology and best industry practices to extract uranium from permeable, uranium-bearing sandstones, located at depths ranging from 300 to 700 feet below surface, through a series of mine units. Each mine unit consists of a "pattern" of production and injection wells, ringed by monitor wells. Once extracted from a mine unit, the uranium will be recovered by means of ion exchange, using commercially available anionic resin, and prepared for shipment as uranium oxide (U_3O_8) "yellowcake" slurry to a facility licensed to process the slurry into dry yellowcake.

OP 1.0 OVERVIEW OF PROPOSED OPERATION

The Lost Creek Permit Area (Permit Area) contains approximately 4,254 acres (**Figure OP-1**). Within that area, the surface to be affected by the ISR operation will total approximately 324 acres (**Figure OP-2a**), following the ore trend which extends east-west through the Permit Area (**Figure OP-2b**). The mine units, the Lost Creek Plant (Plant), the Storage Ponds, and the disposal wells, which are described in more detail below, are the significant surface features associated with the ISR operation. An illustration of a typical ISR operation, such as the Lost Creek Project, is shown on **Figure OP-3a**, and an illustration of a mine unit is shown on **Figure OP-3b**.

The Project requires the preparation, construction, and operation of the following:

- the access roads/utility corridors, including pipelines connecting the mine units to the Plant;
- the Plant, which includes the ion exchange facility and other processing circuits, the shop, the laboratory, storage areas, fuel tanks, the offices, possible living quarters, and parking;
- the Storage Ponds, which will be used in conjunction with the Underground Injection Control (UIC) Class I wells for waste water disposal, located adjacent to the Plant;
- UIC Class I wells; and
- the mine units, which include the header houses, through which fluids are routed to/from the injection/production well patterns, and the monitor wells, including those which ring the pattern area and those in overlying and underlying aquifers.

Site preparation, construction, and operations of the Project will be conducted such that potential environmental effects will be minimized to the greatest extent possible. The measures that will be taken during initial site development and for general maintenance throughout the Project are described in **Section OP 2.0**.

The details of the mine units, well construction, and instrumentation and control are provided in **Section OP 3.0**. The ISR process will be conducted using a carbonate lixiviant, which is pumped from the Plant through buried pipelines to the injection wells in the operational mine unit(s). After circulation through the production zone from the injection wells to the production wells, the lixiviant recovered from the production wells will be pumped from the mine unit(s) through buried pipelines to the ion exchange circuit in the Plant. There, the uranium will be removed by solid resin ion exchange. The carbonate lixiviant will then be regenerated and pumped back to the mine units to recover additional uranium.

Information on the Plant is provided in **Section OP 4.0**. The Plant will house three distinct process circuits: the ion exchange circuit (also called the resin-loading circuit), the elution circuit, and the precipitation/filtration circuit. The final product will be yellowcake slurry with about 40 percent of water by volume. The slurry will be transported from the site via United States (US) Department of Transportation (DOT) approved containers to a facility licensed by the US Nuclear Regulatory Commission (NRC) or an Agreement State for processing the slurry into dry yellowcake.

Effluent control measures that will be used during the Project are described in **Section OP 5.0**. Surface reclamation and groundwater restoration are described in the Reclamation Plan (RP), which is a separate portion of this application.

OP 1.1 Site Facilities Layout

The approximate location of the Permit Area within the general region is shown in **Figure OP-1**. The Plant will be located in the north-central portion of the Permit Area in Section 18, Township 25 North, Range 92 West. It will include all the process circuits, the groundwater restoration facility, administration offices, and shop facilities. A plan view of the Plant is included in **Plate OP-1**. The Storage Ponds are adjacent to the Plant site, as shown on **Plates OP-1** and **OP-2**. The mine units will be along an east-west trend through the Permit Area (**Figures OP-2a** and **OP-2b**). The locations of the five UIC Class I wells are widely scattered, as shown on **Plate OP-1**, to accommodate regulatory requirements and meet the necessary injection criteria .

The Plant will be one of the first features constructed in the Permit Area. The primary access road and associated culverts will be constructed when the Plant is built; and the secondary access roads and associated culverts for each mine unit will be constructed prior to and during installation of that mine unit. Secondary access roads and associated culverts for the UIC Class I wells will be constructed prior to installation of those wells. Road design features are shown on **Figure OP-3c** and discussed in more detail in **Section OP 2.6**.

Electrical power will be brought into the site, through an overhead line, from the transmission line located directly west of the site. The overhead line will branch out to transformer poles located throughout the mine units and at the Plant. The overhead power lines will continue from the transformer poles to the service point at the header houses.

All power lines to the point of transform from 34,500 volts to 480 volts will be overhead lines built compliant to regional raptor specifications. After transform, lines will be installed per the National Electrical Code 2008 Handbook (Earley et al., 2008). Specifically, Table 300.5 in the Handbook details the depth of burial and Article 340, Section II, 340.10, (1) specifies the use of Type UF (Underground Feed) cable for direct burial.

LC ISR, LLC plans to use direct burial cable as allowed in the NEC 2008 Handbook to deliver power to the header house and to the production wells as needed. From the header houses to the production wells, power will be transmitted through underground lines that will be located along the same corridors as the pipelines for fluid transmission to and from the wells.

Three mine units are currently planned for the Lost Creek Project, as shown on **Figure OP-2a** and **Plate OP-1**. The boundaries of each mine unit are considered conceptual until a more detailed 'mine unit package' is prepared for that mine unit and submitted to WDEQ-Land Quality Division (LQD). Each mine unit will consist of a reserve block covering about 100 acres, with about twenty-two header houses. Each header house will be designed to accommodate the well controls and distribution plumbing for approximately twenty production wells and the associated injection wells (usually about 40 injection wells). Therefore, each mine unit will consist of about 1,320 wells. Typically, one or two mine units may be in production at any one time with additional mine units in various states of development and/or restoration.

OP 1.2 Ore Deposits

As described in **Appendix D5** of this permit, the ore deposits in the Permit Area generally occur at depths of 300 to 700 feet below ground surface (ft bgs) in long narrow trends varying from a few hundred to several thousand feet long and 50 to 250 feet wide

(**Figure OP-2b**). The depth depends on the local topography, the dip of the formation, and the stratigraphic horizon. The available geologic and hydrologic data presented in **Appendices D5 and D6**, respectively, identify uranium mineralization in several sandstone layers (e.g., from shallow to deeper, the FG, HJ, and KM Horizons).

The three mineralized sandstone layers (Sands) in the HJ Horizon, from 350 to 500 ft bgs, are targeted for this permit application. The richest mineralized zone, locally designated as the Middle HJ (MHJ) Sand, is about 30 feet thick at 400 to 450 ft bgs, and is believed to contain over 50 percent of the total resource. Depending on the location within the Permit Area, only one, two, or three of the mineralized Sands may be present in the HJ Horizon.

The KM Horizon underlies the HJ Horizon and the Upper KM (UKM) Sand is a potential production zone within the Permit Area. The decision to proceed with a permit revision for production of the UKM Sand will depend on the results of future delineation drilling and characterization.

The mineralized Sands in the Permit Area are fine- to coarse-grained, poorly sorted arkose. The uranium mineralization is of sub-microscopic size. Main uranium minerals are uraninite, a uranium oxide, and coffinite, a uranium silicate. They are mostly associated and at times intergrown with round pyrite particles. The uranium also occurs as a coating around sand grains, as filling of voids between grains, and as minute particles within larger clay particles.

OP 2.0 PROJECT DEVELOPMENT, MAINTENANCE, AND MONITORING

Initial project development is generally limited to facilities, such as the Plant and access road, which are needed throughout the life of the Project. Development of the mine units is progressive, so some mine units may be in operation while others are being developed. This section describes activities that occur for both initial project development and mine unit development, and those maintenance and monitoring activities that are applicable throughout the Project. More detailed information on the mine unit operations is provided in **Section OP 3.0**. The monitoring that will take place throughout the life of the Project is summarized on **Tables OP-1a**, **OP-1b**, and **OP-1c**, which are separated by monitoring that will take place during construction, operations, and reclamation, and described in more detail below.

OP 2.1 Project Schedule

At this time, LC ISR, LLC is planning to develop the mine units shown on **Figure OP-2a** in numerical sequence. **Figure OP-4a** provides the current estimated schedule of operational activities at Lost Creek for the first eleven years of operation. The projected mining schedule is based on an annual production rate of 1,000,000 pounds U_3O_8. The projected ISR operation schedule for each of the mine units, along with the anticipated groundwater restoration schedule, is also provided in **Figure OP-4a.** The basic assumptions for the major aspects of the Project (development, production, and restoration/reclamation) are outlined below.

Development

The schedule generally provides two years for development of a mine unit, including provisions for drilling restrictions to protect wildlife and for submittal of the Hydrologic Test Plan and Report for the mine unit to WDEQ-LQD for review and approval. The time requirement for mine unit development is a function of manpower and drill rigs dedicated to the task. The under-riding driver for the development timeline is the production schedule. Many aspects of the development time line can be adjusted as needed by increasing or decreasing the quantity of drilling rigs and people dedicated to the task **Figure OP-4a** reflects an approximate 42 month plan to complete the development work as follows:

A. Monitor Well Installation: Typically 120 to 140 wells, plan two drill rigs for seven months.
B. Pump Test and Sampling: Allow for three months.
C. Mine Unit Application Preparation: Allow for two months.
D. Injection/Production Well Installation: Typically 22 header houses per unit, 60 wells per header house. Requires 10 drill rigs to complete one header house in approximately 40 days. Allow for 26 months total.
E. Construction – Allow one month per header house (final header house completed in Month 42).

Production

The schedule also provides for two to three and a half years for uranium production depending on the mine unit. All the necessary processing and disposal facilities, including ion exchange columns, storage ponds, and UIC Class I disposal well(s) will be installed prior to mining. The schedule on **Figure 4b** includes five UIC Class I wells.

Mine units are generally developed and activated in stages. Commonly, new production is staged in on the level of header houses, rather than staging in complete new mine units.

Depending on available pipeline and plant capacity, an operator may initiate new production in areas as discrete as individual patterns. Production begins once injection of lixiviant begins. The total time for production of a pattern is dependent on: the efficiency of the areal sweep of the lixiviant; the effectiveness of the oxidation of the uranium in place; and the injectivity and productivity of the formation (well flow rates). The factors below were incorporated into the estimation of the average time for economic production from a pattern at the Lost Creek Project.

A. Production Rate: 32 gallons per minute per production well., based on hydrologic results of several formation characterization tests.
B. Pore Volumes (PV): The estimated number of PVs processed to achieve economic depletion of the pattern is approximately 60.
C. Recovery Percentage: The percentage rate, based on laboratory tests, is 84 to 93% recovery rate. An 80% recovery rate was used for calculations.
D. Production Grade: The grade at which a pattern is expected to be turned off because the lixiviant grade has diminished to an uneconomic level was selected to be 10 milligrams per liter U_3O_8 for the purpose of the production model. The criteria for determining when the transition from production to restoration should occur in a given mine unit are discussed in **Section RP 1.0**.

Using the above information, the required time for economic depletion of a single pattern is calculated to be 12 months. Therefore, production in a mine unit is modeled to be completed 12 months after the initiation of production in the last developed header house in the unit. There is commonly a delay between the completion of development and the commencement of production at a given header house as determined by the availability of flow capacity within the process facility, specifically the ion exchange section. **Figure OP-4A** was developed on the premise that the header houses within a mine unit will be activated in stages and that the final header house will be activated approximately one to two years after the first.

The water balance variations for the Project are included in **Figures OP-5a**, **b**, **c**, **d**, **e** and **f**. The various water balance scenarios presented contemplate the possible operational modes that a typical ISR facility may encounter over the life of the project. By analyzing each scenario, it can be demonstrated that the facility is designed to manage the water flow variations from maximum Plant utilization (**Figure OP-5c**) to minimum Plant utilization (**Figure OP-5f**).

Restoration/Reclamation

The schedule includes 18 to 36 months for aquifer restoration in each mine unit, based on 0.3 pore volumes (PV) of groundwater sweep, 6.0 PV of reverse osmosis, and 1.0 PV of recirculation. (**Section RP 2.3** details the PV calculations). The groundwater restoration infrastructure shown in **Figure OP-4b** will be purchased and installed before commercial operations begin, so the timeline for restoration is not delayed. The time provided for aquifer restoration includes approximately: two months for each header house to serve as a buffer area between impacts of production and restoration; nine months for groundwater sweep; twelve months for reverse osmosis (RO); and one month for recirculation. Additional detail about the time required for each restoration phase is included in **Section RP 2.3**. Stability monitoring will follow restoration and is not included in the total time (**Section RP 2.4**). The monitoring that will take place during restoration and prior to transition from restoration to stability is described in the last paragraph of **Section RP 2.3.2** and in **Section RP 2.5**, respectively. Development of the restoration criteria is discussed in **Section RP 2.2**.

Schedule Adjustments

The schedule will be affected by various factors. These factors typically involve adjustments as necessary to meet production schedules and contractual agreements, longer (or shorter) than predicted mining or restoration times or delays in mine unit installations. In addition, if an area designated as undergoing restoration is directly adjacent to an area undergoing mining, all or a portion of the restoration unit could be serving as a buffer zone, or could be in stability monitoring. The development schedule may also be affected by restrictions to protect wildlife such as exclusion from specific areas during nesting seasons. The current schedule reflects existing restrictions on drilling, and LC ISR, LLC will keep in contact with the US Bureau of Land Management (BLM) and WGFD for updated guidance.

To account for such changes, LC ISR, LLC will include in the Annual Report to WDEQ and NRC a map of the Permit Area showing: the mine units that are being developed, in production, and in restoration; and areas where restoration has been completed. New areas where production or restoration is expected to begin in the subsequent year will also be identified in the Annual Report. The schedule will be compared with that in **Figure OP-4a**, and if it becomes evident that LC ISR, LLC cannot comply with the approved schedule, a request for revision of the schedule will be made, including explanation of the reason(s) for the changes from the approved schedule.

Additional resources are known to exist within the Permit Area, but are not yet adequately characterized for inclusion in the permit application at this time. These resources have the potential to extend the ultimate Project life beyond this initial period. If LC ISR, LLC submits a revision to include these additional resources in the Permit-to-Mine, the operations schedule will be updated as part of the revision to the permit.

OP 2.2 Additional Regulatory Requirements

A list of the necessary permits and licenses for the Project at the federal, state, and local levels is provided in the Adjudication File in **Table ADJ-1.** At the federal level, NRC, EPA, and BLM are involved in permitting the Project. In October 2007, LC ISR, LLC applied for a Source and Byproduct Material License from the NRC (Docket No. 40-9068, Technical Assignment Control No. LU0142). An EPA requirement that must be addressed prior to the commencement of operations is aquifer exemptions (one for injection into the aquifer to be produced and the other for injection into a deeper formation for water disposal). Other EPA requirements are covered by WDEQ permits as the State of Wyoming has primacy for the applicable EPA programs (**Table ADJ-1**). BLM administers the federal land on which the Permit Area is located, and NRC is the federal licensing agency for a Source and Byproduct Material License.

At the State level, Lost Creek must obtain an Air Quality Permit, a UIC Class 1 well permit, and a Storm Water Discharge Permit from the respective WDEQ divisions, in addition to the WDEQ-LQD Permit to Mine and License to Mine. Once the Air Permit is obtained, a copy of the permit will be incorporated into **Attachment OP-1** of this document. Similarly, a copy of the UIC Class 1 well permit, when it is obtained, will be incorporated into **Attachment OP-2** of this document.

During site construction and operation, the storm water discharge permits applicable per the Wyoming Pollution Discharge Elimination System (WYPDES) will be maintained (**Table ADJ-1**). The associated Storm Water Pollution Prevention Plan (SWPPP) will be designed and implemented as part of LC ISR, LLC's compliance with applicable WDEQ-Water Quality Division (WQD) rules. A copy of the SWPPP is included as **Attachment OP-3** of this document, and a copy will be kept in an accessible area of the Project. The SWPPP will focus on protecting waters of the state through prevention and mitigation of chemical spills and topsoil erosion and will contain provisions for routine inspections and audits to ensure the plan is being properly implemented and all employees, and contractors as necessary, are familiar with applicable portions of the plan. Specific commitments in the SWPPP related to this Operations Plan will include:

- Protection of topsoil and vegetation (**Sections 2.5** and **2.7** of this Operations Plan);
- Road construction techniques (**Section 2.6**); and
- Prevention and remediation of accidental releases (**Section 2.9**).

A copy of the Drainage Plan for the Plant is included as **Attachment OP-4.** As discussed in the Drainage Plan, the Plant will be constructed so that extensive sediment control measures will not be required. Therefore a conventional sedimentation pond will not be installed.

Since a conventional sedimentation pond will not be used to capture runoff from the main facilities area LC ISR, LLC has developed an alternate plan for sediment control. The plan follows the guidance provided in LQD Guideline No. 15, "Alternate Sediment Control Measures" (ASCM) developed and approved for sediment control measures for coal mines. The plan mainly consists of installing diversion ditches to divert undisturbed runoff around the Plant and the Storage Ponds as discussed in Section V(C)(1)(a) of Guideline 15. The runoff will be returned to the original drainage flow path once it has bypassed the Plant and Storage Ponds.

To help ensure the appropriate regulatory requirements are addressed, LC ISR, LLC has maintained consistent contact with federal and state agencies. Since the beginning of the Project, quarterly meetings have been conducted with NRC, BLM, and WDEQ.

Representatives from LC ISR, LLC met with the Sweetwater County commissioners on October 16, 2007. LC ISR, LLC described the operations and schedule of the Project to the commissioners and answered related questions. Additional public consultation is planned.

OP 2.3 Land Use

During the life of the Project, a total of approximately 324 acres of the land surface could potentially be disturbed; approximately eight percent of the total Permit Area. While some of the disturbances, such as the Plant and main access roads, are long-term (through the life of the Project), most are temporary, and will be reclaimed within months or years of disturbance. It should be noted that this disturbance acreage is for maximum vegetation disturbance and does not equate with acreage of topsoil removal, which will be less than the vegetation disturbance as discussed in more detail in **Sections OP 2.5** and **OP 2.7**. Ultimately, all disturbed areas will be reclaimed to support the post-operational land uses of the Permit Area, as discussed in the Reclamation Plan.

The existing land uses of the Permit Area are livestock grazing and wildlife habitat, with other uses such as hunting and off-highway vehicle recreation. To control access and to prevent livestock damage, the Plant and Storage Ponds will be fenced for the duration of the Project. Mine units will be fenced as they are constructed and brought on-line. All fences will be constructed according to BLM fencing specifications and WGFD criteria (**Attachment OP-6**). For safety reasons, hunting and other recreation will also be restricted to the extent allowable under BLM guidelines, within the Permit Area.

As discussed in **Appendix D6, Section D6.1.1**, all of the surface water features at the site are ephemeral and relatively small. The only anticipated temporary impacts to the surface water system during operations may occur along roads, where it may be necessary to route drainages through culverts under the roads (**Section OP 2.6**) or route runoff around facilities (**Attachment OP-4**). These features should not affect flow rates or water quality because: of the low relief across the site and the limited surface water flows; only the drainage pattern in the immediate vicinity of the roads and structures may need to be altered (if at all); the culverts will be appropriately sized; and any disturbances associated with installation of the structures will be reclaimed immediately after installation (**Section OP 2.7**). The Stormwater Pollution Prevention Plan also has provisions for evaluating construction impacts and unanticipated impacts such as spills. Provisions for spill detection and response are also addressed in **Section OP 2.9**.

Once reclamation of the site is completed, no permanent impacts to the surface water system are anticipated. As discussed in **Sections RP 3.0** and **4.0** of the Reclamation Plan, all of the surface facilities are scheduled for removal and reclamation. The landowner (BLM) could request that a road (and associated culverts) be left in place, which may mean a permanent change to the drainage pattern. However, by that time, any potential problems with the function of the culvert(s) should have been detected and repaired. As noted above, any spill-related impacts will be addressed at the time of the spill.

OP 2.4 Cultural Resources Mitigation Program

Potential impacts on cultural resources may occur mainly during the site preparation and construction phases, especially when vegetation and topsoil removal is involved. Class I and III cultural resource surveys have been performed over the Permit Area and are submitted in **Appendix D3** (confidential).

Three sites were identified in the Permit Area as meeting the eligibility criteria of the National Register of Historic Places (NRHP). LC ISR, LLC will make every effort to avoid disturbing any of the potential NRHP sites. Site boundaries will be clearly marked and a buffer around the sites will be maintained. Construction and operation activities that occur near significant properties will be monitored by an archaeologist. In the event that significant sites cannot be avoided, LC ISR, LLC will prepare site-specific treatment plans to guide data recovery excavations. Prior to implementation, the treatment plan(s) will be subject to review and approval by BLM and the Wyoming State Historic Preservation Office (SHPO), and will be subject to review and comment by concerned Native American groups.

The possibility exists that, despite precautions, previously unrecorded subsurface artifacts or unmarked graves could be exposed during the course of the Project. LC ISR, LLC will halt work in the immediate area of any such discovery and stabilize the location, so that further degradation will not occur. An archaeologist will examine and evaluate the discovery for significance in accordance with applicable laws and regulations including the Archaeological Resources Protection Act, National Historic Preservation Act, American Indian Religious Freedom Act, and Native American Graves Protection and Repatriation Act.

Based on current projections of areas of disturbance, a mitigation plan for one of the NRHP eligible sites has been prepared. It has been reviewed and approved by BLM and SHPO, pending Project approval. A copy of this mitigation plan has been added to the confidential Appendix D3. Future requirements and protocol for protection of archeological sites will also be incorporated, through a permit revision, into Appendix D3 (confidential), and referenced in this section of the Operations Plan.

OP 2.5 Topsoil Management

Topsoil management practices will include both short-term and long-term protection measures. The short-term measures are needed primarily for delineation drilling and installation of the mine units, and the long-term measures are needed primarily for those facilities that will be present while a given mine unit is in operation or during the life of the Project, such as the Plant and main access road. Vehicular traffic will be minimized during operations and restricted to specific routes. In particular, traffic routes will be established within mine units. This will reduce the occurrence of compacted soils. The SWPPP (**Attachment OP-3**) also addresses topsoil protection measures.

The results from the Order 3 surveys of the main Permit Area and the East and West Access Roads outside the main Permit Area are presented in **Appendix D7 (Plate D7-1)** and **Appendix D - East & West Roads (Figures D7-E&W-1a** and **1b**), respectively. The results from the more detailed Order 1 survey of the Plant are included in **Attachment OP-5a** and the results from the more detailed Order 1 survey of the deep well sites and the new portions of the main access road through the site are included in **Attachments 5b**. Once the layouts of the individual mine units have been prepared, Order 1 surveys of those areas will also be completed and submitted with the respective mine unit package.

Based on the results of the Order 1 soils surveys, three similar soil types are present in the Permit Area: the Pepal sandy loam; the Poposhia loam; and the Teagulf sandy loam. Of these three, the Pepal sandy loam covers upwards of 75% of the Permit Area. The other two soil types are essentially associated only with drainages. For all three soil types, the entire shallow to moderately deep profile is 'suitable' or 'marginally suitable' from a reclamation suitability perspective; however, LC ISR, LLC will focus on the most fertile, upper material for topsoil salvage. The factor affecting the depth of the most suitable material is location relative to drainages - the depth is shallower away from drainages and deeper within drainages, depending on the size of the drainage (ranging from very shallow swales to ephemeral channels).

Topsoil removal will be supervised by a qualified person using the existing data and the detailed soil survey data. Based on this information and on field experience to date, the upper materials that will be salvaged can be readily distinguished from the lower materials. Topsoil stripping depths are shown on Plate OP-3.

The areas from which topsoil is to be stripped are: 'rectangular' areas, such as the deep well sites; which are relatively small (less than 10 acres) and widely separated across the Permit Area; or long, narrow corridors associated with installing new roads and pipelines or upgrading existing roads. Topsoil stripping depths in the 'rectangular' areas are based on the soil sampling results within those areas.

The corridors are generally perpendicular to drainages and may cross all three soil types within relatively short distances. As noted in WDEQ-LQD Guideline 1, if soils are similar, then soil associations can be considered over relatively small acreages (e.g., five acres or less). Therefore, topsoil stripping depths along the corridors will be based on the soil sampling results, field observations during the soil surveys, and field observations during the road or pipeline installation or upgrade - in particular, the location relative to drainages. In general, the topsoil stripping depth between drainages is 16 inches and may be up to 24 inches within drainages. As a field check along roadways and pipelines, LC ISR, LLC will dig pits at intervals where changes in stripping depths to help ensure the most productive portion of the soil profile is salvaged.

Field observations during upgrade of existing roads will be of particular importance to avoid stripping material of indeterminate origin. As with installation of new roads, attention will be given to drainages in which deeper topsoil depths may be expected. The width of topsoil removal from existing road corridors will depend on the width of existing disturbance.

Table OP-2 shows the total acreage of expected disturbance associated with the various facilities at the Lost Creek Project. The table also includes the disturbance acreage by vegetation type and projected topsoil salvage. As discussed below, vegetation and topsoil disturbance are not considered to be equal. The assumptions about the extent of vegetation and topsoil disturbance for each type of project facility are included in **Table OP-2**, with additional detail for the mine units on **Figures OP-6a and OP-6b**.

Per WDEQ-LQD requirements, topsoil will not be stripped from areas where there is minor disturbance, such as light-use-roads, monitoring stations, fences, and drill sites (except for the mud pits); however, topsoil will be removed in situations where it cannot be protected from erosion or loss of soil resource, such as trenches, mud pits, and buildings. Topsoil will be stripped from a monitor well road (or portion of the road) if the road must be upgraded to maintain its integrity.

Stripping topsoil will result in the removal of 100% of the vegetation cover and associated root systems. By leaving topsoil in place where possible, even if the vegetation is disturbed, at least some of the vegetation is expected to survive, and the root system will help maintain the soils integrity thereby minimizing wind and water erosion. The subsoil at the site is composed of generally unconsolidated fines. When exposed to wind and rain this subsoil easily erodes and may contribute to increased sediment load in ephemeral drainages and decreased air quality. In addition, a particular concern at the Lost Creek site is the preservation of sagebrush. In this case, retaining as much sagebrush as possible should help with respect to wildlife habitat.

OP 2.5.1 Short-Term Topsoil Protection

LC ISR, LLC will continue the topsoil protection measures, currently in use for exploration drilling, during the mine unit delineation drilling (generally on closer spacing than exploration drilling) and during well installation. Those measures include topsoil removal and replacement from specific locations (e.g., mud pits), minimizing traffic routes, and general maintenance.

At drilling sites topsoil will be protected by:

- stripping topsoil from the mud pit locations;
- stockpiling that topsoil, separate from the stockpile of the deeper material excavated for the mud pit;
- using one mud pit at nested well locations, if possible;
- after drilling, allowing the mud pit to dry and replacing the deeper excavated material;
- replacing topsoil;
- surface preparation;
- reseeding with the permanent seed mix **(Table RP-3)** at the next appropriate season, or if necessary to prevent erosion prior to the next appropriate season, with a temporary seed mix (rigorous certified weed free annual cover crop such as sterile rye grass or millet).

To avoid degradation of topsoil adjacent to mud pits, the pits will be installed so that at a minimum the primary root zone topsoil (generally the top four to eight inches) will be removed from the area where subsoil will be stockpiled. During reclamation, excess subsoil may remain in this stockpile area. Topsoil will be redistributed as evenly as practical over the excavation area. **Figure OP-6c** shows the typical layout of a drill pit.

LC ISR, LLC will backfill drill pits with subsoil as soon after drilling as is practical. Topsoil will not be re-applied until the subsoil has been given adequate opportunity to settle into the pit. Any incidental overflow of drill mud onto topsoil will be remediated.

For better protection, topsoil stripped from several adjacent locations, such as mud pits in a portion of a mine unit, may be consolidated into one stockpile rather than several smaller stockpiles. In addition, care will be taken to prevent drilling mud from flowing out of mud pits and to keep rig and support vehicle traffic to a minimum number of routes so topsoil compaction, tire ruts, and similar problems are minimized. All but the deep well drilling sites will be in use for only a few days. The deep well drilling sites may be in use for several weeks or a few months.

At staging areas (also called field lay-down areas) for construction equipment and materials, which may be in use for a few months, topsoil will be stripped and stockpiled in a manner to protect it from wind and water erosion. Traffic patterns to and from these areas will also be designated to reduce the risk of topsoil compaction. Once a staging area is no longer needed, all construction materials will be removed and the surface prepared for re-application of topsoil. The topsoil will then be replaced and the area reseeded. For the purposes of estimating disturbance acreage, three staging areas are included in the estimate. The location of the staging area that will be in use for the life of the mine is shown on **Plate OP-2**. Two temporary staging areas may be needed in the future, each of which would be in use for a few months. Specific locations for these temporary staging areas will be included in the mine unit package for which they are needed.

Pipeline installation, such as the pipelines to and from wells and header houses, will require on the order of a few days or weeks for a given route. Topsoil will be windrowed to the side of the pipeline route during installation of the pipeline and then replaced and reseeded.

OP 2.5.2 Long-Term Topsoil Protection

Topsoil will be stripped and stockpiled from those areas on which buildings or other facilities will be located for several months or the life of the Project, such as the Plant. The total area of the Plant and related facilities is expected to be about ten acres, including the two Storage Ponds. Up to five UIC Class I wells will be completed; and the total area for those wells and associated roads is expected to be about five acres. In total, the header house disturbance is projected to occupy less than one acre. Because topsoil removed from these locations will be stockpiled for some time, particular care will be used to ensure the stockpiles are protected from wind and water erosion, using measures such as toe ditches, temporary seeding, or other appropriate measures.

OP 2.5.2.1 Topsoil Stockpiles

All long-term topsoil stockpiles will be labeled and inspected periodically. The stockpiles will be sloped on all sides to a slope of no greater than 3:1 and will be reseeded with the approved permanent seed mixture (**Table RP-3**), minus shrub specie(s), at the next appropriate season after the stockpile is created. As an alternative, the topsoil pile may be seeded with a rigorous certified weed free annual cover crop such as sterile rye grass or millet in order to establish a cover on the topsoil pile. The approved native seed mixture will be planted before the next growing season. A seed drill will be used to the extent possible, however, when slopes dictate, seed may be broadcast and racked in by hand. Topsoil piles will generally be located north or east of roads so they do not serve as snow fences. Locations of the long-term stockpiles are noted in **Table OP-2a**.

OP 2.5.2.2 Facility Siting Criteria

Site selection for permanent facilities will take account the protection of environmental features, such as vegetation and topsoil, as well as safety, cost, and efficiency of operation.

Plant and Staging Area

A full geotechnical engineering report will be performed prior to the construction of the Plant. This report will include engineering analyses on the representative site soils to determine the bearing capacity and potential settlement. The report will be used to determine the foundation type, depth, and allowable bearing capacity as well as provide guidance on preparation, earthwork, and cement type. The staging area will be located to minimize impacts to ephemeral drainages and the associated Lowland Sagebrush habitat .

Mine Units

The layout of each mine unit will take into account the protection of environmental features such as vegetation and topsoil. General design considerations include minimization of:

the footprint of the mine unit structures;
topsoil disturbance and compaction;
disturbance of vegetation (especially varieties of vegetation with greater value to

wildlife); and
impacts to ephemeral drainages.

Safety, cost, and efficiency of operation will also be taken into account. The following specific criteria will be considered in mine unit layouts:

Header Houses – These will generally be located within the pattern area and on a gentle slope to minimize the amount of disturbance. Header houses will not be placed within a drainage channel or located such that a drainage channel must be altered. When possible, header houses will not be placed in areas with large sagebrush. Header houses will also be painted a neutral color that blends into the background.

Header House Roads – Roads will be designed with minimal width while maintaining safety. The road to header houses will generally be a drive-by roads, or will have a small cul de sac for vehicle turn-around, and will follow the shortest path possible through the mine unit or along the edge of the mine unit to minimize disturbance and ease future inspections and operations. Roads to header houses will be stripped of topsoil with the soil placed in long-term stockpiles. The roads will be surfaced with gravel or other acceptable material with culverts placed as needed to ensure proper drainage.

Pipelines: When possible, pipelines will be located either through or along the edge of mine units. Lateral pipelines will be placed in a common trench to the extent possible to minimize the total amount of trenching required. Per standard engineering practice, pipeline routes will be designed by the Engineering Staff to minimize surface disturbance. Specifically, the routes will avoid Lowland Big Sagebrush, drainages and steep slopes to the extent possible. In order to make pipeline inspections easier, the pipelines will be placed near roadways to the extent possible. During construction, topsoil will be temporarily stockpiled. Upon completion of construction, topsoil will be laid back down and revegetated at the proper season.

Power Lines: Like pipelines, power lines will generally be located near the edge of the mine unit to minimize disturbance and ease inspections and maintenance.

OP 2.6 Roads

On-site access will be restricted through roads with appropriate signage, fences, gates, and security. Wherever possible, roads will follow existing two-track routes to minimize additional disturbance as much as possible. The primary access road will extend from the Sooner Road and the Wamsutter-Crooks Gap Road to the Plant. Secondary access roads will connect the header houses within a mine unit and connect each mine unit to the

Plant. Where new roads must be built to provide access from the deep wells to the Plant, those roads will be secondary roads; otherwise, existing two-tracks will be used to minimize additional disturbance. Routes for primary and secondary roads (as defined in WDEQ-LQD Guideline 4 Attachment III Section III(B)) will be stripped of topsoil, as will two-track roads upgraded to secondary or primary roads. The topsoil depth has been determined by Order 1-2 soil surveys as presented in **Attachments OP-5a** and **5b**.

The planned network of on-site primary and secondary roads is portrayed in **Figure OP-2a** and **Plate OP-1.** Roads will be constructed in accordance with BLM guidance found in "BLM Pocket Field Guide, Engineering Road Standards Excerpts from BLM Manual Section 9113." **Figure OP-3c** illustrates general road designs based on BLM guidance. Specific secondary road locations will be included with each mine unit package when the precise locations for each road will be known. The SWPPP will also address mitigation of erosion potential due to road construction and use.

Before moving into an area for exploration, delineation, or mine unit development, the responsible Geologist or Engineer will work with the Environmental Department to determine the best access route. The access route will be as direct as possible and will avoid Lowland Big Sagebrush, drainages, and steep slopes to the extent possible. The responsible Geologist or Engineer will demark the access route in the field and convey its location to all partied who will be working in the area. The responsible individual will also demark areas where no traffic is allowed. The responsible supervisor will perform daily inspections to ensure only designated roads are used. The Environmental Department will also perform weekly inspections to ensure compliance. Non-compliance with these requirements will result in progressive disciplinary action up to dismissal from employment.

Upon determining that long term development will occur in an area the Engineering Staff will layout the roadways using criteria listed above. Long-term improved roads will be established as soon as possible with topsoil being salvaged.

New roads or upgrades to existing roads may require the establishment of a stream crossing. Stream crossings maybe constructed using either culvert installation or establishment of a ford, and in either case, to the degree possible, will be oriented perpendicular to the channel. LC ISR, LLC may elect to construct fords in cases where the stream channel is relatively shallow, on the order of three feet deep or less. Where fords are established, each entrance will be graded to a slope of 5(h):1(v) or less and the base lined with gravel and cobbles to assure traction.

Culvert design criteria are based on WDEQ/LQD Guideline 8 that factors in the design life of the facility along with hydrologic return period or flood frequency probability. Culvert design for the primary access roads will be based on estimated peakflow from the 25-year, 6-hour storm event; and the designs for the secondary roads, including mine unit access roads, will be based on estimated peakflow from the 10-year, 6-hour storm event. Per "BLM Pocket Field Guide, Engineering Road Standards Excerpts from BLM Manual Section 9113," no culvert smaller than 18-inches in diameter be used. Culvert design sizing criteria are presented in **Table OP-4**.

To minimize erosion potential at the culvert outlets, rock riprap aprons will be installed where appropriate. The culvert installations will generally be designed and approved by a Professional Engineer in accordance with current applicable design standards. Records of on-site road and culvert maintenance will be kept at the LC ISR, LLC office.

There will also be two-track (tertiary) access roads within the mine units during field construction and operation to access header houses and monitor wells. As noted in **Section OP 2.5**, these two-track roads will not be improved roads because of the limited traffic on them. However, specific travel routes will be designated within the mine units to reduce the potential for topsoil compaction and erosion.

The off-site transportation routes will be comprised of pre-existing BLM, county, state, and federal roads. If improvements to off-site roads are needed, permits will be obtained from the BLM or other appropriate agency, and all relevant guidelines will be followed.

OP 2.7 Vegetation Protection and Weed Control

Vegetation will be temporarily impacted during the construction and operation of the Project. During construction, vegetation will be removed at some areas of the mine units, supporting facilities, and roads, although vegetation removal will be minimized whenever possible to protect topsoil, preserve wildlife habitat, and improve re-vegetation success. The acreages of the two vegetation communities identified on-site, and the percentage of disturbance of those communities are listed in **Table OP-2**. To stabilize soils and support the ecosystem, vegetation will be established at disturbed areas as soon as conditions allow, using the methods described in the Reclamation Plan (**Section RP 4.5**).

During operations, mine units and supporting facilities will be accessed using a defined road network. Employees will be trained to minimize the impact to vegetation by staying on defined roadways and reducing the amount of vehicle traffic to the extent possible. **Figure OP-6b** illustrates the area of potential topsoil and therefore vegetation disturbance. SWPPP inspections will include a check of active work areas to insure employees are minimizing impacts to vegetation, and any problems noted during inspections will be brought to the attention of the area supervisor for correction.

Drilling and construction activities will be limited or halted when field conditions are muddy in order to minimize damage to vegetation and topsoil. Alternatively, activities may be shifted to areas where they will not impact soil and vegetation. Critical facility monitoring and inspections generally occur in areas with all weather roads and will therefore continue during muddy conditions.

Weed prevention measures following BLM guidelines and recommendations will be implemented (BLM, 1996 and 2004).

OP 2.8 Wildlife Protection and Monitoring

LC ISR, LLC will implement protection and monitoring plans to avoid, minimize, rectify, and better understand Project-related impacts to wildlife. LC ISR, LLC's Wildlife Protection Plan and Wildlife Monitoring Plan are included in **Attachment OP-6**. Approval letters from the United States Fish and Wildlife Service (USFWS) and Wyoming Game and Fish Department (WGFD) are included in **Attachment OP-6**.

Wildlife protection measures described in **Attachment OP-6** include surface activity restrictions during certain times of year in the areas surrounding sage grouse leks and raptor nests. Additional protection measures include: the siting of roads and utility rights of way; speed limits; use of fencing that allows or prevents passage of wildlife, as appropriate; screening and/or deterrents to prevent wildlife injury or mortality; transmission line design and/or burial; employee education and awareness training; and habitat reclamation, including use of native seed mixes.

Sage grouse, raptors, and Migratory Birds of High Federal Interest (MBHFI) are the primary wildlife groups of concern in the Permit Area. Mitigation measures planned for sage grouse, raptors, and MBHFI are described in detail in **Attachment OP-6**. Sage grouse mitigation measures were adapted from the Core Population Area Stipulations (WGFD, 2008) to be practical in an ISR environment. Sage grouse mitigation measures include, but are not limited to: project siting; minimizing/clustering areas of disturbance; activity restrictions; and minimizing noise disturbance. Raptor mitigation measures include: limiting access to areas surrounding active raptor nests; activity restrictions; and construction specifications. MBHFI mitigation measures include: the consideration of breeding habitat when siting project disturbance; minimizing disturbance during nesting and breeding season; and the use of netting and/or deterrents for large fluid-holding structures, if necessary, to prevent mortality.

Wildlife monitoring within and near the Permit Area will occur on an annual basis for the life of the Project. The monitoring results will be reported annually, unless circumstances warrant contacting agencies with new information (e.g., new raptor nesting location). Monitoring for big game, sage grouse, raptors, lagomorphs, MBHFI, non-game birds, non-game animals, and threatened and endangered species is described in detail in **Attachment OP-6**.

OP 2.9 Prevention and Remediation of Accidental Releases

The significant criteria to reduce the potential for accidental releases are: appropriate engineering design, construction, and maintenance; development and implementation of the SWPPP, covering topics such as inspections, notification procedures, and response actions; and on-going employee training in the SWPPP and general health and safety procedures. Specifically, Standard Operating Procedures (SOPs) addressing spill prevention and mitigation will be developed and implemented at the site. The SOPs will address: pipeline installation and testing; automated system monitoring and alarming; site inspections; spill mitigation; and employee training. The facilities which will require specific attention are outlined below.

Facilities will generally be designed to withstand worst case credible upset conditions including but not limited to wind storms, earthquakes, and sheet flooding. In cases where design alone may not be sufficient to withstand such scenarios, continuous monitoring with alarms and/or automatic shutdowns will be used. If an upset condition may result in the release of mining solutions or chemicals to the environment, the affected system(s) will be shut down and thoroughly inspected/tested by an individual familiar with that system before being restarted. Management will verbally notify WDEQ-LQD immediately if an upset condition may result in a release to the environment and cannot be made safe immediately. In such cases, LC ISR, LLC will also submit a written report to WDEQ-LQD within one week detailing the nature, location and cause of the incident, what if any releases to the environment resulted, what efforts were made to correct the problem, and what will be done in the future to prevent or mitigate similar occurrences.

OP 2.9.1 Pipelines, Fittings, Valves, and Tanks

The most common accidental release from ISR operations is from breaks, leaks, or separations in the piping that transfers the lixiviant (injection and production solutions) between the Plant and the mine units. Failures of fittings and valves at the wellheads, in the header houses, at tanks, and other junctions are also a common cause of accidental releases at ISR operations. All the Plant equipment is specified and designed for the life of the Project, and equipment for the mine units is similarly designed. Routine review of functional data for pumps by operational staff will determine the need for maintenance. Visual inspection of pipelines, valve stations, powerlines, header houses, wellheads, fences, roads and culverts is the daily responsibility of all mine site staff. Particularly, it is the responsibility of the mine unit operators to inspect these items on a routine basis.

Pipelines will generally be buried from 48 to 72 inches below surface, minimizing the possibility of freezing in adverse weather and of being damaged by surface traffic. In general, piping to and from the Plant and the mine units and within the mine units will be constructed of high density polyethylene (HDPE) with butt-welded joints or the equivalent.

All pipelines, associated fittings and valves, and any tanks that will be under pressure during operations will be pressure tested before use. Flow through the pipelines will be monitored and will be at a relatively low pressure. Pressurized tanks will also be monitored for performance within specified limits. Sensors wired to automatic alarms and pipeline shutoffs will be installed to detect significant changes in flow rates or pressures in the pipelines and tanks to help prevent significant releases. **Sections OP 3.5** and **3.6.4** contains additional information about leak detection measures in the mine units.

As per standard industry practice, any spill of mining solution greater than 420 gallons or any spill of mining solution which enters a water of the state will be verbally reported to the WDEQ-LQD and WDEQ-WQD within 24 hours. A written report to both agencies will follow within seven days and explain the size, location, cause of the spill and steps taken to prevent reoccurrence.

Within 24 hours of the discovery of any lixiviant spill (regardless of volume), the Radiation Safety Officer, or their trained designee, will characterize the location, size, and potential radiological dose. The lateral extent of the spill will be mapped with the aid of a Global Positioning System (GPS) unit or by hand using reference points if the GPS unit is unavailable. If a spill is mapped by hand it will be remapped using a GPS unit as soon as possible. The GPS map, due to its high level of accuracy, will be used as the permanent record. The vertical extent of the spill will be measured by probe or by digging. The depths will be recorded on the map. The Radiation Safety Officer, or their trained designee, will determine the potential radiological dose to the maximally exposed individual by either taking actual radiological measurements or by performing calculations based on the known radiological content of the lixiviant. The potential dose will be compared against Nuclear Regulatory Commission regulations to determine if site remediation is necessary.

If site remediation is required due to elevated potential radiological dose, the affected soil will be removed and sent to a landfill licensed to receive such material. The Radiation Safety Officer, or their trained designee, will be consulted before any remediation efforts to determine what, if any, radiological issues must be mitigated to ensure protection of the public and employees. Before backfilling the site with soil, the Radiation Safety Officer, or their trained designee, will ensure remediation efforts have been successful. Topsoil will be applied to the area and the area will be smoothed and revegetated.

If SAR values dictate soil remediation, an evaluation will be performed to see if soil amendments can be added to correct the problem. If soil amendments cannot be used to correct the problem then the soil will be removed and sent to a landfill licensed to receive such material. Measurements of the remaining soil will be taken to ensure the remediation was adequate. Upon determining that soil removal is sufficient, the resulting hole will be backfilled with clean soil, covered with topsoil, and revegetated.

Each spill report will be documented in a spill file that will be maintained until the facility is decommissioned and the permit to mine is cancelled. Each annual report submitted to the WDEQ-LQD will contain a map showing the location and date of each reportable spill along with a table characterizing the date, volume, area, depth, contamination level, sampling locations and remediation efforts for each reportable spill.

OP 2.9.2 Wells

Casing and coupling failures in wells, either at the surface or in the subsurface, may release production or injection fluid. Monitoring of well construction, pressures in the ISR system, and appropriate mine unit balancing, as well as routine mechanical integrity tests (MITs) of wells, will help prevent casing and coupling failures. Down-hole casing repair (with follow-up MIT) is generally sufficient to correct the problem; but well abandonment and replacement and delineation drilling may be necessary to address more serious situations.

OP 2.9.3 Buildings

The buildings of most concern with respect to accidental releases include the header houses, the Plant, and the pumphouse(s) for the UIC Class I well(s). Header houses and the pumphouse(s) are not considered as potential sources of pollutants during normal operations, as there will be no liquids stored within them. However, in the event of a pipeline or pump failure in a header house or pumphouse, the impact of that failure will be reduced by sumps equipped with fluid detection sensors wired to automatic alarms and shutoffs. Similarly, the Plant will be constructed with concrete containment curbing and sumps to allow for containment and recovery of any releases within the Plant. The Plant design incorporates concrete berms designed to contain a spill of one or more vessels. The largest tank of processing fluid in the Plant is approximately 21,000 gallons and the total berm containment volume is approximately 163,000 gallons. The berms will also contain waste fluid released if either the piping or the transfer pumps were to fail. All the systems will use instrumentation in the form of level indication and pump operation indication to support leak detection.

The volume of containment in each of the main areas of the Plant is:

- Precipitation Room
    - Area of precipitation room: 39 ft x 178.5 ft ≈ 6961 ft^2
    - Area taken up by tanks/filter presses/pumps/ramps: ≈700 ft^2
    - Total useable area: 6961 ft – 700 ft = 6261 ft^2
    - Volume of sloping foundation: (0.5) x (6261 ft^2) x (.396 ft) ≈1240 ft^3
    - Minimum height of berm: 0.5 ft
    - Volume of bermed area: 0.5 ft x 6261 ft^2 ≈3130 ft^3
    - Volume of sumps (2 at 18 ft^3 each) = 36 ft^3
    - Total containment volume: 3130 ft^3 + 1240 ft^3 + 36 ft^3 = 4406 ft^3 or ≈ 33,000 gallons
- Chemical Room
    - Area of chemical room: 39 ft x 77 ft ≈ 3003 ft^2
    - Area taken up by tanks/pumps/berms: ≈ 1075 ft^2
    - Total useable area: 3003 ft – 1075 ft = 1928 ft^2
    - Volume of sloping foundation: (0.5) x (1928 ft^2) x (.396 ft) ≈ 382 ft^3
    - Minimum height of berm: 1 ft
    - Volume of bermed area: 1 ft x 1928 ft^2 = 1928 ft^3
    - Volume of sumps (2 at 9.5 ft^3 each) = 19 ft^3
    - Total containment volume: 1928 ft^3 + 382 ft^3 + 19 ft^3 = 2329 ft^3 or ≈ 17,400 gallons
- **Maintenance / Future Dryer / Area**
    - Area of interest: 39 ft x 178.5 ft ≈ 6961 ft^2
    - Area taken up by tanks/pumps/berms: ≈ 1030 ft^2
    - Total useable area: 3003 ft – 1075 ft = 5931 ft^2
    - Volume of sloping foundation: (0.5) x (5931 ft^2) x (.396 ft) ≈ 1175 ft^3
    - Minimum height of berm: 0.5 ft
    - Volume of bermed area: 0.5 ft x 5931 ft^2 = 2966 ft^3
    - Volume of sumps (3 at 9.5 ft^3 each) = 28.5 ft^3
    - Total containment volume: 2966 ft^3 + 1175 ft^3 + 28.5 ft^3 ≈ 4170 ft^3 or 31,200 gallons.
- Ion Exchange / Elution / Restoration
    - Area of interest: ≈ 18563 ft^2
    - Area taken up by tanks/pumps/berms: ≈ 2927 ft^2
    - Total useable area: 18563 ft – 2927 ft = 15636 ft^2
    - Volume of sloping foundation: (0.5) x (15636 ft^2) x (.396 ft) ≈ 3096 ft^3
    - Minimum height of berm: 0.5 ft
    - Volume of bermed area: 0.5 ft x 15636 ft^2 = 7818 ft^3
    - Volume of sumps (2 at 9.5 ft^3 each) = 19 ft^3
    - Total containment volume: 3096 ft^3 + 7818 ft^3 + 19 ft^3 ≈ 10,933 ft^3 or 81,780 gallon

OP 2.9.4 Storage Ponds

Two 160 foot by 260 foot storage ponds are proposed for the facility, as shown in **Plate OP-2**. The ponds will be constructed at the site, in accordance with WSEO and NRC standards and equipped with leak detection systems. The primary purpose of the ponds is to allow for shut down of the UIC Class I wells for maintenance, such as Mechanical Integrity Tests (MITs), or repair while the Plant remains in operation. The total pond capacity is designed to accommodate two weeks of Plant operation and is redundant, allowing for maintenance of the ponds in the event of a liner problem.

The water balance (**Section OP 3.6.3.1**) details anticipated normal operating scenarios. Testing or failure of a disposal well when operating at maximum capacity would not be considered a normal scenario. If this occurred, non-essential activities would be reduced, all other disposal wells would be brought to full injection capacity and only mandatory flows to disposal would be maintained. Based on **Figure OP-5c**, these might include:

- A temporary shutoff of low production wells not necessary to maintain wellfield balance;
- A reduction in groundwater sweep flow while still maintaining a cone of depression, and
- A reduction in reverse osmosis flow and treatment while still maintaining restoration balance.

This reduction is estimated to be as much as 55 gpm, yielding a maximum flow to the storage ponds of 60 gpm. The pond design is for redundant capacity to allow four feet of storage in one pond with the other on standby.

A permit from the State Engineer is required prior to construction of the ponds. Maps and plans were submitted with the application to the WSEO, including detailed cross sections of the embankment, liner and leak detection system. The proposed pond designs will comply with the WSEO Safety of Dams program.

The estimated water quality in the ponds is included in **Table OP-5**. The pond water quality will be analyzed for pH, alkalinity, conductivity, TDS, chloride, sodium, sulfate, radium-226, selenium, arsenic, and natural uranium quarterly (four times a year) and whenever a process change may result in a significant change in water quality.

Pond specifications are included in **Attachment OP-7** and were approved by the WSEO in May 2010. After receipt of project approval from the requisite agencies, approximately 5000 cubic yards of topsoil will be stripped and stockpiled followed by excavation and construction of the embankment. Road base will be deposited and compacted next as the pond base. The base will then be covered by an impermeable liner. The liner thickness will be about 40 mils, depending on final geotechnical information and engineering design. A leak detection system consisting of 4-inch slotted pipe and sand is installed next. The slotted pipe will be tied into "dry" wells around the perimeter of the ponds which will be routinely monitored to determine if the liner is leaking. Another liner, of similar thickness as the lower liner, is then placed over the leak detection layer and "keyed" in to the ground surrounding the embankments.

The maximum fluid depth is proposed to be four feet with three feet of freeboard. Two ponds will be constructed measuring 160 feet by 260 feet each. The purpose of two ponds is to allow for complete removal of fluid from one pond to the other in the event of a leaking liner.

It is possible that a storage pond could fail, either in a catastrophic fashion or as a result of a slow leak. In addition, a pond could overflow due to excess inflow from the Plant or excessive precipitation. All of these possibilities will be addressed through periodic monitoring, including daily, weekly, quarterly, and annual inspections required by NRC.

To help maintain the integrity of the ponds by reducing liner exposure to sun, wind, and freezing temperatures, water will be kept in the ponds at all times by diverting a portion of the water that would normally go to the UIC Class I wells. During operations, the leak detection standpipes will be checked for evidence of leakage. Visual inspection of the pond embankments, fences and liners and the measurement of pond freeboard will also be performed during normal operations. The criteria for determining if a leak has been detected include both water level and water quality criteria. If there is an abrupt increase in the water level in one of the leak detection standpipes or if six or more inches of water are present in one of the standpipes, the water in that standpipe will be analyzed for specific conductance. If the specific conductance is more than half the specific conductance of the water in the pond, the water will be further sampled for chloride, alkalinity, sodium, and sulfate. In addition, the liner will be immediately inspected for damage and the appropriate agencies will be notified. Upon verification of a liner leak in one of the ponds, the water level in that pond will be lowered by transferring the contents to the other pond and/or to the UIC Class I wells.

With respect to pond overflow, SOPs will be such that neither pond is allowed to fill to a point where overflow is considered a realistic possibility. Since the primary disposal method will be the UIC Class I wells, the flow rates to the pond are expected to be minimal; and there will be sufficient time to reroute the flow to another pond, or to modify Plant operations to reduce flow for the critical period. If precipitation is excessive, the freeboard allowance of the ponds will be designed to contain significant quantities of precipitation before an overflow occurs. The freeboard allowance will also reduce the possibility of water blowing over the pond walls during high winds.

OP 2.9.5 Fuel Storage Areas

Fuel storage at the site will consist of an above ground gasoline tank with a maximum volume of 5,000 gallons and an above ground diesel tank with a maximum size of 5,000 gallons (**Plate OP-2**). The tank installation will comply with local, state, and federal regulations. Specifically, the tanks, containment, and associated equipment will comply with Chapter 17 of WDEQ-WQD's rules and regulations on storage tanks. The tanks and the containment area will be checked at least weekly for vessel, piping and containment integrity as well as indications of leaks or spills. All are planned to be documented as part of the routine inspection process.

OP 2.10 Air Monitoring

Climate data collection from the on-site air monitoring station will continue. A separate application to the WDEQ-Air Quality Division has been submitted for an Air Quality Permit. Once approved, a copy of the AQD permit will be included as **Attachment AJD-1** of this document.

OP 2.11 Surface Water and Groundwater

OP 2.11.1 Surface Water

As discussed in **Appendix D6**, **Section D6.1.1**, all of the drainages at the site are ephemeral and relatively small. The only anticipated temporary impacts to the drainage system during operations may occur along roads where it may be necessary to construct a stream crossing (**Section OP 2.6**) or route runoff around the Facilities Area (**Attachment OP-4**). These features should not have any discernable impact on water quantity or quality because of: (1) the limited runoff from the associated low relief drainage basins; and (2) the stream crossings and diversions have been / will be appropriately designed to handle the reasonably anticipated flood event given the design life of the structure. All disturbance associated with the installation of a stream crossing or diversion will be reclaimed immediately after construction (**Section OP 2.7**).

OP 2.11.1.1 Drainage, Erosion, and Sediment Control

Sediment production and capture will be controlled with a variety of approaches. LC ISR, LLC's goal is to limit the extent of site erosion. The mine unit development plan calls for establishing a traffic pattern so access to each well and header house is via a route delineated by the environmental/engineering staff (**Section OP 2.6**). To the extent practical, pipe and power line installation will occur alongside access roads, which during construction will limit the overall disturbance footprint. When the road is not the shortest path, the utilities will follow the most direct path available. As discussed in **Section OP 2.5**, LC ISR, LLC's goal is to ensure that 50% or less of a mine unit's areal extent (defined as the area inside the monitor well ring) is undisturbed, so in many instances, a vegetative buffer can be maintained between the disturbed area and the drainage.

There will be areas where maintaining adequate vegetative buffer strip may not be possible, thus, some form of sediment control will be required. LC ISR, LLC does not propose to construct any type of retention pond, rather Alternate Sediment Control Measures (ASCM's), as described in the WDEQ/LQD Guideline 15, will be used. ASCM's anticipated to be used include: silt fence; various types of check dams; and/or small berms/diversions to capture or intercept and divert overland flow. In some instances, depending on the areal extent of contributing drainage area, LC ISR, LLC may use ASCM's in series in order to provide adequate sediment control. Generic designs for various ASCM's are presented in **Attachment OP-4**.

At a minimum, LC ISR, LLC will inspect all ASCM's at the beginning of the runoff season (March 1 to November 1) and after each runoff event. Through the runoff season, ASCM's will be inspected at least once a month. An inspection and maintenance log will be kept to document the condition of each ASCM at the time of each inspection. LC ISR, LLC will log and repair any significant damage to an ASCM as soon as possible after it occurs. The Stormwater Permit issued by WDEQ/WQD can be found in the **Adjudication Section, Attachment ADJ-3,** and as a permit requirement, a Stormwater Pollution Prevention Plan has been developed and will be on file at the Mine Office. Provisions for spill detection and response are also addressed in **Section OP 2.9**.

OP 2.11.2 Groundwater

The groundwater monitoring critical to each mine unit operation is discussed in detail in **Section OP 3.6.4**. In addition, monitoring of select wells will be conducted in order to provide information on the effects for the Permit Area as a whole. The groundwater monitoring program is described in more detail in **Attachment OP-8** to this document.

OP 2.11.2.1 On-Site Wells

Water level measurements will be taken quarterly in the 27 wells that were used to establish baseline conditions within the Permit Area as described in **Appendix D6**. Other samples may be collected from these wells depending on the development of mine units near or encompassing the wells.

Several water supply wells have been permitted within the Lost Creek Permit Area for various uses. In the FG horizon, well LC1W will be used for dust suppression and drill water. An additional potable water well (not yet named) is planned for the FG also. Well LC28 M is completed in the middle HJ horizon and will be used for drill water and dust suppression. The M horizon has three drill water and dust suppression wells completed in it; they are LC32W, LC229W and LC606W. The final on-site well for drill water and dust suppression is LC33W, which is completed in the N horizon. The use categories and anticipated volumes are described in detail below, and an assessment of the drawdown impact from these well is included in Section OP 3.6.3.4:

- Dust Suppression

  The Air Quality Permit submitted to WDEQ-AQD addresses dust suppression and/or the use of a chemical suppressant such as magnesium chloride (**Attachment OP-1**). The need for dust suppression will be highly variable dependant on weather conditions, moisture content in the soil/roadbase, drilling density and construction activities. It is anticipated that some water will be used for dust suppression during the late summer months. The normal anticipated volume during a calendar year is estimated at eight 80-barrel water trucks per suppression event and four suppression events per year. The total usage is estimated at 110,000 gallons per year or 300 gallons per day. The source for the water supply is planned to be one of the permitted water supply wells within the Permit Area.

- Potable Water

  For the Lost Creek Project, potable water is defined as that which will be used for drinking, handwashing or showering. That volume is estimated at 200 gallons per day. The supply will typically be from the water well to be installed adjacent to the Plant.

- Non-Potable Water:
  - Toilets/Urinals: Water use is estimated at 270 gallons per day and the supply will be from the Plant water well.
  - Plant Use: will consist of water for process and wash water. That amount is estimated at 10 gallons per minute or 14,400 gallons per day and will come from the Plant water well or treated water from the production stream as is appropriate.

- Drill Water: LC ISR, LLC estimates it will use 10 drill rigs per week day during the drilling phase of the project. Each drill rig will typically use 150 to 200 barrels of water per day while drilling. Estimated drill rig productivity is four days per week for 50 weeks per year. Therefore, the total estimated drill water usage is 34,500 gallons per day. Supply will normally come from any/all of the permitted water supply wells on the Lost Creek Permit Area.

OP 2.11.2.2 Off-Site Wells

The operational BLM stock wells near the Permit Area (**Appendix D6**) will be sampled on a quarterly basis with BLM's consent. Groundwater samples will be collected in accordance with the protocols contained in LC ISR, LLC's Environmental Manual. At a minimum, the samples will be analyzed for natural uranium and radium-226. Water level data will be collected before sampling if the wellhead design allows access. As noted in **Section D6.3**, throughout the phases of the Project, LC ISR, LLC will correspond with BLM to ensure that the stock reservoirs and wells are not impacted in a manner that restricts the intended use, and LC ISR, LLC will work with BLM to replace the water source if any wells are rendered unusable due to LC ISR LLC's mining activities.

OP 2.12 Exploration and Delineation Drilling

Exploration drilling will be carried out to locate additional mineral reserves throughout the property. A systematic effort to locate all mineable mineralization will optimize the mining process and prevent resources from being stranded at the end of mining. Approximately 470 exploration holes will be drilled throughout the site over the life of the mine. However, the bulk of the exploration drilling will likely occur during the first three years so the mining can efficiently recover all known resources. Delineation drilling is generally on closer spacing than exploration drilling) and finds economic portions of the ore zone mine unit delineation drilling.

OP 2.12.1 Exploration Drilling

Exploration drilling will be conducted by truck-mounted water well-type rotary drill rigs with accompanying water trucks, pipe trucks, logging trucks and personnel vehicle. General specifications for the drill rig(s) and support vehicles are as follows:

1) Three - drill rigs Truck mounted (rubber tired), mud-rotary water well rig; 1500 rating; GVW: approx. 60,000 lbs;
2) Three - Water Trucks: 70-95 bbl capacity (3,000-4,000 gal) GVW: approx. 55,000 lbs (loaded);
3) Three - pipe trucks: GVW: approx. 25,000 (loaded);
4) One - backhoe: rubber-tired;
5) Three - personnel vehicles: 4x4 Pickup; and
6) One - logging truck: Ford F550

Due to the low relief of the project area and the use of a drilling rig with hydraulic leveling jacks, little or no leveling or alteration of surface topography will be required during drilling operations. Therefore, leveling for rig location pads will be rare and minor. Significant surface disturbance will be limited to the digging of a mud-pit for each drill hole. While digging mud-pits, constructing drill pads, or any other excavation, topsoil will be preserved using the techniques described in the Permit to Mine Application. Measurements of past similar drilling activities on the project have shown the surface disturbance per drill hole to average 0.025 acre (approximately 33' x 33'). Disturbance due to mud pits and drill pads is therefore estimated at 11.75 acres [470 sites x 0.025 acres/site]. Surface disturbance will be reclaimed as soon as possible in order to minimize the total amount of land disturbed at any given time. All mud-pits will be fenced while they are open and contain drilling liquid.

During exploration drilling an effort is made to stay on existing two track roads. However, depending on the availability of pre-existing roads and the location of the drill sites, some new two track roads may be generated. Assuming 0.5 acres of new roads are generated per year per section of drilling approximately seven acres of new two track roads will be created. These roads will be reclaimed using the methods described in the Permit to Mine Application as soon as their useful life has ended.

Drill rigs will use native groundwater supplied from wells within the permit area. Drilling fluids may consist of bentonite based muds, polymers, inert lost circulation material, and minor amounts of soda ash to soften drill water. No hazardous chemicals will be used during exploration drilling.

Exploration holes will be backfilled using in a grout mixture which meets WDEQ requirements. The grout will be tremmied into the bottom of the hole to prevent bridging. The grout level will be brought to the ground surface and allowed to settle for at least two days before topping off to approximately 17 feet below the ground surface. Next, two bags of bentonite chips will be added to the hole followed by a spider plug and then a bag of cement or concrete. The final two feet of the hole will be backfilled with native soil.

Exploration drilling typically occurs prior to installation of fences or roads to an area. This type of drilling occurs at various depths and may or may not conform to a grid. Density of drilling is highly dependent upon the results of previous work. Drill locations will be modified, where possible, to reduce the need for drilling in major drainage ways and/or major modifications to terrain.

The steps in exploration drilling are normally as follows:

1) Surveying – initial target locations are surveyed in with stakes placed. For exploration drilling, very few locations are known initially.
2) Access Planning – the access routes for the initial holes are planned and the backhoe operator and drill contractor informed of the routes. If necessary, access may be delineated with markers or posts.
3) Drill Pits – will be installed by the backhoe operator.
    a) Install erosion protection as necessary;
    b) Excavate drill pit, segregating topsoil and subsoil;
    c) Clear/level drill pad as necessary.
4) Fence Drill Pit
5) Drill Exploration Hole
6) Geophysical Log
7) Abandonment – use drill rig or LCI equipment to plug the hole
    a) Initial – typically, grout or cement is pumped into the hole from the bottom up. Depending on hole conditions, bentonite chips may be used to assist in the plugging process. A temporary cover is placed over the hole after plugging is complete.
    b) Topoff – after the plugging material is allowed to settle, the hole will be revisited and the grout or cement will be topped off to approximately 17 feet below the ground surface. Approximately 10 feet of bentonite chips will be placed on top of the grout or cement column.
    c) Surface plug – A plug capable of supporting approximately 5 feet of cement or concrete will be placed on top of the plug. The remaining upper two feet of the hole will be backfilled with native soil.
8) Backfill Pit – the drill pit will be backfilled with subsoil so as not to allow the displacement of drilling fluid from the pit. The temporary fence will be permanently removed once the pit is backfilled. After the pit is backfilled and the fence removed, the topsoil will be evenly applied over the excavated area.
9) Seeding – surface preparation and reseeding will occur at the next available time period appropriate for planting (Section RP 4.5).

OP 2.12.2 Delineation Drilling

Delineation drilling may occur prior to installation of fences or roads to an area or may occur in areas with significant infrastructure. This type of drilling will occur at various depths and may or may not conform to a grid. Density of drilling is reasonably dependent upon the results of previous work. Drill locations will be modified, where possible, to reduce the need for drilling in major drainage ways and/or major modifications to terrain..

The steps in delineation drilling are normally as follows:

1) Surveying – initial target locations are surveyed in with stakes placed. Drilling may be expanded depending on results.
2) Access Planning – the access routes for the holes are planned and the backhoe operator and drill contractor informed of the routes. If necessary, access may be delineated with markers or posts. Existing access routes will be used wherever possible.
3) Drill Pits – will be installed by the backhoe operator.
    a) Install erosion protection as necessary;
    b) Excavate drill pit, segregating topsoil and subsoil;
    c) Clear/level drill pad as necessary.
4) Fence Drill Pit as necessary. If drilling is within existing wellfield fencing, then temporary fencing will not be required.
5) Drill Delineation Hole
6) Geophysical Log
7) Abandonment – utilize drill rig or LCI equipment to plug the hole
    a) Initial – typically, grout or cement is pumped into the hole from the bottom up. Depending on hole conditions, bentonite chips may be used to assist in the plugging process. A temporary cover is placed over the hole after plugging is complete.
    b) Topoff – after the plugging material is allowed to settle, the hole will be revisited and the grout or cement will be topped off to approximately 17 feet below the ground surface. Approximately 10 feet of bentonite chips will be placed on top of the grout or cement column.
    c) Surface plug – A plug capable of supporting approximately 5 feet of cement or concrete will be placed on top of the plug. The remaining upper 2 feet of the hole will be backfilled with native soil.
8) Backfill Pit – the drill pit will be backfilled with subsoil so as not to allow the displacement of drilling fluid from the pit. The temporary fence will be permanently removed once the pit is backfilled. After the pit is backfilled and the fence removed, the topsoil will be evenly applied over the excavated area.
9) Seeding - surface preparation and reseeding will occur at the next available time period appropriate for planting (Section RP 4.5).

OP 3.0 MINE UNIT PROCESSES, INSTRUMENTATION AND CONTROL

The portion of the Permit Area underlain by uranium ore, that is economic to recover, has been divided into mine units for scheduling purposes and for establishing baseline data, monitoring requirements, and restoration criteria. Each mine unit will consist of a reserve block covering about 100 acres and represents an area LC ISR, LLC expects to develop, produce, and restore as a unit. Three mine units are currently planned in the Permit Area. Typically, one or two mine units may be in production at any one time with additional mine units in various states of development and/or restoration.

The mine units will be subdivided into operational areas referred to as header houses; and each mine unit may include as many as twenty-three header houses. Each header house will be designed to accommodate the well controls and distribution plumbing for approximately twenty production wells and the associated injection wells (usually about 40 injection wells). With the Plant operating at a nominal flow rate of 6,000 gpm, approximately 180 production wells and 360 injection wells will be in operation.

OP 3.1 Mine Unit Chemistry

During operations, barren lixiviant will enter the formation through the injection wells and flow to the production wells. The carbonate lixiviant will be made from varying concentrations and combinations of sodium carbonate, sodium bicarbonate, carbon dioxide, oxygen, and/or hydrogen peroxide and antiscalent added to the native groundwater. The combined carbonate/bicarbonate concentration in the injected solution typically will be maintained at less than five grams per liter (g/L), and the hydrogen peroxide and/or oxygen concentration typically will be less than one g/L. These limits help reduce the possibility of "gas lock" in the formation, which reduces ISR efficiency.

The carbonate/bicarbonate lixiviant is used because of its selectivity for uranium and minor reaction with the gangue minerals. The primary chemical reactions expected in the aquifer are provided in **Figure OP-7**. When the lixiviant is injected into the production zone, the dissolved oxidant reacts with the uranium mineral and brings the uranium to the U^{+6} oxidation state. The uranium then complexes with some of the carbonates in the lixiviant to form a uranyl dicarbonate ion $UO_2(CO_3)_2^{-2}$ and/or a uranyl tricarbonate ion $UO_2(CO_3)_3^{-4}$, both of which are soluble and stable in solution. A small portion of the radium content will also be mobilized along with the uranium. Depending on the conditions within a given Sand, other metals such as arsenic, molybdenum, selenium, and/or vanadium, may also be mobilized.

The chemical reactions which mobilize the uranium will continue as long as the lixiviant is being injected into the orebody. Injection and production at each header house, and eventually each mine unit, will be discontinued once uranium recovery is no longer deemed economical, and restoration will be started (**Section RP 1.0**).

OP 3.2 Mine Unit Design

Continued delineation drilling in the Permit Area will better define ore resources for design of mine units. A mine unit will consist of patterns of production and injection wells (e.g., the pattern area) within a ring of monitor wells to detect horizontal excursions of lixiviant away from the mineralized zone. Monitor wells will also be completed in overlying and underlying aquifers as necessary to detect vertical excursions. Inside the pattern area, monitor wells (which may double as production or injection wells) will also be completed in the mineralized zone to provide information on the mining process.

The Project proposes moderate sized mine unit areas, each containing approximately 2.4 million pounds of resources, within the HJ Horizon. In the simplest scenario, where only one ore quality sand is present in a Horizon, the production, injection, and monitor wells will be installed in that sand. Where more than one ore quality sand is present in the Horizon, e.g., the MHJ and LHJ Sands, the sands will be produced concurrently, with each Sand having its own set of production and injection wells.

The wells in the perimeter monitor ring are designed so the open intervals correspond to the depths of all the ore Sands planned for mining in the area adjacent to that monitor well. Observation wells may be installed between the pattern wells and the perimeter monitor wells for early detection of solution migration. The observation wells would be recompleted to track the specific sand layer being mined adjacent to that well. The observation wells installed will be used only for internal tracking and control and will not be considered as points of compliance for water quality purposes. **Section OP 3.6.4** contains additional details regarding mitigation of excursions.

The mine units as currently projected are shown in **Figure OP-2a**. The size and location of the mine units will be modified as needed based on final delineation of the ore deposit, performance of any prior mine units, and development requirements. Prior to installation and operation of any new mine unit, a Hydrologic Test Proposal will be submitted to WDEQ-LQD for review and approval. Following completion of the activities described in the proposal, a Hydrologic Test Report will be submitted to WDEQ-LQD for review and approval. These documents will detail:

- Aquifer conditions in the mine unit, including factors such as ore sand thickness and horizontal and vertical transmissivity;
- Monitor well locations and depths;
- Pattern areas and depths;
- Baseline water quality data for the mine unit, including the WDEQ-Water Quality Division (WQD) water use classification for the pattern area and the monitor wells;
- The impact of any faulting on the mine unit operation, including information on the magnitude of displacement along the section of the Fault within or near the mine unit, because the displacement varies across the Permit Area, and the degree of hydrologic connection along that section of the Fault;
- The potential interference, and measures that will be taken to reduce any adverse impacts from interference, between the new mine unit and any mine units that are in development, operation, and restoration; and
- Other information necessary for efficient operation of the mine unit.

In addition, prior to operation of any new mine unit, LC ISR, LLC will obtain an aquifer exemption from the US Environmental Protection Agency (EPA) for the proposed mine unit, along with a water use reclassification by WDEQ-WQD. The request to EPA for the aquifer exemption must come from WDEQ; however, LC ISR, LLC will provide the supporting information for the request if asked to do so by WDEQ.

Drilling practices, including site preparation/reclamation and drill hole abandonment, currently in use by LC ISR, LLC will continue to be used. Widely adopted industrial practices are followed, and agency consultations were made on drilling site preparation/reclamation and proper drill hole abandonment. LC ISR, LLC has made an effort to research existing information on historic drilling operations in the Permit Area and, if necessary, properly abandon remnant drill holes or wells. If previously unknown drill holes or wells are detected during the mine unit installation and testing, the newly found drill hole or well will be abandoned in accordance with the procedures currently in use, which are outlined in **Section RP 3.1**, respectively.

OP 3.2.1 Injection and Production Well Patterns

The injection and production well pattern design will be based on conventional five-spot patterns, modified as necessary to fit the characteristics of the orebody. The conventional five-spot pattern is four injection wells surrounding a central production well. The cell dimensions will vary depending on the characteristics of the formation and the orebody; but the injection wells are expected to be between 75 and 150 feet apart. An illustration of a typical solution flow pattern is included as **Figure OP-3b**.

The pattern wells will be constructed, so they can be used as either an injection well or a production well. This design allows changes in the solution flow paths to improve uranium recovery and to restore the groundwater in the most efficient manner. Typical injection and production well completions are illustrated in **Figures OP-8a** and **OP-8b.** (**Figure OP-8c** displays a typical monitor well construction, as discussed below.)

Where more than one ore quality sand is present in the Horizon, e.g., the MHJ and LHJ Sands, the sands will be produced and restored concurrently, with each Sand having its own set of production and injection wells. Wells will not be completed into multiple Horizons (FG, HJ and KM). Separate pattern and monitor wells will be installed for each Horizon if/when they overlap, provided a Permit is granted to mine in Horizons other than the HJ. The well completion technique is described further in **Section OP 3.3**.

OP 3.2.2 Monitor Well Locations

Monitor wells will be completed within the Horizon containing the ore-bearing Sands to be mined (e.g., the HJ Horizon) and in overlying and underlying Horizons, if aquifers occur in those Horizons. The monitor wells in the Horizon containing the ore-bearing Sands will include perimeter monitor wells around each mine unit and monitor wells within the production zone of each mine unit. **Figure OP-3b** illustrates a generic mine unit layout and includes the spatial distribution of the monitor well ring.

OP 3.2.2.1 Perimeter Monitor Wells

When only one ore Sand is present, perimeter monitor wells will be installed for the detection of excursions. In more complex scenarios, where more than one ore-bearing Sand is present and the lateral extents of the Sands differ, the perimeter monitor wells may be supplemented with observation wells. These observation wells are in-house tools to assist in pattern balance and will not be points of compliance.

These monitor wells will be located in a perimeter ring around the mine unit. Distances from the perimeter monitor wells to the injection/production pattern wells in each mine unit are anticipated to be on the order of 500 feet. The distance between each of the monitor wells in the ring is also anticipated to be on the order of 500 feet. The actual distances will be based on the aquifer characteristics of that mine unit to ensure any excursion can be detected in a timely manner.

The completion interval of each monitor well will target the production zone adjacent to that well. Where there are adjacent pattern wells in more than one ore-bearing sand (UHJ, MHJ, LHJ), the corresponding monitor wells will be completed to monitor all of the targeted sands and will encompass all of the ore-bearing Sands in the production horizon.

The sampling frequency and parameters to establish baseline conditions and Upper Control Limits (UCLs) for these wells and to detect excursions are described in **Section OP 3.6.4.**

OP 3.2.2.2 Observation Wells

Where two or more ore-bearing Sands will be mined in a Horizon, observation wells may be installed between the pattern area and the perimeter monitor wells for enhanced control of the production zone and possible early detection of solution migration. The number, location, and depths of any observation wells will be based on the characteristics of each mine unit. These wells may be completed sequentially as mining progresses from the deepest to the shallowest Sand in the Horizon. The observation wells installed will be used only for internal tracking and control and will not be considered as points of compliance for water quality purposes. Monitoring parameters and frequency will depend on the purpose for which the observation well was installed.

OP 3.2.2.3 Production Zone Monitor Wells

Production zone monitor wells will be installed inside the pattern area to provide information on baseline conditions and on progress of recovery and restoration. The completion interval of a production zone monitor well will target the mineralized zone(s) adjacent to that well. The number of production zone monitor wells in a given mine unit will be based on the size of that pattern area and the density of production and injection wells in the pattern area. Most production zone monitor wells will also be used as injection and/or production wells. Sampling occurs only during baseline to aid in determining baseline parameters of the mine unit. The wells will be utilized again after mining is complete to monitor restoration progress.

OP 3.2.2.4 Overlying and Underlying Monitor Wells

Overlying and underlying monitor wells will also be completed in the aquifers immediately above and below the uppermost and lowermost mineralized zone, respectively. Overlying and underlying wells will be installed at a density of about one well for each four acres of mine unit area. The actual density will be based on the aquifer characteristics of the mineralized zone and the overlying or underlying aquifer; and specific locations may be targeted depending on the thickness and continuity of the shale separating the mineralized zone from the overlying or underlying aquifer.

If conditions are encountered at a prospective mine unit, such that vertical confining layers are very thin or absent, then the local stratigraphy will be evaluated and the mine unit operations and monitoring will be adjusted for the situation. These adjustments may include placement of the overlying or underlying monitor wells in different stratigraphic horizons within the mine unit, rather than in the separate overlying or underlying aquifer. Other adjustments could include additional operational controls, such as localized higher production rates, to help ensure none of the mining fluids migrate from the mineralized zone. In essence, use of higher localized production rates, without increasing injection rates, provides a more focused bleed rate and, therefore, greater localized control of production and injection fluids. A higher overall bleed rate is not required as the overall bleed will typically remain the same, therefore the water balance would not change. An example of localized higher production rates is shown on **Figure OP-9**.

Regional wells completed in the DE Sand, the uppermost aquifer, that are also within the monitor ring of an unrestored mine unit, will have water levels taken and samples collected once per quarter. The water samples will be analyzed for pH, chloride, and conductivity in an effort to detect any migration of mining solution.

OP 3.3 Well Completion

Monitor, production, and injection wells will be drilled to the target completion interval with a rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The well will then be cased and cemented to isolate the completion interval from all other aquifers. The cement will be placed by pumping it down the casing and forcing it out the bottom of the casing and back up the casing-drill hole annulus.

LC ISR, LLC will perform exploration and delineation drilling in each proposed mine unit prior to installing the injection and production wells. This allows the designing geologist to reasonably know the depth of the underlying shale prior to specifying the screen interval for the injection and production wells. If the underlying confining layer is penetrated, the hole will be plugged back above the confining layer to assure isolation prior to installation of the screen assembly. The screen assembly will not be place directly above (within three feet) of a thin section of the underlying confining layer.

The HJ Production Zone is approximately 425 feet below surface while the static water level for the same formation is approximately 175 feet below surface. A typical casing will be CertainTeed's spline-locking standard dimension ratio (SDR) 17 PVC well casing, which has a nominal 4.5 inch diameter, 0.291 inch minimum wall thickness, and is rated for 160 pounds per square inch (psi) burst pressure and 224 psi collapse pressure. This configuration provides a seal without the installation of screws to hold each joint together and has been proven effective at other ISR facilities. Casing centralizers, located every 40 feet, are run on the casing to ensure it is centered in the drill hole and that an effective cement seal is provided.

The purpose of the cement is to stabilize and strengthen the casing and seal the well annulus to prevent vertical migration of solutions. The volume of cement used is the calculated volume required to fill the annulus and return cement to the surface. In most cases, the cement returns to the surface, at least initially. However, in some cases, the drilling may result in a larger annulus volume than anticipated and cement may not return to the surface. In these cases, the upper portion of the annulus will be cemented from the surface. In the majority of cases, where the cement fails to return to surface, the reason will be a washout or a casing failure. In the event of a casing problem, the well will not pass the MIT. In all cases, wells are required to pass an MIT before operations approval. This will ensure sufficient integrity to allow the use of the well in handling lixiviant.

The typical pressure exerted on the casing during the cementing process is represented by the calculations below:

Collapse pressure: worst case is when the annulus is full of cement and the casing is full of chase fluid that is only comprised of fresh water. The highest collapse pressure occurs at the deepest casing depth:

= Depth of Casing x 0.052 x (Weight of Cement – Weight of Existing Fluid)
= (425 ft)(0.052)(15 ppg – 8.33 ppg)
= 147.4 psi which is less than the 224 psi collapse pressure

After the cement has set, the well will be completed. This involves under-reaming the desired completion interval to a diameter of 9.5 to 11 inches, depending on the tool configuration and the diameter of the original annulus. The well is then air-lifted for about one hour to remove any remaining drilling mud and/or cuttings. A swabbing tool is frequently run in the well for final clean-up and sampling. If sand production or hole stability problems are expected, a slotted liner, wire-wrapped screen or similar device may be installed across the completion interval to minimize the problem.

The maximum external pressure possible is represented by the calculation below. A rare example of this would be if the well were to pump dry with no recharge, especially given the hydrologic properties of the HJ sand unit.

External Pressure = (Depth of Casing – Depth to Water) x Weight of Fluid x 0.052
= (425 ft – 175 ft) x 8.33 lbs/gal x 0.052
= 108.3 psi which is less than the 224 psi collapse pressure

The maximum internal pressure or injection pressure will be governed by the fracture pressure, which is governed by the regional fracture gradient, or 0.7 psi/ft.

Internal Pressure = Depth to Injection Zone x (Fracture Gradient – Water Gradient)
= 425 ft x (0.7 psi/ft – 0.433 psi/ft)
= 113.5 psi which is less than the 160 psi burst pressure

The pressure ratings provided by the manufacturer are at ambient conditions without the benefit of cement supporting the casing or the lower temperatures typically seen subsurface at the Lost Creek Project. Experience at other ISR operations has shown that, using the proper weighting materials during cementing, PVC casing can be used at depths in excess of 1,000 feet below ground surface. In addition, each well must pass a mechanical integrity test prior to operation.

Typical well completions are illustrated in **Figures OP-8a, OP-8b,** and **OP-8c**. **Figure OP-8d** illustrates how wellheads completed in drainages will be protected from runoff from storms. Specifically, the purpose for wellhead protection in drainages is to deflect the force of flood water and heavy objects carried by the water. Completion data for installed wells will be submitted to NRC and WDEQ in the next Annual Report following the completion of the wells.

OP 3.4 Well Integrity Testing

After a well (injection, production, or monitor) has been completed and before it is used for any purpose (including water level measurements, sampling or pump testing), an MIT of the well casing will be conducted. An MIT will also be conducted on any injection well that has been damaged by surface or subsurface activity or that has had a drill bit or cutting tool inserted in the well. Any well with evidence of suspected subsurface damage will require an MIT prior to the well being returned to service. In addition, an MIT of each injection well will be done once every five years unless an alternate schedule has been reviewed and approved by WDEQ-LQD.

In the integrity test, the bottom of the casing adjacent to or below the confining layer above the zone of interest is sealed with an inflatable packer or other suitable device. The top of the casing is then sealed in a similar manner or with a cap, and a pressure gauge is installed to monitor the pressure inside the casing. The pressure in the sealed casing is then increased to a specified test pressure and will maintain 95 percent of this pressure for ten minutes to pass the test. If any well casing that fails the test cannot be repaired, the well shall be plugged and abandoned.

The MIT pressure is determined by the well properties and the type of well. There are three types of wells that will be tested at the Lost Creek Project: monitor well; production well; and injection well. The following discusses the MIT pressure for each:

Monitor Well – The purpose of an MIT on a monitor well is to insure casing integrity and that the samples received are only from the zone of interest; not from fluid leaking into the wellbore from other zones. Because a monitor well is only used for pumping fluid out of the well, no pressure is seen on the casing. Therefore, the MIT pressure cannot be based on the maximum operating pressure. Typically a representative MIT pressure will be chosen that will insure the well has mechanical integrity. Normally this pressure will be at least 50 pounds per square inch (psi) as measured at the wellhead.

Production Well – The purpose of an MIT on a production well is to insure casing integrity below the static and pumping fluid level and for potential future use as an injection well. Because a production well is used for pumping fluid out of the well, no pressure is seen on the casing other than that generated by the production fluid in the wellbore. Therefore, the MIT pressure cannot be based on the maximum operating pressure. However, during the operational life of a wellfield, injection and production wells may be switched to modify production flow paths and increase overall recovery. Because of this, the production well MITs are performed at the same pressure as the injection wells within the same header house, as outlined below.

Injection Well – The purpose of an MIT on an injection well is to insure casing integrity through the entire cased well. The MIT will typically be performed at 125% of the maximum injection pressure as dictated by the fracture gradient and the casing depth. An example is shown below:

MIT Pressure = Casing Depth x (Fracture Gradient – Water Gradient) x 1.25
= 425 ft x (0.7 psi/ft – 0.433 psi/ft) x 1.25
= 142 psi

If there are obvious leaks or the pressure drops by more than five percent during the ten-minute period, the seals and fittings will be reset and/or checked and another test will be conducted. If the pressure drops less than five percent, the well casing is considered to have demonstrated acceptable mechanical integrity.

If a well casing does not meet the mechanical integrity criteria, the casing will be repaired and the well re-tested or the well will be properly plugged within 120 days of the failed test. If a repaired well passes the MIT, it will be employed in its intended service. Also, if the well defect occurs at depth, the well may be plugged back and re-completed, within 120 days of the failed test, for use in a shallower zone, provided it passes an MIT after re-completion. If an acceptable test cannot be obtained after repairs, the well will be plugged within 120 days of the failed post-repair test. The documentation for the MITs will include the well designation, date of the test, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting the test. Results of the integrity tests shall be maintained on-site and will be available for inspection by NRC and WDEQ. A list of wells receiving an MIT, the dates of those MITs, and the designation of whether those wells passed or failed will be reported as part of the Quarterly MIT Report to WDEQ. Additionally, a database maintained at the site will include the records of the investigations performed to determine the cause of individual well failures. This information will be available to provide a tracking system of MIT well failures. Compilations of MIT failures will be produced and reviewed over time to determine if there are common elements or factors that contribute to the well failures.

Additionally, as with any operational or engineering activity, any abnormal or unexplained failures will be investigated. A variety of measures will be used during the investigation including subsequent tests at varying depths and pressures. In addition, a downhole camera may be used to support data obtained during the MIT(s). Also, typical to any investigation will be the correlation of materials, equipment, personnel and downhole conditions to the failure to determine if there is an ongoing problem. Any documentation associated with investigations will be kept on-site and may be included as part of the Quarterly MIT Report to the WDEQ-LQD.

In the event of a casing failure on an operating well, investigations will include all of the above as well as a determination of the extent of the leakage. Once the areal/vertical extent of the release has been determined, a program of remediation will be reviewed with the WDEQ-LQD and appropriate measures determined for containment and/or recapture. Once approved, the remedial action will be initiated and reported in the Quarterly MIT Report to the WDEQ-LQD.

OP 3.5 Mine Unit Piping and Instrumentation

Each injection well and production well will be connected to a specified injection or production manifold in a header house. The manifolds will route the injection solutions and production fluids to and from the Plant. Flow meters and control valves will be installed in the individual well lines to monitor and control the individual well flow rates and pressures.

Mine unit piping will be HDPE, PVC, stainless steel, or equivalent. The mine unit piping will typically be designed for an operating pressure of 150 pound force per square inch gauge (psig); and it will be operated at pressures equal to or less than the design pressure. The typical pressure rating, for both the PVC and HDPE piping materials used, is between 160 and 200 psig. If a higher design pressure is needed, the pressure rating of the materials will be evaluated and, if necessary, materials with a higher pressure rating will be used.

The individual well lines and trunk lines to the Plant will be buried to prevent freezing. The use of header houses and buried lines has been proven an effective method of protecting the pipelines at other ISR facilities with similar weather conditions to those at the Permit Area.

Instrumentation systems will be key to monitoring and maintaining the multiple processes in the field (e.g., the mine units) and in the Plant. Plant and Field Operators will use the data and information provided by the instrumentation systems to better manage the work areas. Operator control of key elements will be maintained; and instrumentation will assist in controlling pump operating levels and valve operation. When operating parameters move outside a specified normal operating range, it will cause an alarm that notifies the operator to initiate corrective action to alleviate the problem. Indication of abnormal operational conditions will initiate automatic shutdown of the related equipment. The key design component of the system will be to minimize the risk of uncontrolled releases of leaching solutions or other solutions and provide maximum safety and protection to the operators, other site personnel and the environment.

OP 3.6 Mine Unit Control

The techniques, that will be employed to ensure each mine unit is operating as efficiently as possible, will include monitoring of: production and injection rates and volumes, manifold pressures, water levels, and water quality. These criteria may be evaluated at more than one level (e.g., by mine unit, by header house, by pattern, or by well) depending on the specific criteria.

The most basic aspect of mine unit control is the bleed system, e.g., overproduction. The bleed system will be used so the volume of injection fluid will be less than the volume of production fluid in a mine unit. The overproduction will result in an inflow of groundwater into the pattern area and help reduce the possibility of an excursion. The anticipated bleed rate is 0.5 to 1.5 percent. Overproduction will be adjusted as necessary to control the distribution of the lixiviant within the production zone.

Monitoring and alarm systems will be located at the header houses and transmitted to the plant either by hardwire, microwave or spread spectrum radio. Systems monitored in the header houses will include:

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- Oxygen: Pressures will be monitored for abnormal operating conditions. High and low data points will be set for oxygen injection piping within the header houses. If pressures are outside the set points, Operators will be notified via alarm and Wellfield Operators will address the upset condition. Pressure switches and interlocks with the injection system will be used to insure that oxygen injection cannot occur without adequate flow and pressure in the injection header. The concept being that if oxygen is only allowed to enter the injection header when water is present, then dangerous concentrations cannot build up in the piping.

- Production Systems: The main header pressure and flow rate will be monitored as well as the flow rate of each of the production wells for abnormal operating conditions. The On/Off status of each of the pumps will also be monitored. The main header pressure and flow rate will have high and low set points. If there is an upset condition, Operators will be notified via alarm and Wellfield Operators will address the upset condition. The same is true for individual production well flow rates as well as the On/Off status of the pumps. Differential flow algorithms may be used to review flow status to determine if there is a potential problem. Production wellheads will have fluid detection systems to alarm of a leak. The fluid will close a circuit that will generate an alarm either locally, at the plant, or both. There are several levels of control and shutdown within the production system. A programmable logic computer will be connected to the Plant and will allow for shutdown of production wells in upset conditions. The main valve will be capable of being shut based on operating conditions, e.g.' sump overflow or ruptured flowline. The motor control center will typically be interlocked with the sump high level shutoff to shut down operating pumps. The wellhead alarm systems will typically use any leaking fluid to complete a circuit and initiate an alarm in the form of either an audible/visible alarm locally or by transmitting an alarm to the operations center. A simple system included in the piping uses check valves to insure that pipeline production fluid cannot enter shutdown sections of pipe.

- Injection Systems: The main header pressure and flow rate will be monitored as well as the flow rate of each of the injection wells for abnormal operating conditions. The main header pressure and flow rate will have high and low set points. If there is an upset condition, Operators will be notified via alarm and Wellfield Operators will address the condition. The same is true for individual injection well flow rates. Differential flow algorithms may be used to review flow status to determine if there is a potential problem. Injection wellheads will have fluid detection systems to alarm of a leak. The fluid will close a circuit that will generate an alarm either locally, at the plant, or both. Control of this system begins with the control valve where the injection fluid enters the header house. This valve will maintain the appropriate pressure and flow for the local operating conditions as well as allow for complete shutdown of injection. Data from the main flow line and the individual injection wells will be transmitted to the Plant for review. If there is an upset condition, operators will be notified and suspect area will be shut down for maintenance.

- Sumps: Levels and the operating status of the sump pumps in the header houses will be monitored and transmitted to the Plant for review/alarm. If sumps have fluid in them, the sumps will be activated and the fluid pumped into the production header or alternate means of transport to the waste disposal system. Any time the sumps are activated, the Plant Operator will receive an indication. If a high level in the sump is received, the Operator will receive an alarm and the Wellfield Operator will address the upset condition. High sump levels will also initiate a shutdown in the header house flow systems.

The Plant Control Room will be the central point where data from header houses and all plant operating systems will be available. A Plant Operator will be on-site 24 hours a day and available to respond to upset conditions as transmitted to the Control Room monitoring system. Monitoring and alarming of production systems in the mine units and in the plant will also occur 24 hours a day. Data will be captured and stored as appropriate, locally at the point of monitoring with alarms and trending stored at the plant control room as well. The Control Room system will monitor and/or store the following:

- Header House injection and production flow totals, header pressures, high/low set point alarms, individual well alarms and sump alarms;

- All operational data and alarms for plant internal systems including, but not limited to, ion exchange, elution, precipitation, restoration, waste storage, waste disposal and chemicals.

The monitoring and alarming of the production systems allows the operations staff to control mine unit flow and balance through flow set points, alarms, monitoring of overlying, underlying and surrounding monitor wells and through a regular presence in the wellfield with Lost Creek's operators and other operational staff. This, in conjunction with testing of systems prior to operation, timely maintenance of faulty systems and task training of personnel in installation and operation of monitoring systems will insure proper control of production units. An additional control measure will be the manual review of each operating header house at least once per shift.

OP 3.6.1 Header House Control

Within each mine unit, injection and production balance will be monitored in well groupings related to header houses. The production and injection wells within each header house will be monitored individually or by production or injection headers, which are groups of production or injection wells piped together, depending on the monitoring parameter. The instrumentation will allow: monitoring of the header house solution balance; monitoring manifold pressures; and shutdown of flows in the event of a piping failure. Other instrumentation in the header house will include automatic oxygen shut-off and leak detection.

The hydrologic balance is determined by summing the flow rates of the injection and production wells separately and controlling the rates such that each header house is receiving the same injection volume per unit time as is being produced, minus the bleed volume. In a stable operating mine unit, the well flows observed will only fluctuate minimally from day to day. Appropriately designed flow meters will be used to measure the individual flow rates of each well. As a redundant control measure, flow meters will also be installed on the main pipelines entering and exiting each header house. The individual well flows will be monitored and adjusted daily and the pipeline meter will be monitored continuously with the instrumentation system.

All production and injection headers will have pressure gauges; and the pressures will be recorded daily. Pressure switches will be installed on the production wells and injection header in each header house. These switches will be designed to detect a piping failure and to shut down power to the production wells. In normal operation, when one header house has an event that trips the power to that house, the pressure change is noticeable throughout the system and other header houses will alarm the operator and subsequently shutdown.

The pressure information on the injection well headers is necessary to help ensure that the injection pressures do not exceed the formation fracture pressure or the rated pressure for the well casing. Regional information and historical operational practices indicate that the minimum pressure that could initiate hydraulic fracturing is 0.70 psi per foot of well depth. Further, injection pressures also will be limited to the pressure at which the well was integrity tested. During mine unit operations, injection pressures shall not exceed the MIT pressures at the injection wellheads (**Section OP 3.4**). Not withstanding this restriction, the maximum injection operating wellhead pressures shall not exceed 90% of the production zone fracture pressure or 95% of the American Society for Testing and

Materials (ASTM) maximum recommended operating pressure at 75°F for the well casing at the surface, whichever is less.

An example of the determination of the maximum injection pressure would be as follows:

Maximum injection pressure will be the lesser of the following:

Minimum MIT Pressure = 95% of the Manufacturer's Maximum Internal Pressure;
95% of the ASTM and/or Manufacturer Maximum Operating Casing Pressure; or
90% of the Production Zone Facture Pressure.

Using the following values:

Well Casing Depth = D in feet;
Maximum Casing Pressure from Manufacturer and/or ASTM = $P_{max;}$
Fracture Gradient = G_f = 0.7 psi/ft;
Water Gradient = G_w = 0.433 psi/ft; and
Lixiviant Gradient = G_w = 0.437 psi/ft;

the maximum injection pressure would be the less of:

P_{mit} = Maximum Injection Pressure based on Passing MIT Pressure = 0.95 x P_{max};
P_{csg} = Maximum Injection Pressure based on ASTM and/or Manufacturer = 0.95 x P_{max}; or
P_{Frac} = Maximum Injection Pressure based on Fracture Gradient = 0.9 x D x $(G_f - G_w)$

The oxygen system in each header house will have solenoid operated valves that will close in the event of a power loss or injection flow shutdown. This will prevent the continued delivery of oxygen to the pipeline when the field is not operating. Other operational safety features include, but are not limited to, a set of wet contacts or a conductivity probe installed in the sump in each header house to detect fluids on the floor of the house. If fluids are detected, the shunt will be tripped and electrical power to the production wells will be turned off. An audible and visual alarm system will be activated. Remote shutoff of the well pump power supply will also be available at each of the header houses.

OP 3.6.1.1 Plant Control Room

The Plant Control Room will house the main computer system that will monitor wellfield operating systems. Data from the wellfield instrumentation will be transmitted to the plant control room either by hardwire or wireless means. A Plant Operator will be on-site 24 hours a day to monitor the data being sent from the wellfield and a Wellfield Operator will be on-site 24 hours a day to respond to upset conditions.

The wellfield instrumentation will monitor the flows and pressures of production and injection systems. If the set tolerance limits for a monitored parameter is exceeded, then an alarm located within the plant facility will alert the Plant Operator of an upset condition in the wellfield and to its location. Radio communications between the Plant and Wellfield Operators will allow for timely response to alarms regardless of location. A record of each alarm will be noted in the plant control room log book, indicting the date, time and who responded in the wellfield. Also, each alarm event will be captured and stored electronically on the plant control room computer system.

All Operators will be task trained in the proper operation of systems within their department. Maintenance on systems deemed faulty will be the responsibility of the Wellfield Operators or the Maintenance department depending on the nature of the fault. Employees will be task trained on the appropriate installation and testing of monitoring systems and all systems will be tested prior to initial operation.

The wellfield instrumentation system is comprised of the following components: Leak Detection; System Integrity; Tolerance Limits; Oversight; and Redundancy.

Leak Detection

The basis for monitoring flow and pressure in pipelines is the prevention of leaks. There will be three layers of protection associated with the wellfield instrumentation:

1) Monitoring and Data Output;
2) Alarm and Notification; and
3) Control and Shutdown.

Additional details about each of these layers of protection are included below.

1) Monitoring and Data Output
   a) Oxygen: Oxygen pressures will be monitored for abnormal operating conditions.
   b) Production Systems: The main header pressure and flow rate will be monitored as well as the flow rate of each of the production wells for abnormal operating conditions. The On/Off status of each of the pumps will also be monitored.
   c) Injection Systems: The main header pressure and flow rate will be monitored as well as the flow rate of each of the injection wells for abnormal operating conditions.
   d) Header House Sumps: Sump levels and the operating status of the sump pumps in the header house basements will be monitored and transmitted to the Plant for review/alarm.
2) Alarm and Notification
   a) Oxygen: High and low data points will be set for oxygen injection piping within the header houses. If pressures are outside the set points, the Plant Operator will be notified via alarm and the Wellfield Operator will address the upset condition.
   b) Production Systems: The main header pressure and flow rate will have high and low set points. If there is an upset condition, the Plant Operator will be notified via alarm and the Wellfield Operator will address the upset condition. The same is true for individual production well flow rates as well as the On/Off status of the pumps. Differential flow algorithms may be utilized to review differential flow status to determine if there is a potential problem. Production wellheads will have fluid detection systems to alarm of a leak. The fluid will close a circuit that will generate an alarm either locally, at the plant, or both.
   c) Injection Systems: The main header pressure and flow rate will have high and low set points. If there is an upset condition, the Plant Operator will be notified via alarm and the Wellfield Operator will address the upset condition. The same is true for individual injection well flow rates. Differential flow algorithms may be utilized to review differential flow status to determine if there is a potential problem. Injection wellheads will have fluid detection systems to alarm of a leak. The fluid will close a circuit that will generate an alarm either locally, at the plant, or both.
   d) Header House Sumps: If sumps have fluid in them, the sumps will be activated and the fluid pumped to the plant. Anytime the sumps are activated, the Plant Operator will receive an indication. If a high level in the sump is received, the Plant Operator will receive an alarm and the Wellfield Operator will address the upset condition.

3) Control and Shutdown
   a) Oxygen: Pressure switches and interlocks with the injection system will be utilized to insure that oxygen injection cannot occur without adequate flow and pressure in the injection header. The concept being that if oxygen is only allowed to enter the injection header when water is present, then dangerous concentrations cannot build up in the piping.
   b) Production Systems: There are several levels of control and shutdown within the production system. The Programmable Logic Controller (PLC) will be connected to the Plant and will allow for shutdown/startup of all production wells in upset conditions. The main valve will be capable of being shut based on operating conditions, i.e. sump overflow, ruptured flowline, etc. The motor control center (MCC) will typically be interlocked with the sump high level shutoff to shut down operating pumps. The wellheads will typically utilize any leaking fluid to complete a circuit and initiate an alarm in the form of either an audible/visible alarm locally or by transmitting an alarm to the plant control room. Simple systems included in the piping include check valves to insure that pipeline production fluid cannot enter shutdown sections of pipe.
   c) Injection Systems: Control of this system begins with the control valve where the injection fluid enters the header house. This valve will maintain the appropriate pressure and flow for the local operating conditions as well as allow for complete shutdown of injection. Data from the main flow line and the individual injection wells will be transmitted to the Plant for review. If there is an upset condition, operators will be notified and the suspect area will be shut down for maintenance. The wellheads will typically utilize any leaking fluid to complete a circuit and initiate an alarm in the form of either an audible/visible alarm locally or by transmitting an alarm to the operations center.
   d) Header House Sumps: High sump levels will initiate a shutdown in the production wells and alarm the Operators.

System Integrity

As with any system, one of the keys to the overall integrity is a regular presence of Operators in the mine units. The Operators will be responsible for taking measurements and looking for leaks and problems at the header houses. In addition, their regular routine will include checking each of the wellheads for leaks or salts and repairing them as needed. They will also be required to drive the pipeline routes and check the valve stations for leaks and signs of moisture. Also key to the proper operation is the additional review of operational data by managers and engineers. Verifying data through calculation and providing technical support to the operators will be routine to their activities.

Tolerance Limits

Differential flow algorithms may be utilized to review differential flow status to determine if there is a potential problem.

Oversight

The facility will have coverage 24 hours a day, 7 days a week from both Wellfield Operators and Plant Operators.

Redundancy

The system has multiple components with varying points of redundancy, including:

- Flow data capture/analysis and sump alarms and wellhead leak detection in header houses;
- Pipelines have flow measurement at the distribution and reception points as well as pressure comparison.

OP 3.6.2 Pattern Control

Balanced patterns are necessary to achieve optimum production and to minimize flare of the lixiviant from the pattern areas. Increased flare from the patterns reduces production efficiencies and increases the effort required to restore the groundwater after production is concluded. Balanced patterns are also necessary to prevent excursions of production fluids from the mine units.

Patterns will be balanced by adjusting the injection and production flow rates to maintain production flow rates equal to injection rates plus the bleed rate. There are two types of operational constraints encountered in mine unit balancing: injection limitations and production limitations. Injection-limited patterns have more available production capacity than the injection wells can accept. This situation usually arises due to plugging of injection wells and can be remediated by servicing the injection wells. Production-limited patterns have a greater injection capacity than the production well can effectively produce.

OP 3.6.3 Projected Water Balance and Water Level Changes

In addition to evaluating the operation of each mine unit individually, the overall water balance and water level changes will be taken into account to ensure all aspects of the operation (e.g., ISR and restoration) are being conducted as efficiently as possible. The overall water balance is based on the potential pumping and injection rates at the mine units and the capacity of the Plant and Class III UIC wells for production and for restoration. The water level changes, including both drawdown and mounding from production and injection, respectively, will be evaluated to minimize interference among the mine units and to determine cumulative drawdown.

OP 3.6.3.1 Water Balance

The water balance requirements for the facility over various life-of-project operational modes are presented in this section for the purpose of discussing the correlation of the capacity requirements of the production and restoration schedules with the water/waste water treatment and disposal systems. The water balance discussion, figures and tables included in this section consider the production and restoration phases to be operating at maximum flow capacity so, the full potential contribution of each unit operation to the water balance can be analyzed.

Full production plant capacity is planned for a nominal maximum flow rate of 6,000 gpm. This capacity is determined by the pump and pipeline system design along with the flow rate design capacity of the ion-exchange system. Process plant facilities downstream of the ion exchange circuit have little to no impact on the water balance requirements. A 200 gpm reverse osmosis (RO) treatment unit is incorporated into the production system design. The RO system output will be adjustable to produce concentrated brine at a rate equivalent to the production bleed requirement of 0.5 to 1.5 percent of the production flow. When operating at maximum capacity, the bleed stream will be at or near 60 gpm. The RO permeate produced (140 gpm) will be returned to the injection lixiviant stream. Incorporating a RO unit into the production stream throughout the operating life will result in lower concentrations of contaminants building up in the lixiviant circuit. The design is expected to ultimately reduce the time and volume requirements for groundwater restoration without altering the production water balance inputs and outputs.

The restoration circuit is designed to process produced water from both the ground water sweep (GWS) and the RO treatment phases of restoration. The circuit will be installed within a designated area of the plant facility. The restoration circuit will be designed to treat a nominal maximum flow of 600 gpm. The capacity of the circuit is determined by the sizing of the ion-exchange and primary RO systems. The primary restoration RO units will be designed to produce a 75/25 split of permeate/brine. The permeate stream will be treated for injection into the active restoration areas while the brine is managed as waste water or treated with a secondary reverse osmosis unit.

A secondary reverse osmosis system will be installed to re-treat the combined brine streams of the primary restoration and production RO units. The unit will have a designed feed capacity of 250 gpm. The secondary RO unit will be operated as a water management tool whenever the combined flow rate of the two primary brine streams exceeds the objective for net consumptive removal of the operating areas. Permeate from the secondary RO will be beneficially used in the restoration circuit to reduce the rate of consumptive removal from the process. The brine produced by the secondary RO will be managed as waste water. This type of system has been demonstrated as technically viable during the groundwater restoration operations of the Christensen Ranch ISR facility and incorporation of the secondary RO unit into the process is considered BPT.

The capacity (flow rate) of the mine unit injection wells will determine the number of wells required in operation to arrive at the plant flow rate capacities for production and injection. LC ISR, LLC has used transmissivity and storativity data determined from aquifer characterization tests (**Appendix D6**) to arrive at an expected average flow rate of 32 gpm per recovery well. Since injection well efficiency approximates production well efficiency and the transmissivity of the formation ultimately defines the rate that water moves through the pore space, the number of injection wells should be expected to closely approximate the number of production wells. However, other factors including ore geometry and effective pattern design often result in injector to producer well ratios of 2:1 or greater. The design basis for the Lost Creek Project is derived to provide the nominal maximum production plant capacity (6,000 gpm) from each typical mine unit. Therefore, each typical mine unit includes approximately 180 (32 x 180 = 5,760 gpm) production wells and 360 (2:1) injection wells in use at any given point in time. The capacity of the mine unit injection wells is not expected to be diminished during the restoration operations. Therefore, full restoration activities will only occur in a portion of a given mine unit at any point in time.

The process liquid waste will be managed through a UIC Class I well system. LC ISR LLC has applied to the WDEQ-WQD for approval of up to five Class I wells to serve the waste water disposal needs of the Project. The application, if approved, would authorize the operation of each well at a rate not exceeding 50 gpm (250 gpm total). LC ISR, LLC anticipates that the installation and operation of three Class I wells will capably exceed the maximum rate of waste water production (gross consumptive use) throughout the planned life of the Project. LC ISR, LLC will install additional disposal wells (up to five in total) as required to meet the disposal needs. The maximum rate of waste water production is further discussed in the remainder of this section.

LC ISR, LLC intends to install two waste water storage ponds at the Lost Creek plant site. Each pond will have the capacity to store 2.3 acre-foot (approximately 750,000 gallons) of water. While the ponds will naturally create a net annual loss of water via evaporation, the primary purpose and function of the ponds is to provide an outlet for flow surges during brief periods of process adjustments. The water balance does not take into account any requirement for water disposal via evaporation at the waste water storage ponds.

The plant processes occasionally require fresh water for chemical solution make-up, cooling, cleaning and other general uses. A well will be installed for the purpose of supplying plant process water. The well will not be completed in the uranium mineralization host formation (HJ Horizon) and thus will not contribute to the net consumptive removal and cumulative draw down of the HJ Horizon. LC ISR, LLC estimates that a facility of this type and capacity will require on average 10 gpm of process water. Once used for process purposes, the water is assumed to require disposal via the waste water management system.

The water balance for the project is based on the operating scenarios shown in **Figure OP-4a**. As the project begins operations, groundwater will be pumped from the first mine unit production zone to the processing plant. This water will be run over ion exchange beds for uranium capture and pumped back to the mine unit for injection after being fortified as described in **Section OP 3.1**. The flow is planned to increase in a stepwise fashion with a header house (estimated 640 gpm) brought on each month until approximately 6,000 gpm of flow is attained. Additional header houses will be brought on-line as others are taken off-line with the emphasis on maintaining productive flow through the plant at 6,000 gpm. Flow from the next mine unit will begin in sequence following the previous mine unit without interruption. Therefore, the total production flow makeup coming into the plant will typically be a combination of flow from more than one mine unit without exceeding the maximum permitted flow rate through the plant.

Figure OP-4a also details the timing of restoration flow. To facilitate proper control of both production and restoration fluids, restoration will not typically begin in any mine unit until all production flow has ceased. Because of this, production may occur from more than one mine unit to maintain the maximum allowable production flow without restoration occurring simultaneously in those mine units. **Figure OP-4a** demonstrates this principle by showing production from more than one mine unit on two occasions. This figure also shows the same concept with restoration occurring in more than one mine unit. For example, in Year 4, two mine units should be in production, and one mine unit should be in restoration; in Year 6 one mine unit should be in production, and two mine units should be in restoration. Again, the basic concept is to maximum restoration performance and restoration equipment usage to optimize restoration. Any changes to the schedule will be addressed as discussed in **Section OP 2.1** (Project Schedule).

The water balance for the Lost Creek Project is presented for six representative operational modes in **Table OP-6** (Water Balance Summary) and **Table OP-7** (Water Balance – Calculation Details). The water balance for the same six operational modes is illustrated in **Figures OP-5a**, **b**, **c**, **d**, **e** and **f.** The following discussion presents the correlation of the capacity requirements of the production and restoration schedules with the water/waste water treatment and disposal systems for each of the six representative operational modes.

Initially, the project should be ramped up to the nominal maximum production rate while no mine units are available for restoration activities. **Figure OP-4a** indicates this operational mode to occur during the first 26 months of operation. **Figure OP-5a** illustrates the "Production Only" project water balance representing early stage operations at the project. The net consumptive removal would be limited to the level of bleed required to control the flow of fluids within the mine unit(s) in production (1% of 6000 gpm = 60 gpm). The plant process water supply well contributes an additional 10 gpm to the water balance (in and out). The restoration plant is idle while waiting for the first mine unit to become available for groundwater restoration activities. There is insufficient flow available to operate a secondary RO unit. The gross consumptive use of groundwater is 70 gpm (60 + 10). It will be necessary to have an operational waste water disposal capacity of 70 GPM during this operational mode. Two disposal wells will be required. The net consumptive removal from the mine unit(s) contributing to the cumulative drawdown of the aquifer is 60 gpm (**Table OP-6**).

As the project matures, the first mine unit will be determined to be depleted and ready for groundwater restoration operations. Groundwater restoration will be initiated with the GWS phase to prepare a portion of the unit (one or more header house areas) for reverse osmosis treatment. The second operational mode (**Figure OP-5b**) is projected to last for only two-months (**Figure OP-4a**). Plant inflows (**Table OP-6**) will consist of 6,000 gpm of production, 30 gpm of GWS and 10 gpm of process water. Plant outflows will consist of 5940 gpm of injection, and 100 gpm of waste water. The restoration plant primary and secondary RO units will be idle due to insufficient available feed. The gross consumptive use of groundwater is 100 gpm (60 brine + 30 GWS + 10 process bleed). It will be necessary to have an operational waste water disposal capacity of 100 gpm during this operational mode. Three disposal wells will be required. The net consumptive removal from the mine unit(s) contributing to the cumulative drawdown of the aquifer is 90 gpm (**Table OP-6**).

As GWS is completed in a large enough portion of the first mine unit, the third operational mode as depicted in **Figure OP-5c** will be initiated. It is anticipated that production operations, restoration sweep and groundwater treatment (RO) will all occur contemporaneously for an extended period during the life of the project. In this operational mode, plant inflows (**Table OP-6**) will total 6610 gpm; consisting 6000 gpm of production, 30 gpm of GWS, 570 gpm of RO phase recovery and 10 gpm of process water. Plant outflows will also total 6610 gpm; consisting of 5940 gpm of injection to the production mine units, 555 gpm of permeate going to the restoration mine unit and 115 gpm of waste water. The gross consumptive use of groundwater is 115 gpm (105 brine + 10 process bleed). Three disposal wells will be required. The net consumptive removal from the mine unit(s) contributing to the cumulative drawdown of the aquifer is 105 gpm (**Table OP-6**).

Although not presently projected, production operations could occur with RO restoration but not GWS restoration as depicted in **Figure OP-5d.** This mode could occur if GWS was deemed complete in all available mine units but RO restoration requirements are ongoing. The water balance as a whole is not significantly changed by the shifting of the source of restoration recovered water from GWS to RO. The waste water requirements for this mode are unchanged from the operational mode illustrated previously.

Restoration operations will continue for a period of time after production operations are completed. **Figure OP-5e** illustrates the post-production mode when both GWS and RO restoration are active. The 200 gpm production RO Unit will be tied in to the restoration circuit to increase the rate of active restoration. In this operational mode, plant inflows (**Table OP-6**) will total 810 gpm; consisting of 40 gpm of GWS, 760 gpm of RO phase recovery and 10 gpm of process water. Plant outflows will also total 810 gpm; consisting of 700 gpm of permeate going to the restoration mine unit and 110 gpm of waste water. The gross consumptive use of groundwater is 110 gpm (100 brine + 10 process bleed). Three disposal wells will be required. The net consumptive removal from the mine unit(s) contributing to the cumulative drawdown of the aquifer is 100 gpm (see **Table OP-6**).

It would not be technically feasible to have restoration flow rates equal to production flow rates. The restoration processes produce a higher ratio of waste water to produced water than production processes, creating a more pronounced drawdown of the aquifer's piezometric surface. Therefore, to avoid 'pulling in' considerable quantities of unaffected groundwater (i.e., a higher bleed rate), dropping water levels below pumps; and other consequences of pronounced drawdown, the flow rate during restoration is not the same as the production flow rate. Further, restoration is expected to be completed in a fraction (2/10th) of the pore volumes it takes to complete production. If an operator restored wellfields at a flow rate equal to the production flow rate, the restoration circuit would be idle nearly 80% of the time and the required waste water disposal rate would be many times higher (when operated) than the disposal rate included in the operating plan. This scenario could not be justified because of: the extreme rate and volume of waste water generated over short periods of time (estimated at 1,150 GPM); extreme and unsustainable drawdown and recharge during the periodic restoration activities; and economic considerations (capital requirements for a 6,000 GPM water purification facility).

It should however be feasible to maintain a rate of restoration progress equal to the rate of production progress. The result of a proper design would be that wellfields are restored in an equal amount of time as the production life of a typical wellfield. This is the design basis for LC ISR LLC's proposed mine plan (**Figure OP-4a**) and water balance (**Figures OP-5a** through **OP-5f**). LC ISR, LLC planned for a 60 pore volume (PV) production life at 6,000 GPM. The critical restoration stage (RO) is projected to require 10% of the production PVs (i.e., 6 PVs) and to thus operate at 10% of the production flow rate (average over life-of-project is approximately 600 GPM). The rate of completion of the groundwater sweep (GWS) phase of restoration would also match the rate of depletion of the production areas when properly designed and planned. Since GWS will involve less than one pore volume (see response to Response to Comment OP5, RP#1 for complete explanation), the required flow rate for GWS is designed to commonly be 30 GPM. Operating GWS at pre-determined/controlled flow rate will minimize the likelihood of excessive consumption of groundwater resources for this minimally effective restoration activity. The end result of proper design and planning is that there is adequate and appropriate restoration capacity available for each wellfield at the point in time that it is expected to be depleted and ready for restoration. When the restoration rate equals the production rate, operations would not be extended in one operational phase due to lack of capacity for the next sequential phase.

As restoration operations are nearing completion, GWS will be deemed complete and the only restoration activity remaining that impacts the water balance will be RO treatment. **Figure OP-5f** illustrates the post-production mode when only RO restoration is active. The water balance as a whole is not significantly changed by the shifting of the source of restoration recovered water from GWS to RO. The waste water requirements for this mode are unchanged from the operational mode illustrated previously.

Incorporating the water balance design parameters discussed above into the schedule presented in **Figure OP-4a**, an average net consumptive removal flow (gpm) from the mine units over the life-of project was determined to be 89 gpm. The impact of this consumptive removal on the cumulative drawdown of the aquifer is discussed in **Section OP 3.6.3.3**.

OP 3.6.3.2 Mine Unit Interference

Decisions about the order in which mine units will be brought on line and the rates at which they will be developed and restored will depend, in part, on the potential for interference among the mine units. As noted in **Section OP 3.2**, any particular concerns about interference will be addressed in the Hydrologic Test Proposal and Report.

OP 3.6.3.3 Cumulative Drawdown - Mine Unit Operations

As discussed in **Appendix D6**, a regional pump test has been conducted to assess the hydraulic characteristics of the HJ Horizon and overlying and underlying confining units. Pump tests also will be performed for each successive mine unit in order to assess hydraulic containment above and below the production zone, demonstrate communication between the pattern area and perimeter monitor wells, and to further evaluate the hydraulic properties of the HJ Horizon.

Based on a bleed of 0.5 to 1.5 percent, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 98 percent) of groundwater used in the ISR production and restoration process will be treated and re-injected (**Table OP-6**).

During ISR operations, extraction of groundwater will result in drawdown within the production zone aquifer, and potentially, in the overlying and underlying aquifers. Additional drawdown will occur in aquifers that are pumped to the water supply requirements for dust suppression, drilling, plant process and wash water, and potable water. Drawdown estimates for the mine units are described below, and **Section 3.6.3.4** addresses drawdown related to water supply requirements.

Drawdown will be greatest in the immediate vicinity of the mine units. A numerical model was used to assess drawdown impacts from Lost Creek ISR operations. The model was developed using site-specific data based on geologic and hydrologic information collected from site characterization activities. The model development, calibration and simulations are described in the report "Numerical Modeling of Hydrologic Conditions at the Lost Creek In-Situ Recovery Uranium Project, Wyoming" found in Addendum 5-1 of the MU1 Volume. Simulations were run representing the full production-restoration sequence for Mine Unit 1. The simulation included a production phase at a maximum rate of 5,838 gpm (with a net bleed of 38 gpm or 0.65%) for a period of 26 months (791 days), groundwater sweep at 30 gpm for 12 months (365 days), and treatment with RO at 541 gpm for 18 months (548 days). The total simulation period was 56 months (4.75 years). During RO, the simulated consumptive use (reject brine) was 67.6 gpm. Simulated drawdown during the maximum production rate is shown on **Plate OP-4a**. Drawdown during the RO phase is shown on **Plate OP-4b**. The 5-foot drawdown contour extends a maximum of 3.3 miles (17,250 feet) beyond the Permit Area boundary. The maximum drawdown outside the Permit Area boundary is slightly greater than 25 feet. This occurs where Mine Unit 1 is closest to the Permit Area boundary. Although this simulation only represents production and restoration from Mine Unit 1, the production and RO rates are maximized. During a portion of the Lost Creek ISR operations, full production and restoration could occur simultaneously; thus, the cumulative effect is represented by combining the predictions represented on **Plates OP-4a** and **OP-4b** and accounting for some shift in mine unit location.

The nearest surface water body to the Permit Area is the Sweetwater Mill Pit Lake (**Plates OP-4a** and **OP-4b**). It is unknown if the Sweetwater Mill Pit intercepts strata that are the stratigraphic equivalent of the HJ Horizon. The effects of the Sweetwater Mill Pit Lake on the hydrology of the HJ Horizon, or vice versa, are unknown. Regardless, performing the Cumulative Effect Analysis described in the previous paragraph of projected Lost Creek ISR operations, approximately two feet or less of drawdown is projected at distances as far as the Sweetwater Mill Pit Lake. The Sweetwater Mill operation (Permit 481) has collected water level data from the Pit Lake for approximately 20 years. Based on a review of the Permit 481 Annual Report, it appears that Pit Lake water levels have remained relatively constant over 12 years. Water elevation records for the Pit Lake are believed to be of sufficient length to provide a reasonable baseline of expected fluctuations. In conjunction with the data collected as specified in the Monitoring Plan (see **Attachment OP-8**), LC ISR, LLC will utilize the data available in the Permit 481 Annual Report to perform an ongoing assessment of impacts. In the event that the Sweetwater Mill Pit Lake experiences unacceptable drawdown (greater than two feet), LC ISR, LLC will cooperate with the owner of the Sweetwater Mill to determine the cause of the drawdown. If the Lost Creek ISR operations are determined to be the cause of the drawdown, LC ISR, LLC will work with the Sweetwater Mill Pit Lake owner to develop and implement a mutually agreeable solution.

The estimated drawdown from production and restoration will not result in loss of use of wells outside of the Permit Area. Even so, as discussed in **Section OP 2.11.2.2**, monitoring of off-site wells is planned.

OP 3.6.3.4 Cumulative Drawdown - Water Supply Wells

Drawdown will occur in aquifers that are pumped to meet the water supply requirements for dust suppression, drilling, plant process and wash water, and potable water. Water supply wells will include two wells completed in the FG Horizon, one well completed in the HJ Horizon, three wells completed in the KM Horizon, and one well completed in the N Horizon. Potable water and dust suppression requirements are minimal at 250 and 300 gallons per day, respectively (0.17 and 0.21 gpm). Plant process and wash water will require approximately 10 gpm, and drill water will require approximately 24 gpm. The proportion of water to be pumped from each of the water supply wells has not been determined. It is assumed that more water will be pumped from the deeper aquifers than from the FG horizon because of generally lower transmissivity of that aquifer. For purposes of this estimate, the 35 gpm is divided between the seven water supply wells as follows:

Aquifer	Number of Wells	Total Pumping Rate (gpm)
FG	2	5
HJ	1	10
KM	3	10
N	1	10

Aquifer properties of the FG and KM (as the UKM) aquifers are listed in **Table D6-11**. The representative values for the transmissivity of the FG Horizon are between 8 and 28 ft^2/d (60 and 200 gpd/ft^2). A value of 18 ft^2/d is used for the calculations. The representative values for the KM Horizon transmissivity are between 60 and 92 ft^2/d (450 and 570 gpd/ft^2). A value of 76 ft^2/d is used for the calculations. Because no data are available for the N sand, it is assumed that unit has similar properties to the overlying KM Horizon. No storativity data are available so it is also assumed that all of the aquifers have a similar value to the HJ Horizon of 7.0E-05. An eight-year life-of-mine is assumed. The estimated drawdown at distances from the centroid of the Permit Area for each of the aquifers at the end of eight years is estimated using the Theis non-equilibrium solution.

The calculated drawdown is as follows:

	Drawdown (ft)		
Aquifer	2 miles	3 miles	5 miles
FG	11.7	8.4	4.7
KM	8.4	6.8	4.8
N	8.4	6.8	4.8

The drawdown in the HJ Horizon was not calculated herein, because the modeling previously described indicates that pumping of 10 gpm will result in less than 5 feet of drawdown outside the Permit Area.

Use of the Theis solution implies numerous assumptions that are not fully applicable. In particular, because the Theis solution does not account for recharge to the aquifers, the predicted drawdown is overestimated. Therefore, the drawdown resulting from water supply wells will most likely be less than five feet in the FG, KM and N Horizons at distances greater than three miles from the center of the Permit Area (or generally two miles outside the Permit Area). Furthermore, if excessive drawdown were to occur to the shallow FG Horizon during water supply pumping, the allocation of pumping rates would be shifted so as to withdraw a greater proportion of water supply from the other water supply wells completed in the deeper aquifers.

OP 3.6.4 Excursion Monitoring and Control

Excursion monitoring and control is designed to identify any unanticipated impacts to hydrology of the Permit Area and its vicinity during ISR activities and provide measures that may be used singly or in combination to address the unanticipated impacts. The excursion monitoring augments the above information on production and injection control, such as injection rates and pattern balance, which is instrumental to efficient ISR.

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OP 3.6.4.1 Mine Unit Baseline Water Quality and Upper Control Limits

Excursion monitoring includes the monitor ring wells completed in the same sand as the pattern area and monitor wells in overlying or underlying water-bearing strata. Excursion detection is based on comparison of concentrations of specific parameters with the Upper Control Limits (UCLs) for those parameters, which are calculated from the baseline concentrations of those parameters.

After delineation of a pattern area, monitor wells will be installed around that area as described in **Section OP 3.2**. A pump test will be used to verify communication between monitor wells in the monitor ring and the pattern area and lack of communication between the pattern area and overlying and underlying monitor wells. Baseline groundwater samples will be collected in accordance with the protocols in LC ISR, LLC's Environmental Manual.

As a part of the baseline assessment, all the mine unit monitor wells will be sampled at least four times at intervals at least 14 days apart. Water levels will be measured at the same frequency as the monitor well sampling. One round of samples will be analyzed for the parameters listed in **Table OP-8** and three rounds will be analyzed for just the UCL parameters. As outlined below, the analytical results will be evaluated for outliers prior to the UCL calculations, and the information submitted in the mine unit package.

Outlier Evaluation

The water quality data of the monitor wells will be evaluated to identify and remove potential outliers (anomalously high or low values relative to other values) that may otherwise strongly influence the general characterization of the wells. The outliers will be identified according to Attachment I of WDEQ-LQD Guideline No. 4 (2000). An outlier may result from one or more of the following conditions:

- transcription errors;
- sampling errors;
- analytical errors;
- incorrect units of measurement;
- natural water quality variability; and
- differences in geology within the sampled aquifer.

The inclusion of an outlier in a database may have a disproportionately large influence on statistical analyses of water quality data. Therefore, the following tolerance-limit formula (Loftis et al., 1987) was used to screen outliers from the baseline data:

tolerance interval = $x \pm kS$

where:

x = mean of observations in sample

k = tolerance limit factor

S = standard deviation of sample

and assuming:

alpha = 0.05

$p = 0.99$

The tolerance limit factor (k) is a function of sample size (n), confidence level (1 – alpha), and proportionality values (p). The assumed alpha value of 0.05 is based solely on its historical use for statistical evaluation of hydrologic data. The 99 percent proportionality value (p) is the highest value for which k values are available.

For a given sample size (n) of 100, only one value should be expected to be discarded as an outlier when it may actually be a representative value. If one or more wells have parameter values that contain a relatively large number of outliers, then these wells are treated separately as an additional baseline database.

Well outliers will be identified from the combined quarterly water quality sampling results of each type of monitor well. As noted in WDEQ-LQD Guideline No. 4, "there are no hard and fast rules regarding the initial selection of potential outliers" (2000). The water quality data will be visually screened for anomalous values or groups of values, which will then be subjectively evaluated as especially high or low relative to other values. Each potential outlier will be compared to its tolerance interval, which will be calculated excluding the potential outlier from the dataset. Each potential outlier will be considered an outlier if its value is not within the calculated tolerance limit, unless it only marginally differs from the tolerance interval, is one of only a few detected samples, or is similar to multiple samples.

Upper Control Limit (UCL) Selection and Calculation

UCLs will be set for parameters indicative of migration of lixiviant from the mine unit. These parameters will generally be chloride, conductivity, and total alkalinity. Chloride is a common UCL parameter in Wyoming due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the ion exchange process (uranium is exchanged for chloride on the ion exchange resin). Chloride is also a very mobile constituent in the groundwater and will show up quickly in the case of a lixiviant migration to a monitor well. The lixiviant TDS concentration generally differs than that of the baseline groundwater quality and does not appreciably change with sediment interaction; therefore, conductivity is an excellent indicator due to its direct correlation to TDS. Total alkalinity concentrations should be affected during a potential excursion, as bicarbonate is the major constituent added to the lixiviant during mining. If another parameter is determined to be more suitable for a given mine unit, it will be identified in the respective mine unit package, along with explanation of its suitability.

UCLs will established for each M, MO and MU well. As recommended in WDEQ-LQD's Guideline No. 4 (2000), the alkalinity and specific conductance UCLs were calculated by adding five standard deviations to each UCL parameter baseline mean. Each chloride UCL was calculated by adding five standard deviations to each mean chloride concentration or by adding 15 mg/L to each mean chloride concentration, whichever was larger. Identified outliers will be excluded from the UCL calculations.

OP 3.6.4.2 Excursion Detection

Excursion detection will consist of sampling the monitor wells at least twice per month, and no less than ten days apart, and analyzing the samples for the UCL parameters. The monitor wells will be sampled as per the above schedule except in the event of certain situations. These situations include inclement weather, mechanical failure, holiday scheduling, or other factors that may result in placing an employee at risk or potentially damaging the surrounding environment. In these situations, LC ISR, LLC will document the cause and the duration of any delays. In no event shall a delay be greater than five days. Records of UCL monitoring, including chemical assays, shall be maintained until Permit termination.

Water levels will be measured at the same frequency as the monitor well sampling. Sudden changes in water levels may indicate that the mine unit flow is out of balance. Increases in water levels in the overlying or underlying aquifers may be an indication of fluid migration from the production zone. Flow rates would be adjusted to correct this situation. Adjustments to well flow rates or complete shutdown of individual wells may be required to correct this situation. Increases in water levels in the overlying or underlying aquifers may also be an indication of casing failure in a production, injection or monitor well. Isolation and shutdown of individual wells can be used to determine the well causing the water level increases. MIT's of production and injection wells in the area of a suspected failure may also be performed to locate the failed well.

OP 3.6.4.3 Excursion Verification and Corrective Action

During routine sampling, if two of the three UCL values are exceeded in a monitor well, or if one UCL value is exceeded by 20 percent, the well will be re-sampled within 24 hours of receipt of the results from the routine sampling and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third sample will be taken within 24 hours of receipt of the second sample results. If neither the second or third sample results exceed the UCLs, the first sample will be considered in error.

If the second or third sample confirms an exceedance, the WDEQ-LQD Project Manager will be verbally notified within 24 hours of confirmation. If the Project Manager cannot be reached, a voice message will be left on the WDEQ-LQD Administrator's phone and an email notification will be sent to both the Administrator and the Project Manager. A written report will also be submitted to WDEQ-LQD within five days. The written report will detail: recent chemical trends of the monitor well on excursion; the reason for the excursion, and actions to be taken to recover the excursion. In addition, a monthly report will be submitted to WDEQ-LQD until the excursion is over. The monthly report will detail: concentrations of UCL parameters in the well on excursion and surrounding wells; evidence the excursion is being controlled; a review of the adequacy of the bond to cover the expense of excursion recovery; and corrective actions taken. If a well is still on excursion after 60 days, a plan and schedule will be submitted within 30 days to bring the well off excursion per WDEQ-LQD requirements.

If an excursion is confirmed, the following methods of corrective action will be instituted (not necessarily in the order given), dependent upon the circumstances.

- A preliminary investigation will be completed to determine the probable cause.
- Production and/or injection rates in the vicinity of the monitor well will be adjusted as necessary to generate an effective net process bleed, thus forming a hydraulic gradient toward the production zone.
- Individual wells will be pumped to enhance recovery of ISR solutions.
- Injection into the pattern area adjacent to the monitor well may be suspended. Recovery operations will continue, thus increasing the overall bleed rate and the recovery of the ISR solutions.

In addition to the above actions, the sampling frequency of the monitor well on excursion will be increased to weekly. If the excursion is not corrected within 30 days, a sample will be collected and analyzed for parameters in WDEQ-LQD Guideline 8 Appendix I Sections IV and VA(1) parameters and applicable EPA MCLs. Once parameters no longer exceed the UCLs, a final sampling and analysis of the Guideline 8 parameters will be performed. An excursion will be considered over when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive one-week samples, and a summary report of the sampling results and corrective actions has been submitted to WDEQ-LQD.

OP 3.6.4.4 Ability to Control an Excursion

Assuming a total mine unit flow of 6,000 gpm, with approximately 180 production wells, the groundwater extraction per production well is 30 to 35 gpm. Conversely, the injection rate for each well pattern is also approximately 30 to 35 gpm (minus the one percent bleed). Shutting off the injection from two to four well patterns near the monitor well that has a verified excursion would result in approximately 60 to 140 gpm of additional net extraction in the area of the excursion. Based on results from the 2007 pump test, corrective pumping on the order of 60 to 140 gpm would be sufficient to quickly and efficiently control an excursion.

OP 4.0 PLANT PROCESSES, INSTRUMENTATION, AND CONTROL

The Plant is designed for the concentration of uranium from dilute solutions by ion exchange. The Plant will house three distinct process circuits: the ion exchange circuit (also called the resin-loading circuit), the elution circuit, and the precipitation/filtration circuit. The final product will be yellowcake slurry. The slurry will be transported from the Permit Area via DOT-approved tankers to a facility licensed by NRC or an Agreement State for processing the slurry into dry yellowcake.

The Plant will be designed to process up to 6,000 gpm of lixiviant through the ion exchange circuit. All of the uranium-laden resin will be transferred via pipe to the elution circuit. In addition to processing on-site generated resins, the elution circuit will be designed to accept truckloads of loaded resins from satellite facilities operated by LC ISR, LLC or its affiliates and/or from third-party facilities. The elution and precipitation/filtration circuits will be designed on the basis of a two million pound-per-year processing rate, with an initial nominal operating rate of one million pounds per year to match the projected production rate from the Permit Area.

The Plant building will house all auxiliary equipment and systems required to support an operation of this type. In addition, the Plant will contain equipment and facilities capable of treating up to 1,000 gpm of groundwater from mine units that are in both production and restoration (**Figures OP-5b**, **c**, and **d**).

OP 4.1 Ion Exchange (Resin-Loading) Circuit

Uranium concentrations averaging 40 to 50 parts per million (ppm) U_3O_8, are expected in the production fluid. Standard, commercially available ion exchange resins have been demonstrated to function well under conditions such as those at the Project. The ion exchange resins preferentially remove the uranyl dicarbonate or uranyl tricarbonate from the solution. The ion exchange circuit will consist of pressurized, "down-flow" vessels that are internally screened to maintain the resin in place but allow the lixiviant to flow through the vessel. Once the resin becomes loaded, the vessel is isolated from the normal process flow and the resin is transferred via piping to a separate vessel for elution.

Approximately 200 gpm of the barren lixiviant will be routed through an RO unit prior to leaving the Plant. RO, at this point, allows approximately one percent of the total flow required for bleed to exit as waste brine instead of injection fluid. The RO permeate is added back to the injection stream. The solution leaving the ion exchange circuit will normally contain less than five ppm of uranium. Sodium carbonate, sodium bicarbonate, oxidants, and carbon dioxide will be added to the barren solution, as required, prior to re-injection. The resin-loading circuit is graphically represented in **Figure OP-11a**.

OP 4.2 Elution Circuit

When resin in an ion exchange vessel is fully loaded and/or removing very little additional uranium, the vessel will be isolated from the normal process flow. The loaded resin will be transferred in 500 cubic foot lots from the ion exchange vessel to the elution circuit. In this circuit, the loaded resin will first be passed over vibrating screens with wash water to remove entrained sand particles and other fine trash. The loaded resin will then move by gravity from the screens into down-flow elution vessels for uranium recovery and resin regeneration. The Plant will also have the capability to receive loaded resin from other operations via bulk transport for processing in the elution circuit.

Once in the elution vessel, the loaded resin will be contacted with an eluant composed of approximately 90 g/L sodium chloride and 20 g/L sodium carbonate (soda ash). The eluted resin is subsequently rinsed with fresh water and returned to an empty ion exchange vessel or bulk trailer (**Figure OP-11b**).

In a three-stage batch elution process, a total of 45,000 gallons of eluant contact the 500 cubic feet of resin. The process generates 15,000 gallons of rich eluate with a concentration of 10 to 20 g/L U_3O_8. Each elution produces 30,000 gallons of eluate that is re-used in the next elution. Likewise, 15,000 gallons of fresh eluant will be required per elution. The fresh eluant is prepared by mixing the proper quantities of a saturated sodium chloride (salt) solution, a saturated sodium carbonate (soda ash) solution, and water. The saturated salt solution is generated in commercially available salt saturators (brine generators). Saturated soda ash solution is prepared by passing warm water (greater than 105° F) through a bed of soda ash.

OP 4.3 Precipitation/Filtration Circuit

From the elution circuit, the uranium-rich eluate will be sent to an agitator tank for batch precipitation. To initiate the precipitation cycle, hydrochloric or sulfuric acid will be added to the eluate to breakdown the uranyl carbonate present in the solution (**Figure OP-11b**). Caustic soda solution is then added to elevate the pH. Hydrogen peroxide will then be added to the eluate to effect precipitation of the uranium as uranyl peroxide. Caustic soda solution will again be added for pH control and to promote growth of uranyl peroxide crystals and to make the slurry safer to handle in the subsequent process steps.

After precipitation, the crystalline uranyl peroxide will be washed, to remove excess chlorides and other soluble contaminants, and then de-watered and filtered to form the yellowcake slurry. This slurry will then be stored in holding tanks or in transport tanks parked in a secure area inside the fenced-in Plant site. The holding and transport tanks will be used solely for yellowcake slurry. On-site inventory of U_3O_8 in the slurry form will typically be less than 100,000 pounds. However, in periods of inclement weather or other interruptions to product shipments, there will be capacity for up to 200,000 pounds of slurry within the Plant. The yellowcake slurry will be shipped by exclusive-use, authorized transport to a facility licensed by NRC or an Agreement State for processing the slurry into dry yellowcake.

OP 4.4 Major Process Equipment and Instrumentation

The major process equipment in the Plant will include: ion exchange vessels; elution vessels; precipitation tanks; filter presses; slurry storage tanks; and the piping, pumps, valves, filters, and associated equipment required to control and move the solutions through the various process circuits. The process equipment will be installed as needed to meet the required flow rates and production levels. The ion exchange, elution, and precipitation/filtration circuits will have instrumentation designed to monitor key fluid levels, flow rates and pressures. In addition to monitoring, there will be varying levels of control, such as automatic shut-offs, for pumps, valves, and operating systems.

OP 5.0 EFFLUENT CONTROL SYSTEMS

During the Project, gaseous/airborne, liquid, and solid effluents will be produced from the processes associated with ISR operations. All the effluents are typical for ISR projects currently operating in Wyoming; and existing technologies are amenable to all aspects of effluent control in the Permit Area. The waste streams are summarized in **Table OP-10**, and additional details about the types of effluents and storage, treatment, reuse/recycling, and disposal practices and their potential impacts are provided below.

Effluents will be reduced by minimizing disturbance and reusing/recycling materials whenever possible. On-site waste handling facilities will have proper storage to segregate the materials and signage to indicate the types of materials present. These areas will be routinely checked to ensure proper waste segregation and storage. All materials delivered to or transported from the facility, including wastes, will be packaged in accordance with US DOT requirements. Employees will receive training, guidance, and personal protective equipment (PPE) to safely handle, store, decontaminate, and dispose of waste materials. Employees will also be trained to recognize potential hazards and to perform assigned duties in a safe and healthy manner to help reduce the possibility of accidental release. SOPs will be accessible for guidance on routine activities, and for unusual circumstances, an approved work plan and/or approved Radiation Work Permit (RWP), as required by the NRC, will provide guidance. Spill Prevention and Response Plans will also be in place to help reduce the possibility of accidental release and provide for appropriate action in the event of a release.

OP 5.1 Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents will be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent will be radon gas. The types of effluents and the control systems that will be in place for them are summarized below. The WDEQ-AQD permit and NRC license for the effluents and controls are listed in **Table ADJ-1** and **Section OP 2.2**. A copy of the WDEQ-AQD permit is included in **Attachment OP-1**.

OP 5.1.1 Non-Radioactive Emissions and Particulates

Gaseous emissions will result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles will produce small amounts of carbon monoxide, sulfur dioxide, and other internal-combustion engine emissions. Regular maintenance, SOPs, and pollution prevention equipment will be used to reduce gaseous emissions. Bussing of employees or credit for employee car-pooling will be considered to help reduce fuel consumption and emissions.

Most of the airborne particulates will be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit. Restricted vehicular access and speed limits will be used to minimize dust from roads; and additional dust control measures may include water spraying, application of gravel, or application of organic/chemical dust suppressants. Disturbance will be minimized to the extent possible; and disturbed areas will be revegetated during the first available seeding window.

Airborne particulates may also include insignificant amounts of salt and soda ash releases during deliveries to the Plant, and drilling mud or cement dust during the installation of wells at the mine units. Construction activities may also generate airborne particulates. Examples of this might be welding fumes or dust from grinding on steel. Standardized delivery procedures that minimize material loss (and address health and safety concerns) and efficient construction practices will be used to minimize generation of such particulates.

Carbon dioxide and oxygen will be used as part of the extraction and concentration of uranium during mining; and hydrogen sulfide may be used during groundwater restoration after mining. However, use of these gases will be controlled to prevent waste and potential adverse safety conditions. Similarly, any fumes from the limited use of liquid chemicals, such as hydrochloric or sulfuric acid, will be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities will produce some non-radioactive gaseous emissions, such as carbon dioxide, oxygen, and water vapor, but the primary effluent of concern from pressure venting is radon gas, as discussed in more detail below.

OP 5.1.2 Radioactive Emissions

Radioactive airborne effluents will be minimal, as compared to other ISR operations in Wyoming, because yellowcake drying and packaging will not occur within the Permit Area and because the Storage Ponds will be kept wet.

Radon will be the radioactive gaseous emission from the mining and ore processing, as it is present in the orebody and collected with the lixiviant solution. Radon will be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells will be open at the surface; however, water levels will typically be low and radon venting will be minimal. All of the well releases will be outside of buildings and are directly vented to the atmosphere. Radon will also be released during ion exchange resin transfers and subsequent ore processing steps. The UIC Class I well pumphouses will also be vented. Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings using high-volume exhaust fans, PPE, and limited exposure durations, in accordance with SOPs, or an RWP during non-routine work. Occupational and public exposures to radon emitted from the mine units and from the ore processing were analyzed using the MILDOS computer model to ensure the discharged amount will be within regulatory dose limits (LC ISR, LLC October 2007 Technical Report (**Section 7.1.13**) and Environmental Report (**Section 4.12.1.2**) in support of the application to NRC for a Source and Byproduct Material License, Docket No. 40-9068, Technical Assignment Control No. LU0142).

OP 5.2 Liquid Wastes

The Project will generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct materials by NRC. The different types of liquid wastes the Project will generate are:

- "native" groundwater generated during well development, sample collection, and pump testing;
- storm water runoff;
- waste petroleum products and chemicals;
- domestic sewage; and
- the three 11(e)(2) byproduct materials:
  - liquid process wastes, including laboratory chemicals,
  - "affected" groundwater generated during well development, and
  - groundwater generated during aquifer restoration.

OP 5.2.1 Liquid Non-11(e)(2) Byproduct Materials

Appropriate storage, treatment, and disposal methods for these liquids differ, as outlined below.

OP 5.2.1.1 "Native" Groundwater Recovered during Well Development, Sample Collection, and Pump Testing

Groundwater is recovered during well installation, sample collection, and pump testing conducted prior to mining or from portions of the Permit Area not affected by mining. This "native" groundwater has not been exposed to any mining process or chemicals. During well development, sample collection, and pump testing, this water will be discharged to the surface under the provisions of a general WYPDES permit, in a manner that mitigates erosion, or reused in the drilling process.

OP 5.2.1.2 Storm Water Runoff

Procedural and engineering controls will be implemented such that storm water runoff from the area of the Plant will not pose a potential source of pollution. Per the requirements of the WYPDES, the applicable permits for runoff control during construction and operation of the Plant will be obtained from WDEQ-WQD.

OP 5.2.1.3 Waste Petroleum Products and Chemicals

These wastes will be typical for ISR facilities, and will include items such as waste oil and out-of-date reagents, none of which will have been closely associated with the processing of 11(e)(2) byproduct materials. Any of these wastes that are non-hazardous will be stored in appropriate containers in an indoor, bermed, and ventilated area adjacent to the maintenance shop, prior to disposal by a contracted waste disposal operator, at an approved off-site waste disposal facility, such as the Carbon County Landfill.

Waste petroleum products will be clearly labeled and stored in sealed containers above ground, in an indoor, bermed, and ventilated area adjacent to the maintenance shop, in accordance with the requirements of the Wyoming Department of Labor, State Mine Inspector, and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will generate about 40 to 80 gallons of waste petroleum products per month, and will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition.

Waste chemicals not closely associated with the processing of 11(e)(2) byproduct material will be dealt with in one of two ways:

- Waste items not immediately associated with laboratory operations will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the EPA. These containers will be kept in berms suitable for their contents, e.g., acid waste containers will be stored in the acid tank berm. These wastes will be periodically collected by a commercial business for recycling or disposal in a licensed disposal facility. An estimated five to ten gallons of waste chemicals will be disposed of per year.

- Waste chemicals typically associated with the laboratory and its operations will be captured in the drains and/or sumps within the laboratory and will go straight to plant waste tanks for eventual deep well disposal. An estimated five to ten gallons of waste chemicals will be disposed of per year

OP 5.2.1.4 Domestic Liquid Waste

Domestic liquid wastes will be disposed of in an approved septic system that meets the requirements of WDEQ-WQD. A permit will be obtained for the septic system prior to construction of the system, and a copy of that permit will be included in **Attachment OP-10**. The septic system will receive waste from restrooms, shower facilities, and miscellaneous sinks located within the office. In addition, chemical toilets may be temporarily placed in mine units and other drilling areas. An estimated 500 to 700 gallons of domestic liquid waste will be disposed of daily; and the septic system and chemical toilets will be maintained by a licensed contractor.

OP 5.2.2 Sources of Liquid 11(e)(2) Byproduct Material

The sources of the liquid 11(e)(2) byproduct materials are:

- liquid process wastes, including laboratory chemicals and water generated during decontamination of equipment;
- "affected" groundwater generated during well development and sample collection; and
- groundwater generated during aquifer restoration,

Each source is described further in this section, and the disposal methods are described in the next section.

OP 5.2.2.1 Liquid Process Wastes

Ore processing produces three liquid wastes with important volumes, a production bleed, an eluate bleed, and yellowcake wash water. The volume of production bleed will be on the order of 100 gpm, depending on the on-going operations, as shown on **Figures OP-**

5a, b, c, d, e, and f. The combined volume of eluate bleed and yellowcake wash water will be on the order of 5 gpm. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters will generate liquid waste on the order of 25 gallons per day. These wastes will be collected, treated and the waste discharged to the Storage Ponds and UIC Class I well(s).

During operations, there will also be an occasional need to decontaminate equipment so it can be disposed of, sent to another NRC licensed facility, or released for unrestricted use. The first step for decontaminating equipment will be to wash the object with high pressure water to remove any potential contaminants. The RSO or Health Physics Technician (HPT) will then scan the object with the appropriate instrument to determine if release standards have been met. If the standards have not been met then an additional wash may be performed to remove residual contamination. The RSO or HPT will then perform a second scan to determine if the item can be released. Since high pressure water will typically be used to decontaminate objects, the volume of water generated is minimal; on the order of 200 gallons per week. The water resulting from decontamination will enter the waste water circuit through a sump and will ultimately be disposed of in the UIC Class I well(s).

The same process used for decontaminating plant equipment during operations will also be used for decommissioning. The bond calculation conservatively assumes that 100% of the equipment in the plant will require decontamination regardless if it is disposed of at a landfill or as byproduct material. Assuming it takes two hours to pressure wash each piece of equipment at a rate of 3.5 gpm and about 65 pieces of equipment (representative pieces and quantities listed below) must be washed, the total volume of water generated will be about 26,000 gallons:

Fourteen IX columns;
Two elution vessels;
Six eluant storage vessels;
Two waste water storage tanks;
Six RO systems;
Four water storage tanks;
Two yellowcake slurry tanks;
Two filter presses;
Four precipitation cells;
Four resin shakers;
Sixteen pumps and stands.

In addition to the equipment which must be decontaminated, the surface of the concrete plant floor will also need to be decontaminated. The area of the plant floor requiring decontamination will be approximately 22,500 square feet. Assuming an employee can power wash 10 square feet in 1 minute, it will take 2,250 minutes to wash the affected plant floor. At 3.5 gpm this equates to about 8,000 gallons of water.

Therefore, the total quantity of water required to decontaminate the plant equipment and floor is about 34,000 gallons. After applying a conservative contingency factor of 100%, the total volume of water required for decontaminating at decommissioning is about 68,000 gallons. The waste water generated during final decommissioning will be disposed of in the UIC Class I well(s). Given that the deep well(s) disposal capacity will be greater than 100 gpm, all of the waste water generated during final decommissioning could be disposed of during the course of a day. It will be necessary to leave the deep well disposal system in place until the very final stages of decommissioning.

Any equipment which cannot be decontaminated during operations or decommissioning will be stored in a designated restricted area of the plant or plant yard until it can be disposed of as byproduct material at an NRC licensed disposal site or sent to another NRC licensed facility for use. The annual bond assessment will include the cost of disposing of all byproduct material in storage and that which may be generated during decommissioning. Byproduct waste will be stored in a manner that prevents the spread of contamination. For example, openings in tanks will be sealed off if they could leak contaminated material, removable contamination will be washed from the exterior of equipment, and employees will wear appropriate PPE when handling by-product material and will survey according to procedures before exiting the restricted area.

OP 5.2.2.2 "Affected" Groundwater Generated during Well Development and Sample Collection

It may be necessary to develop (or redevelop) wells and collect samples of groundwater that has been affected by the mining operation to the extent that surface discharge of the water is not appropriate. During well development and sample collection, this water will be collected and treated; and the waste will be discharged to the Storage Ponds and UIC Class I wells.

OP 5.2.2.3 Groundwater Generated during Aquifer Restoration

During the various steps of aquifer restoration (**Section RP 2.3**), groundwater will be generated; and disposal of some or all of the water will be required. During sweep, groundwater will be pumped from the production zone, creating an area of drawdown. This will create an influx of water from outside the production zone that will replace the affected volume of water within the production zone. In most cases, the water produced during sweep will be processed for residual uranium content through the ion exchange circuit, and then disposed directly to the UIC Class I wells. In some cases, the groundwater pumped from the production zone may be treated by RO to reduce the waste volume; and the treated water (permeate) may be used in Plant processes or for makeup water in other restoration activities. To maintain the area of drawdown, the permeate will not be re-injected into the production zone, but will be transferred to other mine units for use as makeup water or injected into the UIC Class I wells. The concentrated byproduct material (brine) will also be injected into the UIC Class I wells.

During RO, groundwater will be pumped from the production zone. The pumped water will be treated by RO; and the permeate will be injected back into the production zone. To maintain an area of drawdown, an effective bleed will occur by adding additional permeate from other RO activities or by adding clean water to the permeate at a rate less than the produced rate. The brine from the RO treatment will be injected into the UIC Class I wells. Similarly, during other restoration steps, the amount of groundwater pumped from the aquifer will exceed the amount pumped back to the aquifer; and that excess water will be disposed of in the UIC Class I wells.

OP 5.2.3 Disposal of Liquid 11(e)(2) Byproduct Materials

The liquid 11(e)(2) byproduct materials generated during the Project will be managed by deep well injection in conjunction with Storage Ponds.

OP 5.2.3.1 Storage Ponds

The two Storage Ponds described in **Section OP 2.9.4** will be used to temporarily store the water that will ultimately be disposed of in the UIC Class I wells. To help maintain the integrity of the ponds by reducing liner exposure to sun, wind, and freezing temperatures, water will be kept in the ponds at all times by diverting a portion of the water that would normally go to the UIC Class I wells. The exception would be during pond maintenance or repair, at which times the liquid would be piped directly to the UIC Class I wells.

Routine pond inspections and monitoring will be conducted as specified in **Section OP 2.9** of this report. The inspection reports and monitoring results will be maintained on-site and summarized in the Annual Report submitted to NRC and WDEQ-LQD. Any maintenance issues identified during an inspection will be addressed in a timely manner to reduce the chance for damage to the pond integrity or liquid release to the environment.

LC ISR, LLC commits to maintain the concentration of selenium in the holding ponds to less than or equal to 0.02 mg/L, which is the level at which selenium concentrations can become detrimental to some wildlife including birds. The growth of algae and other plant growth in the ponds will be minimized through the use of a biocide. This will minimize the growth of plants and therefore minimize the potential for bioaccumulation of selenium. If the level of selenium in the ponds cannot be maintained at a level of less than or equal to 0.02 mg/L selenium, the ponds will be covered to prevent access by birds and/or the affected water will be drained.

OP 5.2.3.2 UIC Class I Wells

Two to five UIC Class I wells are planned in the southern portion of the Permit Area as the primary disposal method for the liquid 11(e)(2) byproduct materials. LC ISR, LLC has submitted the UIC Class I permit application to WDEQ-WQD, which has primacy in Wyoming for the UIC program. An electronic copy of the application is located in **Attachment OP-2**. In addition to the liquid 11(e)(2) byproduct materials, other compatible liquid wastes will be disposed of in the wells (**Section OP 5.2.1**). The wells will be monitored in accordance with the requirements of the UIC permit; and an evaluation of the well performance will be included in the Annual Report submitted to NRC and WDEQ.

Injection for ISR will not start at the Lost Creek Project until the UIC Class I permit is obtained. When the UIC Class I permit is approved, a copy of the permit will be added to **Attachment OP-2**. Additionally, LC ISR, LLC will incorporate capacity test data, from each UIC Class I well that is installed, into **Attachment OP-2**.

OP 5.3 Solid Wastes

Solid wastes, some of which will be classified as NRC 11(e)(2) byproduct materials, will be produced during construction, operation, and reclamation activities of the Project. Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

OP 5.3.1 Solid Non-11(e)(2) Byproduct Materials

The solid non-11(e)(2) byproduct materials will include: non-hazardous materials typical of office facilities, such as paper, wood products, plastic, steel, biodegradable items, and sewage sludge; and hazardous materials also typical of office and ISR facilities, such as waste petroleum products and used batteries. None of these materials are closely associated with ISR and ore processing.

The non-hazardous materials, with the exception of sewage sludge, will be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at an approved off-site solid waste disposal facility, such as the Carbon County Landfill. An estimated 500 to 700 cubic yards of non-11(e)(2) byproduct materials will be generated annually. An estimated three to five cubic yards of sewage sludge will be disposed of annually off-site at an approved facility by a licensed contractor.

Hazardous wastes will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition, generating about ten to 20 pounds of batteries and similar items per year.

OP 5.3.2 Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and will include equipment that becomes contaminated during ISR and ore processing. These items include tanks, vessels, PPE, and process pipe and equipment. Such wastes could also include soils contaminated from spills.

Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be placed in clearly labeled, covered containers and temporarily stored in restricted areas with clearly visible radioactive warning signs. The solid 11(e)(2) byproduct materials will then be disposed of at an NRC-licensed facility, typically a uranium mill tailings impoundment, by personnel qualified to dispose of radioactive wastes. An estimated 80 to 100 cubic yards of solid 11(e)(2) byproduct material will be generated annually exclusive of final reclamation material. LC ISR, LLC is in the process of negotiating a written contract with an NRC-licensed facility for disposal of this material.

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