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2.0 PROPOSED ACTION AND ALTERNATIVES

LCI proposes to develop in-situ recovery of uranium within the Lost Creek mining area. Approving the Proposed Action would result in development of the federal mineral estate and the disturbance and reclamation of public lands administered by the BLM. Under 43 CFR 3809, mining operations that perform more than 'casual use' activities on five or more acres of public lands must submit a Plan of Operations to BLM for review and approval. A synopsis of the Plan of Operations, NRC License, and the WDEQ-LQD Permit to Mine, including a summary of site facilities, schedule, and operation and reclamation plans, is presented in **Section 2.1**.

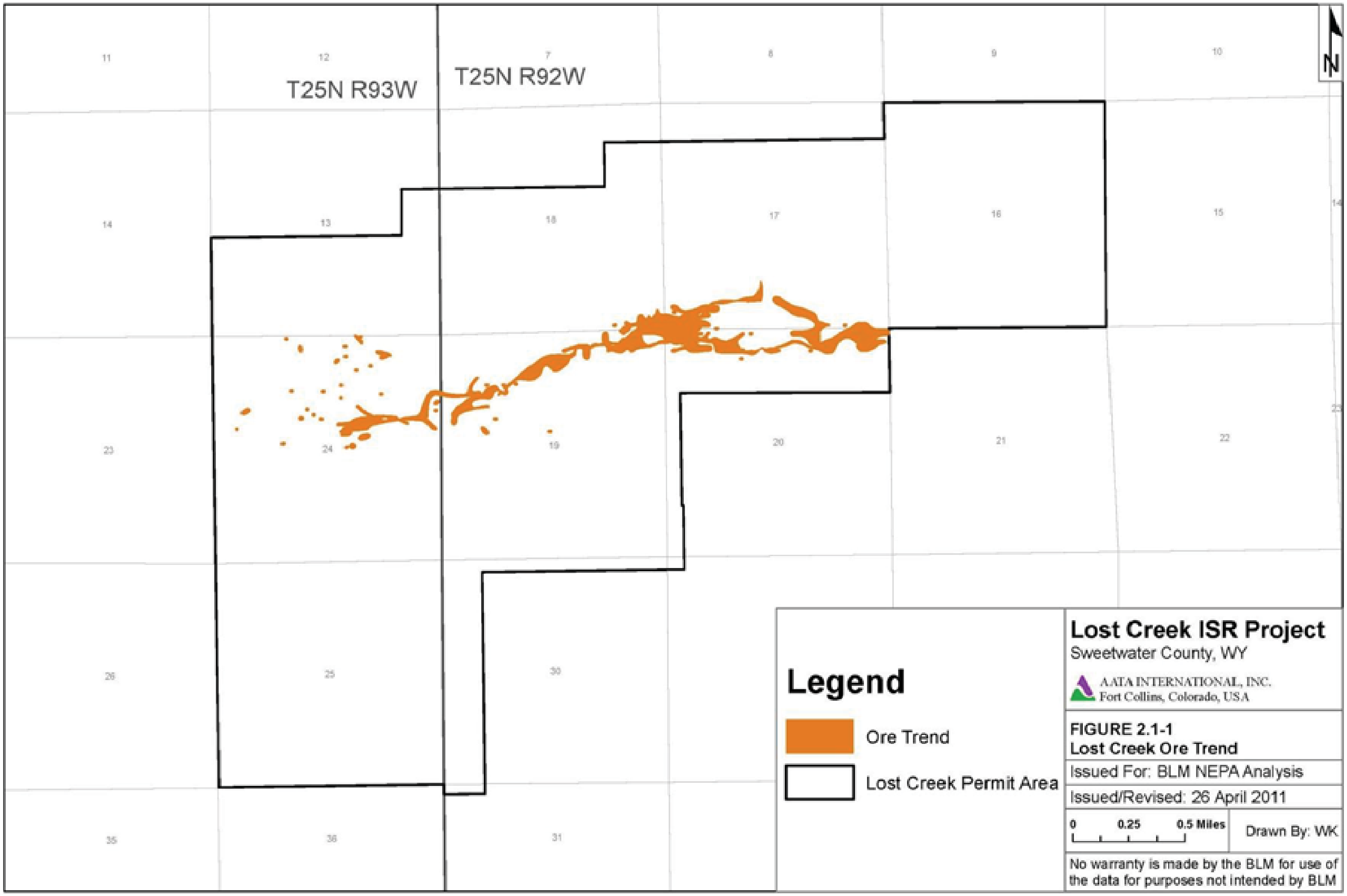
Under the rules and regulations of NRC and WDEQ-LQD, mines are required to collect extensive baseline information and to implement extensive monitoring programs and protective measures. These agency required measures are considered part of the Proposed Action and the alternatives considered in this document. These measures, and the additional measures required by the BLM, are mentioned in **Section 2.1** and addressed in more detail in **Section 2.2**.

Section 2.3 provides information on alternatives to the Proposed Action, including the No Action Alternative as required under NEPA. Under that alternative, development of the Project on BLM-administered land would not be allowed. **Section 2.3.1** describes the alternatives considered in detail, and **Section 2.3.2** provides a comparative summary of the impacts from those alternatives. The alternatives considered but eliminated from detailed analysis, and the rationale for eliminating them in accordance with 40 CFR 1502.14, are discussed in **Section 2.3.3**.

2.1 Proposed Action

2.1.1 Summary of the Proposed Action

As discussed in **Section 1.0**, the Lost Creek Permit Area (Permit Area) contains approximately 4,254 acres, and the surface to be affected by the Project would total approximately 345 acres (see **Section 4.5** for specific disturbance areas). The majority of the surface disturbance would follow the ore trend through the Permit Area (**Figure 2.1-1**). The mine units (following the ore trend), the Lost Creek Plant (Plant), the Storage Ponds, the disposal wells, and the roads are the significant surface features associated with the ISR operation. An illustration of a typical ISR operation, such as the Project, is shown on **Figure 2.1-2**.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T25N R92W
N
Legend
Ore Trend
Lost Creek Permit Area
Lost Creek ISR Project
Sweetwater County, WY
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
FIGURE 2.1-1
Lost Creek Ore Trend
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0 0.25 0.5 Miles
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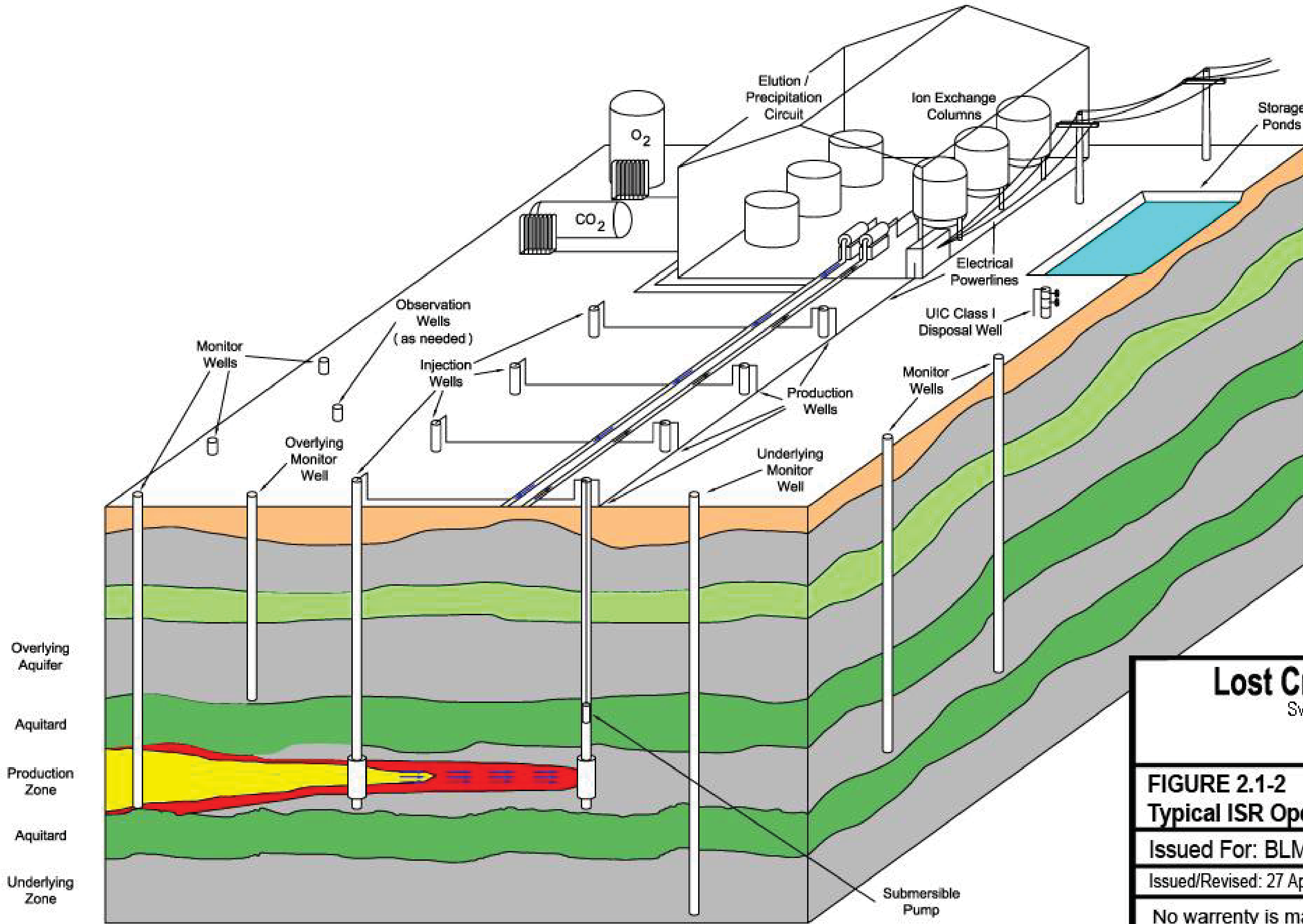

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FIGURE 2.1-2
Typical ISR Operation

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A uranium ISR operation extracts the mineral from permeable, uranium-bearing sandstones through a series of mine units. The mine units follow the ore body delineated by exploration drilling. Exploration drilling evaluates host stratigraphic formations and better defines the location and nature of the uranium deposit. (The ore deposits within the Permit Area generally occur at depths of 300 to 700 feet below the ground surface in long, narrow trends varying from a few hundred to several thousand feet long and 50 to 250 feet wide.) The scale and number of the mine units for a given ISR operation depends on a variety of factors, including ore distribution, aquifer characteristics, plant capacity design, and operational feasibility. In Wyoming, a Hydrologic Test Proposal for each individual mine unit is submitted to WDEQ-LQD for review and approval prior to installation and operation of a new mine unit. Following completion of the activities described in the proposal, a Hydrologic Test Report is submitted to WDEQ-LQD for review and approval. The Hydrologic Test Proposal and Report detail: subsurface conditions (structural geology and results of the hydrogeologic pump tests); monitor well locations and depths; pattern areas and depths; surface conditions (including mine unit layout, soil, and vegetation); baseline water quality sampling results; the impact of faulting; potential interference; mine unit operations (including upper control limit calculations, historic drill hole locations, and well permit information); and restoration and reclamation.

Each mine unit consists of patterns of production and injection wells (i.e., the pattern area) within a ring of monitor wells. The injection and production well pattern design would be based on conventional five-spot patterns, modified as necessary to fit the characteristics of the orebody. (In the Proposed Action, the injection wells are expected to be spaced 75 to 150 feet apart. The injection and production wells would be installed in the mineralized HJ Horizon, which is about 350 to 500 feet below the ground surface.) Water quality samples would be collected from the ring of monitor wells and analyzed to detect a horizontal excursion (unanticipated movement of lixiviant) in the production zone. (In the Proposed Action, the monitor well ring is anticipated to be spaced about 500 feet from the pattern area. The distance between each monitor well in the ring is anticipated to be about 500 feet, although actual distances would be based on the aquifer characteristics of the mine unit to ensure any excursion can be detected in a timely manner.) Water quality samples would also be collected from monitor wells completed in overlying and underlying aquifers to detect a vertical excursion. (These wells would be located within the mine unit boundary at a density of about one overlying and one underlying well per four acres, depending on the hydrologic characteristics of each mine unit.) In addition, monitor wells located within the pattern area and completed in the production zone provide information on the mining process and may double as production or injection wells.

A lixiviant is pumped from the Plant through buried pipelines to the injection wells in the operational mine unit(s). The lixiviant oxidizes the uranium mineral, thereby allowing the dissolution of uranium in groundwater. (The Proposed Action applies a carbonate lixiviant.) After circulation through the production zone (i.e., from the injection wells to the production wells), the resulting uranium-laden solution (i.e., pregnant lixiviant) is pumped from the production wells in the mine unit(s) through buried pipelines to the Plant. There, the uranium is recovered by a series of circuits (e.g., ion exchange, elution, precipitation). The lixiviant is then regenerated and pumped back to the mine unit(s) to recover additional uranium. As in the case of the Proposed Action, storage ponds may be used in conjunction with UIC Class I wells for waste water disposal at depths between 6,139 and 9,590 feet below the ground surface.

The Proposed Action would be conducted in phases including Construction, Operation, and Reclamation. During the Initial Construction phase, the Plant and associated utilities would be built, the Storage Ponds and UIC Class I Wells would be installed, and the East and West Access Roads would be upgraded. Mine Unit Development is also included under Construction, although the development of the mine units is progressive (so that one mine unit may be in operation while another is being developed). Similarly, Reclamation includes both the progressive reclamation of mine units and the final reclamation of the Plant. Therefore, some of the Construction, Operation, and Reclamation activities may overlap. The major work under each phase is outlined in **Section 2.1.4**.

2.1.2 Site Facilities

2.1.2.1 Process Plant and Utilities

The Plant would be one of the first features to be constructed in the Permit Area. The Plant would house four distinct process circuits: the ion exchange circuit (also called the resin-loading circuit), the elution circuit, the precipitation/filtration circuit; and the dryer circuit. The layout of the Plant is presented in **Figure 2.1-3**. The Plant would be capable of processing 6,000 pounds U_3O_8 per day (2.2 million pounds per year) and normally operating at 90 percent of its designed capacity. Additional details on the Plant processes are available in the documents of the WDEQ-LQD Permit to Mine and the NRC Material License (LCI, 2010 and 2011b).

Electrical power would be brought into the Permit Area, through the installation of a new overhead line (**Figure 1.2-3**), from the existing transmission line located along the western edge of the Permit Area. The overhead line would branch to transformer poles located throughout the mine units, the UIC Class I wells, and at the Plant. The overhead power lines would continue from the transformer poles to the service points within the mine units (the header houses), where power to the production and injection wells would be transmitted through underground lines (tertiary lines) located along the same corridors as the buried pipelines for fluid transmission to and from the wells. All power lines to the point of transform (from 34,500 volts to 480 volts [Earley et al., 2008]) would be overhead lines that comply with regional raptor specifications. Additional details on the electrical utility are available in the documents of the WDEQ-LQD Permit to Mine and the NRC Material License (LCI, 2010 and 2011b).

There are two sets of pipelines, one conveys fluids to and from the mine units and the other conveys fluids to the UIC Class I wells. The pipelines to and from the mine units would consist of a main trunk line to the Plant that would be extended to the individual mine units as they are developed. The pipelines to each UIC well would be installed as each well is brought on-line. The pipeline corridors would follow roads wherever possible to minimize disturbance.

2.1.2.2 Storage Ponds

Two fenced 160-by-260-foot Storage Ponds would be constructed adjacent to the Plant as shown on **Figure 2.1-3**. The primary purpose of the Storage 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 capacity of the Storage Ponds is designed to accommodate two weeks of reduced Plant operation and is redundant, allowing for maintenance of the Storage Ponds in the event of a liner problem. The Storage Ponds would be lined with a double synthetic liner, including a leak detection system, and a series of monitoring wells would be installed to detect leaks into the surrounding sediments. In May 2010, the Wyoming State Engineer's Office granted Permit No. 13595R to LCI for the construction of the two Storage Ponds. In November 2010, LCI submitted an application for approval of the pond construction to EPA to evaluate compliance with the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) for radon, and that application was approved in December 2011. A complete description of the Storage Ponds and associated monitoring is provided in Sections OP 2.9.4 and 5.2.2.1 of the Operations Plan in the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 4.2.5.4 and 5.3.2 of the NRC Technical Report (LCI, 2010).

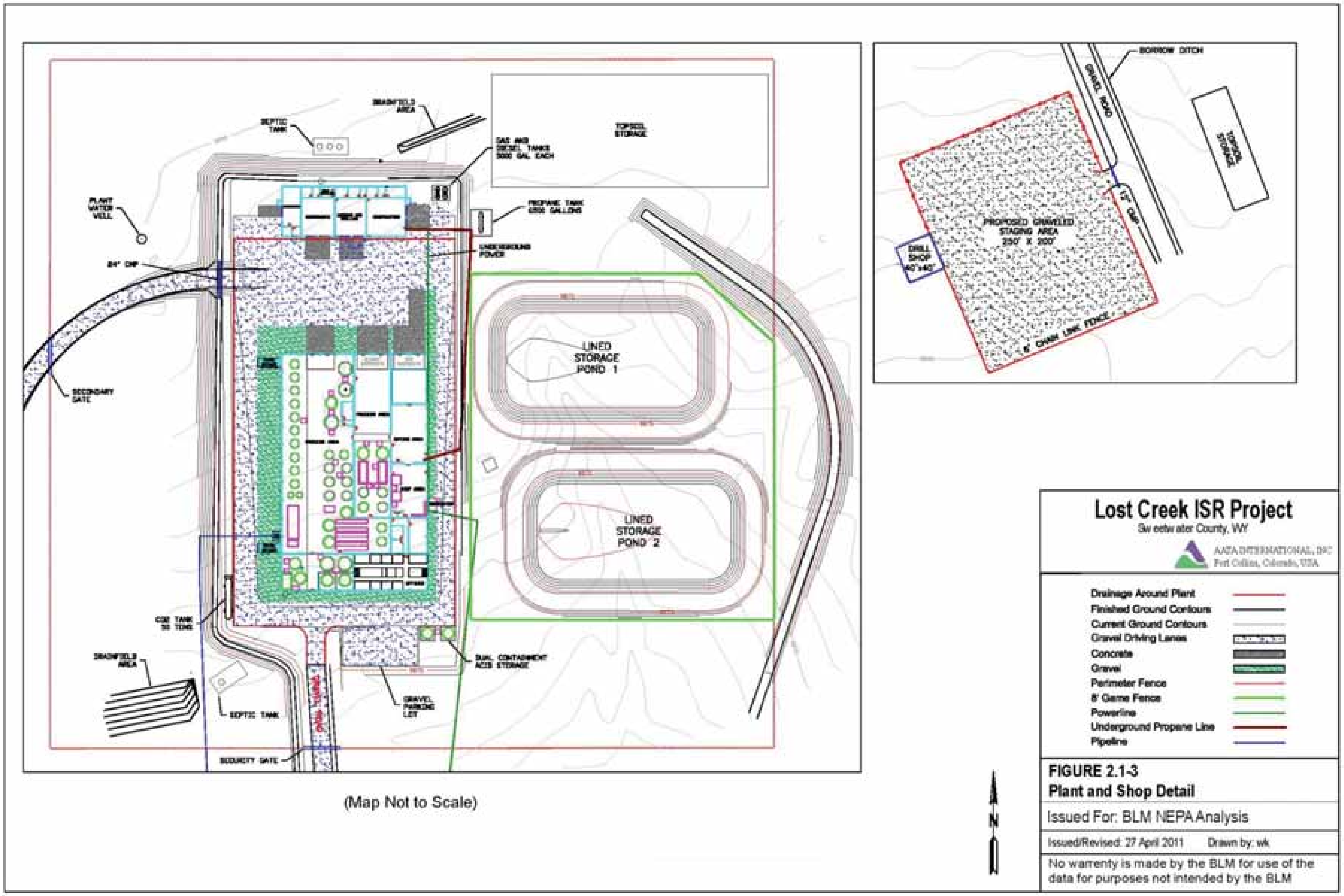

FIGURE 2.1-3
Plant and Shop Detail

2.1.2.3 Mine Units

Mining would progress along the ore trend through a series of mine units. The specific number of mine units and 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-LQD.

The layout of each mine unit consists of production and injection wells in a pattern area surrounded by a monitor well ring. The layout of wells in a typical mine unit are shown on **Figure 2.1-4**. There are four types of monitor wells: those completed in the monitor ring around the production zone; those completed in aquifers directly overlying and underlying the production zone; and those completed within the pattern areas. A fifth type of monitor well, a trend well, may be used in specific circumstances to provide more detailed information in a localized area. Prior to mine unit production, monitor wells are drilled and installed to provide information about subsurface conditions. During mine unit operation, water quality samples from the monitor wells are collected and analyzed to detect an excursion or, if screened in the production zone, to provide information on the mining process. The wells in the monitor ring would be spaced about 500 feet apart, depending on the hydrogeology of the production zone, and would be located approximately 500 feet outside the pattern area. Monitor wells in the overlying and underlying aquifers are generally uniformly distributed across the pattern area, with approximately one overlying and one underlying well every four acres of the pattern area. Similarly, monitor wells in the production zone are generally uniformly distributed across the pattern area, with one well every four acres of the pattern area. Specific criteria for the monitor wells depend on the mine unit characteristics (e.g., see the WDEQ-LQD Mine Unit 1 documents [LCI, 2011b]).

The surface facilities in a typical mine unit are shown on **Figure 2.1-5**. Each production and injection well is connected to a manifold in a building commonly called a header house. Each header house accommodates the well controls and distribution plumbing for approximately twenty production wells and the associated injection wells (usually about 40 injection wells). The manifolds route solutions in pipelines to and from the ion exchange circuit in the Plant. Other mine unit facilities on or just below the surface include roads, pipelines, and transmission lines. Topsoil stockpiles are also present for storage of topsoil removed from areas that would be disturbed for the life of the mine unit, e.g., underneath header houses. Surface disturbance in each mine unit was estimated for the WDEQ-LQD Permit to Mine, and the estimates are refined, if necessary, in each mine unit package.

MU1 Figure 2.1-4
Mine Unit 1 Monitoring Well Locations

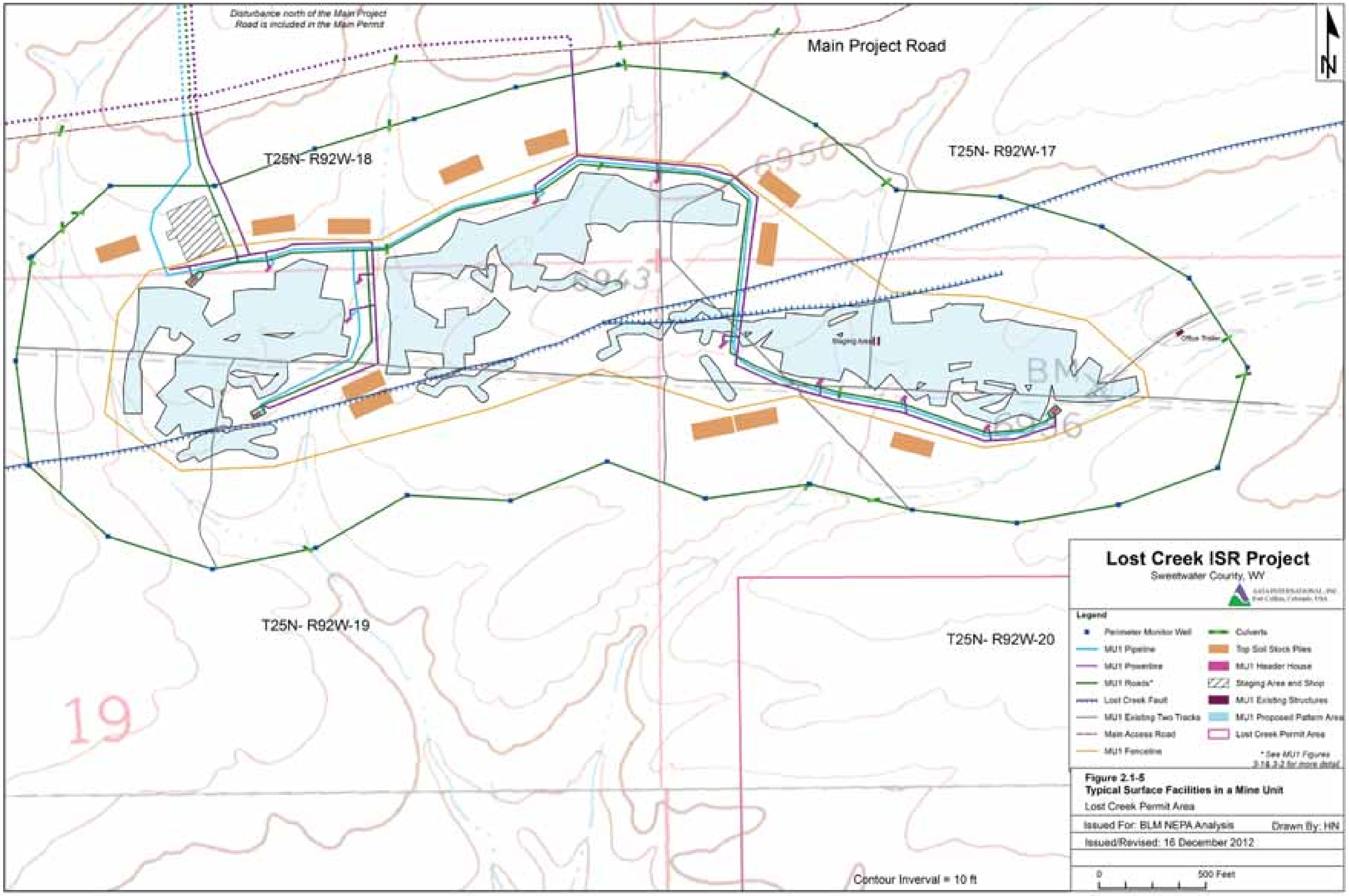

Figure 2.1-5
Typical Surface Facilities in a Mine Unit
Lost Creek Permit Area

2.1.2.4 UIC Class I Wells

On May 28, 2010, LCI obtained the UIC Class I Permit No. 09-586 from WDEQ-WQD, which has primacy in Wyoming for the UIC program. The permit authorizes LCI to drill, complete and operate up to five wells for waste water disposal at depths between 6,139 and 9,590 feet below the ground surface and according to procedures and conditions of UIC Class I Permit Application No. 09-586 (Attachment ADJ-2 of the Adjudication Files in the WDEQ-LQD Permit to Mine [LCI, 2011b]) and to the requirements and other conditions of UIC Class I Permit No. 09-586, in compliance with the Wyoming Environmental Quality Act (Wyoming Statute (WS) §§ 35-11-101 through 1104, specifically 301(a)(i) through 301 (a)(iv), Laws 1973, Ch. 250, Section 1) and Wyoming Water Quality Rules and Regulations Chapter 13. Not all of these wells may be needed and not all of them would be installed initially. The wells are planned as the primary disposal method for the liquid 11(e)(2) byproduct materials, which are defined in Section 11(e)(2) of the Atomic Energy Act as tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. The 11(e)(2) byproduct material is regulated by the NRC under Title 10 CFR Part 40. In addition to the liquid 11(e)(2) byproduct materials, other compatible liquid wastes would be disposed of in the wells. The wells would be monitored in accordance with the requirements of the UIC permit; and an evaluation of the well performance would be included in the Annual Report submitted to WDEQ, NRC, and BLM.

A deep well in the southwest corner of the Permit Area was installed in November and December 2008 and tested in February 2009 (under a WDEQ-LQD mineral exploration permit) to obtain necessary subsurface information on the feasibility of this disposal option. As noted in Attachment ADJ-2 of the Adjudication Files in the WDEQ-LQD Permit to Mine, the waters in the proposed injection zone (between 6,100 and 10,000 feet below the surface) and all waters below the injection zone qualify for WDEQ classification as Class VI groundwater (LCI, 2011b). The laboratory results of water quality samples collected from the proposed injection zone indicated poor water quality: total dissolved solids concentrations in excess of 10,000 milligrams per liter; exceedances of groundwater quality standards for organic constituents (benzene, ethylbenzene, and oil and grease); exceedances of groundwater quality standards for inorganic constituents (mercury, manganese, barium, lead, arsenic, and iron); and exceedances of groundwater quality standards for radionuclides (gross alpha particle activity and combined radium 226+228). Hence, the formations below the proposed injection zone are not underground sources of drinking water. Thus, the proposed wells are Class I injectors, as defined in Federal and State UIC regulations (40 CFR Part 144 and WDEQ Chapter XIII, respectively). Upper level confinement would be provided by about a 300-foot-thick shale sequence in the basal Wasatch/Battle Spring and injection would be confined below by the low-permeability shales of the Upper Lance Formation. The locations of the five

UIC Class I wells are widely scattered to accommodate regulatory requirements and meet the necessary injection criteria in compliance with the Wyoming Environmental Quality Act (WS §§ 35-11-101 through 1104, specifically 301(a)(i) through 301 (a)(iv), Laws 1973, Ch. 250, Section 1) and Wyoming Water Quality Rules and Regulations Chapter 13.

2.1.2.5 Roads

Roads in the Permit Area are defined as primary, secondary, or tertiary per WDEQ-LQD Guideline No. 4 (2000a) Attachment III, Section III(B) based on their dimensions, construction, and frequency of use. Wherever possible, roads would follow existing two-track routes to minimize additional disturbance. Roads would be constructed or improved in accordance with BLM guidance found in "Engineering: Road Standards: Excerpts from BLM Manual, Section 9113" (BLM, 1996a). **Figure 2.1-6** illustrates general road designs based on BLM guidance.

The primary access roads, the East and West Access Roads, would extend from the Sooner Road and the Wamsutter-Crooks Gap Road, respectively, to the Plant. These roads would be upgraded immediately prior to plant construction. Secondary access roads and associated culverts for the UIC Class I wells would be constructed prior to the installation of those wells. The secondary access roads and associated culverts for each mine unit would be constructed prior to and during the installation of each mine unit. These roads would connect the header houses within a mine unit and connect each mine unit to the Plant. Specific locations of the secondary roads would be included with each mine unit package, when their precise locations are known. There would also be two-track (tertiary) access roads within the mine units during field construction and operation to access header houses and monitor wells. These two-track roads would not be improved roads because of the limited traffic on them. However, with WDEQ-LQD concurrence, specific travel routes would be designated within the mine units to reduce the potential for topsoil compaction and erosion.

New roads or upgrades to existing roads may require the establishment of an ephemeral drainage crossing. Ephemeral drainage crossings may be constructed using either culvert installation or establishment of a ford, and in either case, to the degree possible, would be oriented perpendicular to the channel. LCI may elect to construct fords in cases where the ephemeral drainage channel is relatively shallow, on the order of three feet deep or less. Where fords are established, each entrance would be graded to a slope of 5(horizontal):1(vertical) or less and the base would be lined with gravel and cobbles to assure traction. Once final road design has been developed, BLM would evaluate each ephemeral drainage crossing to ensure proper plans have been developed for the site-specific conditions.

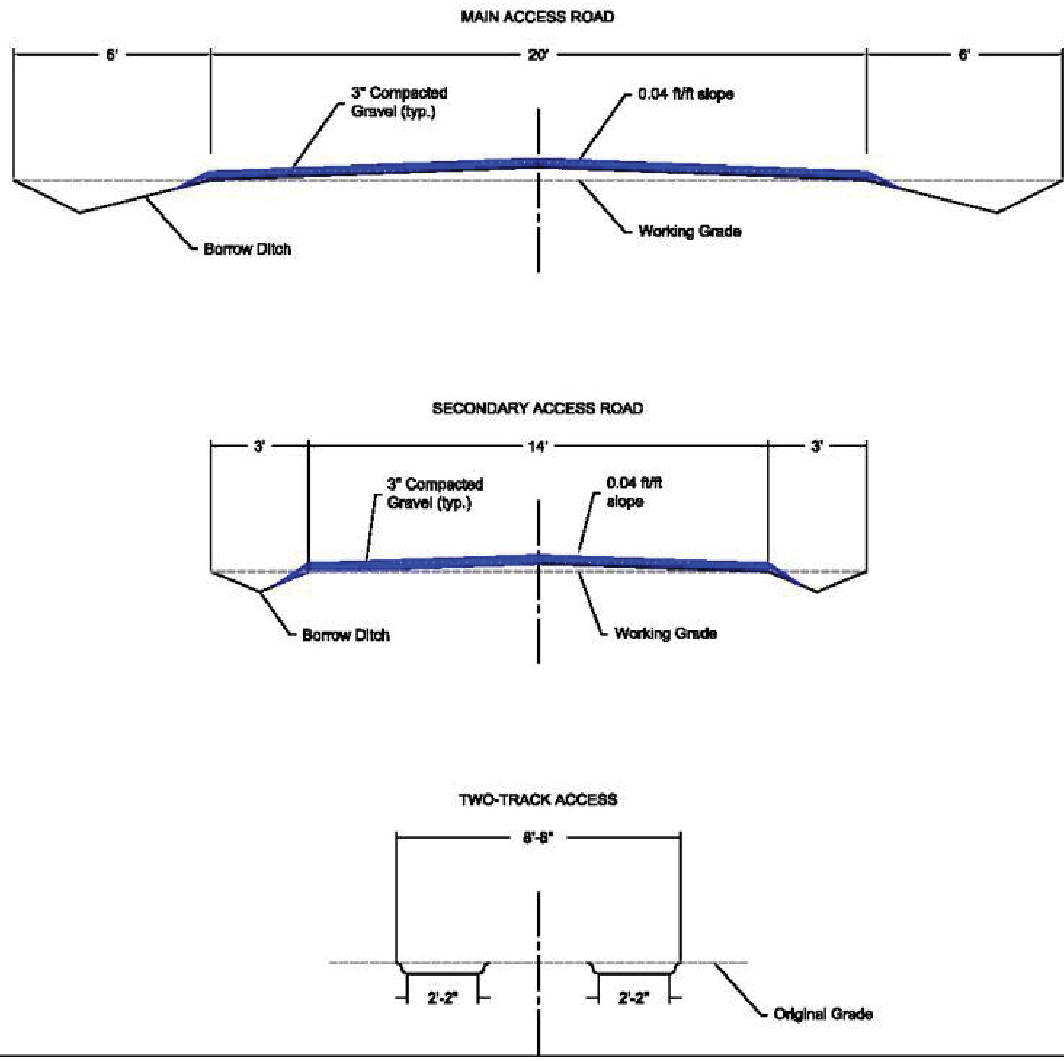

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FIGURE 2.1-6
Road Design Features

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Culvert design criteria are based on WDEQ-LQD Guideline No. 8 (2005a) that factors in the design life of the Project along with the hydrologic return period or flood frequency probability. Culvert design for the primary access roads would be based on the estimated peak flow from the 25-year, six-hour storm event; and the designs for the secondary roads would be based on the estimated peak flow from the ten-year, six-hour storm event. Per "Engineering: Road Standards: Excerpts from BLM Manual, Section 9113," no culvert smaller than 18 inches in diameter would be used (BLM, 1996a). To minimize erosion potential at the culvert outlets, rock riprap aprons would be installed where appropriate.

2.1.2.6 Fences

The Plant and Storage Ponds would be fenced for the duration of the Project. Pattern areas in the mine units (excluding the monitor ring) would also be fenced as they are constructed and brought on-line. Exploration drilling mud pits located outside of the fenced portion of the mine units would also be temporarily fenced. All fences would be constructed according to BLM fencing specifications and WGFD criteria.

The fence around the Plant would be standard wildlife friendly fencing based on BLM Manual Handbook 1741-1, Fencing (1989), which would keep cattle and wild horses out but would allow the passage of pronghorn and other wildlife. The fence around the Storage Ponds would be constructed to prevent access by wildlife, cattle, and wild horses and for safety reasons (Type I fencing per WDEQ-LQD Guideline No. 10 [1994c]).

Because the mine units are mined in succession, not all the pattern areas would necessarily be fenced at the same time. Pattern area fences would be standard wildlife friendly fencing based on BLM Manual Handbook 1741-1, Fencing (1989), which would keep cattle and wild horses out but would allow the passage of pronghorn and other wildlife. The fences would be removed after ISR operations are complete and vegetation has become reestablished in accordance with permit requirements as described in Section RP 4.5.4 of the WDEQ-LQD Permit to Mine Reclamation Plan (LCI, 2011b) unless otherwise approved and agreed upon with the landowner (BLM).

Access to the fenced areas would be through gates (e.g., at the Storage Ponds) or pitless cattle guards (e.g., at the pattern areas). Because there is the potential for gates to be inadvertently left open on occasion, pitless cattle guards may be used in conjunction with gates to prevent cattle and wild horses from entering an open gate and becoming trapped in the fenced area.

2.1.3 Construction

The Construction phase includes both the initial construction of the Plant and other life-of-mine facilities and the progressive development of mine units during the Project.

2.1.3.1 Initial Construction

Standard construction techniques for industrial facilities would be used for construction of the Plant, Storage Ponds, and associated facilities. The construction would involve the use of heavy equipment, such as bulldozers, excavators, and cranes, to excavate footings, erect buildings, build the ponds, and place tanks and other large containers. Supplies and specialized equipment would generally be delivered by tractor-trailers, with some equipment being delivered by rail and then tractor-trailers, or delivered by smaller trucks or vans.

Graders, bulldozers, rollers, and similar equipment would be used for road upgrades. Specifications for the facilities and roads are included in the WDEQ-LQD Permit to Mine and the NRC Material License (LCI, 2010 and 2011b).

Construction and testing requirements for the UIC Class I wells are included in Sections G and L of the WDEQ-WQD UIC Permit, which is included in Attachment ADJ-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Drilling would be conducted by a carrier-mounted rotary drill rig (similar to ones typically used for oil and gas drilling) with accompanying generators, mud systems, pipe racks, logging trucks and personnel vehicles. For the purpose of calculating surface disturbance for the Project, it was assumed that a three-acre drilling pad would be needed for drilling each deep well and that, upon drilling completion, a well house (cumulatively requiring about one acre) would be constructed and the remaining two acres of the drilling pad would be reclaimed.

2.1.3.2 Mine Unit Development

The activities during development of each mine unit are similar, with the unit-specific details included in the Hydrologic Test Proposal and subsequent Test Report submitted to WDEQ-LQD for review and approval prior to construction of each mine unit.

Drilling

Exploration, delineation and well drilling would be conducted by truck-mounted water well-type rotary drill rigs with accompanying water trucks, pipe trucks, logging trucks and personnel vehicles. Due to the low relief of the Permit Area and the use of a drilling rig with hydraulic leveling jacks, little or no leveling or alteration of surface topography would be required during drilling operations. While digging mud pits, constructing drill pads, or any other excavation, topsoil would be preserved using the techniques required by the WDEQ-LQD Permit to Mine (e.g., Section OP 2.5, LCI, 2011b). Disturbance areas would be reclaimed as soon as possible in order to minimize the total amount of land disturbed at any given time in accordance with WDEQ-LQD and BLM policies.

Because of the limited amount of traffic, and small size of equipment needed to drill units within the mine, no developed roads would be constructed. Traffic routes would be delineated by stakes to reduce overall potential for multiple routes being developed within each mine unit.

Drill rigs would 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 would be used during drilling. Drilling locations would be modified, where possible, to avoid drilling in major drainage ways and/or major modifications to the terrain.

To avoid degradation of topsoil adjacent to mud pits, the pits would be installed so, at a minimum, the primary root zone topsoil (generally the top four to eight inches) would be removed and stockpiled separate from the stockpile of the subsoil excavated for the mud pit. One mud pit would be used at nested well locations, if possible. After drilling, the mud pit would be allowed to dry and then the subsoil would be replaced, followed by the replacement of topsoil, which would be redistributed as evenly as practical over the excavation area. Finally, the surface would be prepared and reseeded with the permanent seed mix 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). **Figure 2.1-7** shows the typical layout of a drill pit.

Drill pits would be backfilled with subsoil as soon after drilling as is practical. Topsoil would not be re-applied until the subsoil had been given adequate opportunity to settle into the pit. All but the UIC Class I well drilling sites would be in use for only a few days. The UIC Class I well drilling sites may be in use for several weeks or a few months.

Well Construction and Casing Integrity

The injection, production, and monitor wells would be drilled, logged, and cased in accordance with the requirements described in Section OP 3.3 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Additional details on well integrity testing procedures are included in Section OP 3.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

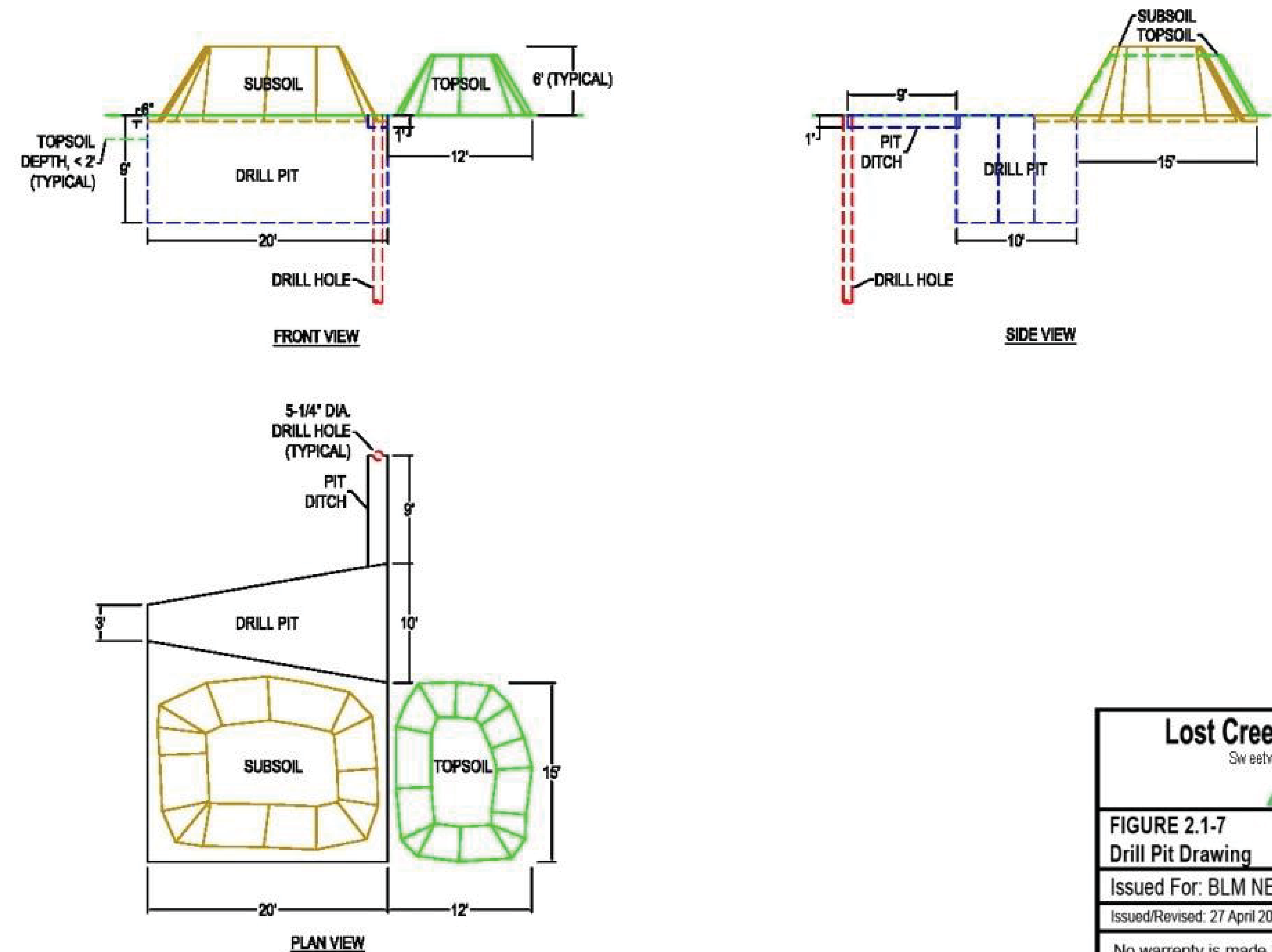

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FIGURE 2.1-7
Drill Pit Drawing

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Pump Testing and Water Quality Sampling

For each mine unit, the monitor well ring and monitor wells in the proposed pattern area and overlying and underlying aquifers would be installed first. A multi-day pump test would then be conducted to ensure that the monitor ring spacing is sufficient to detect any excursions from the pattern area. The pump test would also be used to ensure adequate separation between the production zone and the overlying and underlying aquifers and whether any trend wells are needed at locations where unanticipated conditions might occur.

Once pump testing is complete, the monitor wells would be sampled to establish baseline water quality and excursion parameters and limits (commonly referred to as Upper Control Limits). The monitoring must be conducted at specified intervals, as described in Section OP 3.6.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

Surface Facilities

The layout of each mine unit, including roads, pipelines, power lines, and header houses, would be designated in the Hydrologic Test Report submitted to WDEQ-LQD. The construction equipment for the surface facilities in the mine units is relatively small in comparison to the equipment needed for the Plant. Small dozers and graders would be used for road improvements, as necessary. If possible, a 'ditch witch' would be used for pipeline installation, or a small backhoe may be needed in some locations. Truck-mounted cranes may be used to place header houses assembled elsewhere on-site (e.g., at the Plant) or the header houses may be assembled on location. Pumps would be set with truck-mounted equipment.

To minimize erosion potential, weed invasion, and related problems, the mine unit reclamation activities would commence immediately upon construction completion. Vegetative cover would be maintained during the mine unit operation through monitoring and additional seedings when necessary.

An essential activity that would occur throughout the life of the Project is monitoring of all aspects of the system, including operational and environmental parameters, by qualified personnel and review of the data to ensure the results are as anticipated. **Section 2.1.7** provides a general overview of monitoring related to the Project.

2.1.4 Operation (Production)

2.1.4.1 Mine Units

Mine units are generally developed and activated in stages. Commonly, new production is started by header house, rather than by complete new mine unit.

Depending on available pipeline and Plant capacity, an operator may initiate new production in areas as discrete as individual patterns.

The uranium ISR process starts at the mine units by introducing lixiviant into the ore zone through the injection wells. The lixiviant is composed of native groundwater, carbon dioxide and oxygen or an equivalent oxidizing agent. Carbon dioxide would be added either at the Plant and/or at the header houses. Oxygen would be added to the barren lixiviant at the mine unit header houses.

When the lixiviant is injected into the ore 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 would also be mobilized along with the uranium. Depending on the site conditions, other metals, such as arsenic, molybdenum, selenium, and/or vanadium, may also be mobilized. The resultant uranium-bearing solution would be recovered from the production wells to the surface. The injection and production rates would be balanced to control the movement of fluids in the aquifer. Section OP 3.6 and Attachment OP-2 of the WDEQ-LQD Permit to Mine describe the mine unit control procedures in detail (LCI, 2011b).

In each mine unit, more uranium-bearing solution would be extracted than lixiviant injected, which creates a localized hydrological cone of depression or pressure sink. The anticipated overproduction or bleed would be a nominal 0.5 percent to one percent of the production rate. Under this pressure gradient, the groundwater in the surrounding area would move toward the mine unit, minimizing the possibility of an excursion.

2.1.4.2 Plant

The ion exchange circuit at the Plant receives the uranium-bearing solution from the mine unit(s) through buried pipelines. The Plant is designed for a flow rate of 6,000 gallons per minute (gpm), and the balance of production and restoration capacities is described in detail in Section OP 3.6.3.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Several processes occur in the Plant, many of which involve waste disposal, which is discussed in **Section 2.1.4.4**. Effluent control systems (including gaseous emissions, liquid wastes, and solid wastes) have been evaluated by NRC in Sections 4.14 and 5.14 of the SEIS (2011a) and by WDEQ-LQD in Section 5.0 of the Permit to Mine (LCI, 2011b). The following operations, described in more detail in Section OP 4.0 of the WDEQ-LQD Permit to Mine (LCI, 2011b) occur inside the Plant:

Resin Loading

The dissolved uranium in the pregnant lixiviant from the mine units would chemically adsorb onto the ion exchange resin as the lixiviant passes through the resin. The barren lixiviant exiting the resin would normally contain less than five milligrams per liter of uranium. A slip stream of the barren lixiviant would be treated with reverse osmosis (RO) to remove any remaining impurities (e.g., other metals) before sending the lixiviant back to the field for re-injection. The bleed portion of the fluid would be treated and disposed of via a UIC Class I well.

Resin Elution

When resin in an ion exchange vessel is loaded and removing very little additional uranium from the incoming solution, the resin would then be transferred to an elution vessel. The resin would be contacted with an eluate composed of approximately 90 grams per liter (g/L) sodium chloride and 20 g/L sodium carbonate (soda ash). The eluted resin would be rinsed with fresh water and transported back to the ion exchange facility and placed in an ion exchange vessel for additional uranium recovery. The rinse water would be collected, treated, and the waste discharged to the Storage Ponds and UIC Class I wells.

Precipitation and Filtration

From the elution circuit, the uranium-bearing eluate would be sent to an agitator tank for batch precipitation. To initiate the precipitation cycle, hydrochloric or sulfuric acid would be added to the eluate to breakdown the uranyl carbonate present in the solution. Hydrogen peroxide would then be added to the eluate to effect precipitation of the uranium as uranyl peroxide. Caustic soda solution would then be added to elevate the pH, which promotes growth of uranyl peroxide crystals and makes the slurry safer to handle in the subsequent process steps.

After precipitation, the precipitated uranium would be washed, to remove excess chlorides and other soluble contaminants, and then de-watered and filtered to form the yellowcake slurry. This slurry of approximately 40 percent of water would then be stored in holding tanks or in transport tanks parked in a secure area in the Plant. The holding and transport tanks would be used solely for yellowcake slurry. On-site inventory of U_3O_8 in the slurry form would typically be less than 100,000 pounds. However, in periods of inclement weather or other interruptions to product shipments, there would be capacity for up to 200,000 pounds of slurry within the Plant. The yellowcake slurry would be shipped by exclusive-use, authorized transport to a facility licensed by NRC for processing the slurry into dry yellowcake. A final destination for outgoing shipments of yellowcake slurry has not been determined at this time. Transportation associated with the Project is discussed in **Section 4.3**. Transport of product and waste has undergone thorough review by NRC in Section 4.3 of the SEIS (2011a).

2.1.4.3 Instrumentation and Control

For control and monitoring purposes, two separate control systems would be used during ISR operations (Sections OP 3.5 and 4.4 of the WDEQ-LQD Permit to Mine [LCI, 2011b]). Each system would be designed and instrumented to accommodate the steady state or batch flow characteristic of particular process flow streams or unit operations. The control systems would employ state-of-the-art hardware and software with proven as well as demonstrated process logic.

Since the mine unit resin loading circuit operates at a steady state, modest deviations from the normal operating flow rates and pressure profiles (plus or minus ten percent or greater) would be indicative of major operating upsets. An automatic Emergency Shut Down (ESD) system, consisting of pressure and flow rate switches, would be provided for this circuit. In the event of an automatic shutdown, an alarm would notify the operator of the situation. Once the major upset (broken piping, leaking vessel, etc.) is identified and corrective action taken, only then can the circuit be manually restarted. This type of control system provides the best protection against fluid spills to the environment and product losses. The back-up for the automatic ESD system is provided by local displays of the same flow rates and pressures that the ESD system monitors. Due to spill prevention practices in place, including monitoring of changes in pressure and flow rate and regular equipment checks, there would be a low risk for severe spills. In the case of accidental release of mining or process fluids, LCI would use designated equipment to recover as much of the solution as possible. If the fluid was radioactive, LCI staff would perform a radiological risk assessment. If a more severe spill were to occur, NRC would be informed, as required by 10 CFR 20 and 10 CFR 40 (LCI, 2010). If any accidental release to the environment occurred, LCI would verbally notify WDEQ-LQD and BLM. Additionally, LCI would submit a written report within one week describing the location, nature, and cause of the incident, and summarizing any potential releases to the environment, problem solving efforts, and future preventative or mitigative measures that could be taken in similar events (LCI, 2011b).

The elution, precipitation, and product filtering, circuits would operate in a batch nature. These circuits are controlled by Programmable Logic Controllers (PLCs), which sequence the opening and closing of appropriate valves once the processes are manually initiated. In addition, the PLCs would provide closed-loop feedback control for the elution and precipitation circuits. All automatic valves would be equipped with manual control override. Local indication of pressures, levels, flow rates, and pH would be provided for the complete manual control of these circuits if required.

Process water treatment and disposal circuits would operate under semi-continuous, steady-state conditions, which require control systems that integrate components of both steady-state and batch operations.

2.1.4.4 Effluent Control Systems

During the Project, gaseous/airborne, liquid, and solid effluents would 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 effluents and procedures for ensuring appropriate handling and disposal are summarized below and described in more detail in Section OP 5.0 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 4.0 and 5.0 of the NRC Technical Report (LCI, 2010).

Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents would be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent would be radon gas.

Non-radioactive gaseous emissions would result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles would produce small amounts of carbon monoxide, sulfur dioxide, and other internal-combustion engine emissions. Most of the airborne particulates would be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit. 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.

Carbon dioxide and oxygen would 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 would 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, would be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities would 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.

Radon would 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 would be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells would be open at the surface; however, water levels would typically be low and radon venting would be minimal. All of the well releases would be outside of buildings and are directly vented to the atmosphere. Radon would also be released during ion exchange resin transfers and subsequent ore processing steps. The UIC Class I well pump houses would also be vented.

Liquid Wastes

The Project would generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct materials by NRC. The descriptions of these wastes follow, and **Table 2.1-1** summarizes the quantities and disposal methods.

Native Groundwater

Groundwater is recovered during well installation, sample collection, and pump testing 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 and would be discharged to the surface under the provisions of a general Wyoming Pollutant Discharge Elimination System (WYPDES) permit, in a manner that mitigates erosion, or reused in drilling.

Storm Water Runoff

Procedural and engineering controls would be implemented so storm water runoff from the area of the Plant would 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 would be obtained from WDEQ-WQD.

Domestic Liquid Waste

Domestic liquid wastes would be disposed of in an approved septic system, which would 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. The septic system and chemical toilets would be maintained by a licensed contractor.

Waste Petroleum Products and Chemicals

These wastes would be typical for ISR facilities, and would include items such as waste oil and out-of-date reagents, none of which would have been closely associated with the processing of 11(e)(2) byproduct materials. LCI would 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 would be dealt with in one of two ways, depending on whether or not they were part of laboratory operations. Waste items not immediately associated with laboratory operations would be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the EPA.

These wastes would be periodically collected by a commercial business for recycling or disposal in a licensed disposal facility. Waste chemicals typically associated with the laboratory and its operations would be captured in the drains and/or sumps within the laboratory and would go straight to Plant waste tanks for eventual deep well disposal.

Liquid Process Wastes (11(e)(2) Byproduct Material)

Ore processing produces three liquid wastes with important volumes, a production (or hydrologic) bleed (**Section 2.1.4.1**), an eluate bleed, and yellowcake wash water (**Section 2.1.4.2**). The volume of production bleed would be on the order of 100 gpm, depending on the on-going activities. The combined volume of eluate bleed and yellowcake wash water (part of the Plant process water) would be on the order of 5 gpm. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters would generate liquid waste on the order of 25 gallons per day. The production bleed, eluate bleed, and yellowcake wash water would be collected, treated and the waste discharged to the Storage Ponds and UIC Class I well(s).

During operations, there would also be an occasional need to decontaminate equipment with high-pressure water wash so it can be disposed of, sent to another NRC-licensed facility, or released for unrestricted use. The water resulting from decontamination would enter the waste water circuit through a sump and would ultimately be disposed of in the UIC Class I well(s).

Groundwater Generated during Well Development and Sample Collection (11(e)(2) Byproduct Material)

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 would be collected and treated; and the waste would be discharged to the Storage Ponds and UIC Class I wells.

Table 2.1-1 Waste Streams (Page 1 of 2)

Class of Waste	Specific Waste Type	Estimated Monthly Quantity	Storage Method	Disposal Method
Liquid Waste				
Non-11(e)(2) Byproduct	Native groundwater	Intermittent	None	Surface discharge per WYPDES requirements or reuse
	Storm water runoff	Intermittent	None	
	Domestic sewage	20,000 gallons	None	Septic tank w/ leach field
	Waste petroleum products	40 to 80 gallons	1 (1)	1 (1)
11(e)(2) Byproduct	Hydrologic Bleed	3,060,000 (2)	Wells with ponds available (3)	Disposal Well
	RO Brine	6,600,000 (2)		
	Groundwater Sweep	5,300,000 (2)		
	Plant Process Water	440,000 (2)		
Hazardous Material (Petroleum products & chemicals)	Not associated w/ laboratory	<1 gallon	2	2
	Associated w/ laboratory	<1 gallon	None	Disposal Well
Solid Waste				
Non-11(e)(2) Byproduct	Paper	1.7 cubic yards (yd^3)	Recycle bins	3
	Cardboard	4.2 yd^3	Recycle bins	3
	Kitchen garbage	4.2 yd^3	Trash can with transfer to dumpster	4
	Sewer sludge	0.3 yd^3	No storage; immediate transfer to disposal upon collecting	4
	Mud/cement sacks	16.7 yd^3	Dumpster	4
	HDPE/PVC pipe scrap	8.3 yd^3	Dumpster	4
	Wooden pallets	16.7 yd^3	Stored outdoors	5
	Miscellaneous	--	Appropriate to material	3

Table 2.1-1 Waste Streams (Page 2 of 2)

Class of Waste	Specific Waste Type	Estimated Monthly Quantity	Storage Method	Disposal Method
Solid Wastes (cont'd)				
11(e)(2) Byproduct	Bag filters	2.9 yd^3	6	7
	Spent resin	0.2 yd^3	6	7
	Tank sludge	0.2 yd^3	6	7
	Gloves	0.1 yd^3	6	7
	Protective coveralls (i.e., Tyvek)	0.2 yd^3	6	7
	Scale	0.1 yd^3	6	7
	Piping	2.9 yd^3	6	7
	Valves	0.2 yd^3	6	7
	Cardboard	0.3 yd^3	6	7
	Paper	0.1 yd^3	6	7
	Miscellaneous	---	6	7
Hazardous Material	Fluorescent bulbs	2 bulbs	Packaged/ labeled according to EPA regulations and placed in dumpster	4
	Ballast	0.2 ballasts	Stored indoors until disposal	4
	Rechargeable batteries	1 pound		3
	Miscellaneous	---	Appropriate to material	3

(1) 1 - Store in sealed, strong, tight, waterproof, labeled container(s) in indoor, bermed, and ventilated area adjacent to maintenance shop. Waste petroleum products may be burned on-site to generate heat. If not burned on-site, the petroleum waste would be sent to a local permitted recycling facility, such as the Casper landfill.

2 - Store in sealed, strong, tight, waterproof, labeled containers above ground in accordance with EPA requirements and in berms suitable for their contents, e.g., acid waste containers in the acid tank berm.

3 - Recycle to extent possible; remainder of material sent to local licensed landfill.

4 - Send to local permitted landfill or sewage pond as appropriate

5 - Recycle to extent possible; remainder of pallets sent to local licensed landfill or burned on-site with an air quality permit from WDEQ-AQD.

6 - Place in trash container in Plant and then transferred to a DOT-approved container for disposal.

7 - Dispose of at a facility licensed by NRC or an Agreement State to receive 11(e)(2) byproduct material for disposal. Where possible, equipment would be decontaminated for disposal as non-11(e)(2) byproduct materials or for re-use.

(2) The processes generating these waste water streams do not always operate concurrently or at full capacity. The quantity shown for each waste type (e.g., Hydrologic Bleed) is the maximum.

(3) Generally, 11(e)(2) waste water would be sent directly to the disposal well. However, the option for storage in the lined Storage Ponds is available as needed.

Groundwater Generated during Aquifer Restoration (11(e)(2) Byproduct Material)

During the various steps of aquifer restoration, groundwater would be generated; and disposal of some or all of the water would be required. During sweep, groundwater would be pumped from the production zone, creating an area of drawdown. This would create an influx of water from outside the production zone that would replace the affected volume of water within the production zone. In most cases, the water produced during sweep would 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 reverse osmosis (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 would not be re-injected into the production zone, but could be transferred to other mine units for use as makeup water or injected into the UIC Class I wells. The concentrated byproduct material (brine) would also be injected into the UIC Class I wells.

During RO, groundwater would be pumped from the production zone. The pumped water would be treated by RO; and the permeate would be injected back into the production zone. To maintain an area of drawdown, an effective bleed would 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 would be injected into the UIC Class I wells. Similarly, during other restoration steps, the amount of groundwater pumped from the aquifer would exceed the amount pumped back to the aquifer; and that excess water would be disposed of in the UIC Class I wells.

Solid Wastes

Solid wastes, some of which would be classified as NRC 11(e)(2) byproduct materials, would be produced during the Project. The descriptions of these wastes are presented below, and **Table 2.1-1** summarizes the quantities and disposal methods.

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

The solid non-11(e)(2) byproduct materials would 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. LCI would be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition.

Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials would include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and would include used 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.

2.1.5 Reclamation

The Reclamation phase includes both the progressive groundwater restoration and surface reclamation of the mine units and the final reclamation of all the life-of-mine facilities, such as the Plant. Reclamation would be in accordance with the requirements of the NRC License, the WDEQ-LQD Permit to Mine, and the BLM Rawlins RMP and associated documents (BLM, 2008c, 2009b, and 2011e).

2.1.5.1 Mine Unit Restoration and Reclamation

Technical, economic, and operational criteria would be reviewed to determine if uranium recovery is complete in a given header house and/or mine unit. When the mineral is sufficiently recovered, the lixiviant injection ceases and groundwater restoration commences. If a mined unit is adjacent to another unit being produced, restoration of a portion of the unit may be deferred to minimize interference with the operating unit. However, LCI intends to concurrently conduct restoration and mining, e.g., each mine unit would be restored following mining. (Sections RP 1.0 and 2.0 of the WDEQ-LQD Permit [LCI, 2011b]).

The aquifer restoration program would use a combination of three primary techniques including: groundwater sweep; reverse osmosis treatment with permeate injection; and recirculation. During groundwater sweep, water would pumped from the mine unit without offsetting with water injection. This pumping would create an influx of baseline quality native groundwater into the unit, thereby flushing contaminants from areas affected by the horizontal and vertical spreading (flare) of the lixiviant during mining. Following sweep, RO would be used to treat water pumped from the mine unit, and the treated water would be reinjected into the mine unit to reduce contaminant concentrations. After RO, recirculation would be initiated. During recirculation, water would be pumped from the mine unit and re-injected to homogenize the overall groundwater conditions. Other techniques that may be used include groundwater transfer (moving groundwater between a mine unit in restoration and another mine unit in operation), addition of a reductant (to reduce metal solubility), and biorestoration (to reduce specific parameters). The same equipment used for production from a mine unit would also be used for restoration, with the possible addition of one or two trailers housing reverse osmosis (RO) treatment equipment. (Section RP 2.3 of the WDEQ-LQD Permit [LCI, 2011b]).

The goal of groundwater restoration would be to return the water quality parameters to the pre-operational class of use as defined by WDEQ-WQD and to the requirements of 10 CFR Part 40, Appendix A, Criterion 5B(5) (Section RP 2.2 of the WDEQ-LQD Permit [LCI, 2011b] and Section 6.1.3.1 of the NRC SER [NRC, 2011c]). After completion of groundwater restoration, which would be approved by WDEQ and NRC, all cased wells would be permanently plugged and capped. The well casings would be cut off below plow depth and the sites revegetated. Well abandonment would be conducted with truck-mounted rigs similar to those used for well construction (Section RP 3.1 of the WDEQ-LQD Permit [LCI, 2011b]).

As noted in **Section 2.1.3**, to minimize erosion potential, weed invasion, and related problems, surface reclamation in a mine unit would begin immediately upon construction completion, and vegetative cover would be maintained during mine unit operation. However, after completion of groundwater restoration in a mine unit, the subsequent well abandonment, pipeline removal, and demolition of surface facilities would result in surface redisturbance within the mine unit, which would need to be reclaimed. Prior to the commencement of this post-mining surface reclamation, affected areas and buildings (i.e., header houses) would be surveyed and decontaminated, and facilities and ancillary equipment would be decommissioned and removed in accordance with NRC requirements. Equipment used for decommissioning and removal is similar to that used for construction.

Prior to revegetation of the mine unit, a tractor may be needed for surface preparation of compacted areas, such as two-track roads, and a small backhoe and grader for topsoil replacement. Vegetation would be reestablished with the approved seed mix, which would adequately support the post-operational land uses, livestock grazing and wildlife habitat, and was approved by the BLM Rawlins Office on January 14, 2010 and WDEQ-LQD (Section RP 4.5.4 of the WDEQ-LQD Permit (LCI, 2011b). If any of the approved seed were unavailable or prohibitive in cost at the time of seeding, other locally adapted and certified seed would be substituted with prior approval of BLM and WDEQ-LQD. On occasion, soil may be stabilized by planting a vigorous annual cover crop of rhizomatous species as directed in WDEQ-LQD Guideline No. 2 (1997), in which case, LCI would seek and receive approval from BLM and WDEQ-LQD before planting such species. Specific requirements for surface reclamation are included in Sections OP 3.0 and 4.5 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

2.1.5.2 Final Reclamation

The facilities that would require reclamation and decommissioning include:

- processing and water treatment equipment, which includes tanks, filters, ion-exchange columns, pipes, pumps, and related equipment;
- buildings and structures, parking areas, processing facilities, shipping areas, laydown areas, and offices;

- waste storage, treatment, and disposal facilities, including the UIC Class I wells and the Storage Ponds;
- buried pipes;
- topsoil and subsoil stockpile locations;
- engineering control structures, such as dams and culverts; and
- roads.

Final reclamation and decommissioning would begin following any radiation surveys and or soil or equipment remediation required by NRC.

With the exception of any facilities, including roads, approved for post-operational use, all of the facilities associated with the Project would be removed once uranium processing and groundwater restoration were complete. (Approval for post-operational use must be supported by the landowners and/or lessees request, and approval from BLM, which is the surface management agency of the Permit Area, and WDEQ-LQD. If any facility, including a road, remained post-operation, the responsibility for long-term maintenance and ultimate reclamation of the facility or road would be transferred to the accepting party.)

Over a period of six months, the Plant and support facilities would be: radiologically decontaminated; and decommissioned, dismantled, and removed. In addition, during the same six-month period, surface preparation and reseeding would be completed.

Removal and Disposal of Facilities and Equipment

Prior to removal and disposal, facilities and equipment would be decontaminated, if necessary, in accordance with NRC requirements. Radiologically contaminated materials would be disposed of at an NRC-licensed facility; and materials contaminated with other industrial constituents would be disposed of at an appropriately licensed facility. Decontaminated and non-contaminated materials would be removed for salvage or disposed of at an appropriately licensed solid waste facility. Equipment used for decommissioning and removal would be similar to that used for construction.

Structures would be decontaminated, if necessary, and moved to a new location, salvaged, or dismantled and disposed at an appropriately licensed solid waste facility. Concrete flooring, foundations, and foundation materials would be decontaminated, if necessary, broken up, and disposed of at an appropriately licensed facility. Soil would be replaced at sites from which structures are removed in accordance with the depths and acreages salvaged prior to installation of the structures.

Waste Storage, Treatment, and Disposal Facilities

Those facilities for which a separate license is obtained, e.g., a UIC Class I well for waste water disposal, would be transferred to another owner or operator in accordance with applicable requirements or reclaimed and decommissioned in accordance with the separate license requirements.

Any contaminated sludge accumulation in the Storage Ponds, the pond liner, and, if necessary, the leak detection equipment would be removed, in accordance with the standard operating procedure for handling of contaminated materials, and disposed of at an NRC-licensed facility. The soil underneath the pond would be surveyed for radiological contamination, and any areas in which concentrations exceed limits for unrestricted use would be excavated and the contaminated material disposed of at an NRC-licensed facility. Confirmation surveying and sampling would be conducted in accordance with applicable requirements to ensure all contaminated material has been removed.

Buried Piping and Engineering Control Structures

Buried piping and engineering control structures would be decontaminated and removed.

Roads

Improved or constructed roads would be reclaimed by removal of culverts, removal of road surfacing and road bed materials, and recontouring, as necessary. Unimproved roads would be recontoured, if necessary, and scarified, ripped, or disced to reduce compaction.

Soil Replacement and Revegetation

Areas in which reclamation would be required within the Permit Area include the mine units, in particular, where the header houses and roads would be removed, and the Plant area. Disturbed areas would be reclaimed to the approved post-operations land use by regrading the surface to the approximate pre-operations contour, re-establishing drainages, replacing salvaged soil, and revegetating the areas, in accordance with the procedures outlined below.

During site reclamation, the storm water discharge permits applicable per the (WYPDES) would be maintained. The associated Storm Water Pollution Prevention Plan (SWPPP) would be designed and implemented as part of LCI's compliance with applicable WDEQ-WQD rules and would be kept in an accessible area of the Project.

Post-Operational Land Use

The post-operational land use would be livestock grazing and wildlife habitat, which is the same as the pre-operational land use. Buildings, roads, wells, or other facilities constructed as part of the Project would be removed and the disturbance reclaimed, unless prior approval was obtained from the landowner (BLM) and WDEQ to leave the facilities in place to improve post-operational access or land use.

Surface Preparation

The small areas of disturbance that may be necessary (e.g., due to culvert removal) would be graded to approximate pre-operational contours and drainage patterns. To avoid creating ruts or other surface damage, loss of soil resources, and/or equipment damage, seed bed preparation would be performed under appropriate soil conditions (e.g., not when the ground is wet, frozen, or exceptionally dry) and climatic conditions (e.g., not during significant precipitation events or if the wind is excessive).

In areas where soil was not removed but was compacted due to site operations, e.g., two-track roads used to access monitor wells, soils would be scarified, ripped, or disced, as necessary, to aid in revegetation. In areas where soil was removed, the disturbed areas would be scarified, ripped, or disced as necessary to a depth of 12 inches to ensure soil stability after replacement. In areas with viable sagebrush, the soil would not be ripped and seed would be broadcast and worked in by appropriate means, such as a harrow, drag, or rake. Similar to reclamation of the mine units, a tractor may be needed for surface preparation of compacted areas.

Soil Replacement

Excavated soils would be replaced at the location from which they were excavated, unless the area from which the soils were excavated was approved for a different post-mine land use (e.g., BLM requests that a road or building remain in place and that request is approved by WDEQ-LQD). In such a case, the excavated soil from the road or building area would be used in another area where the original topsoil depth was thin or non-existent (e.g., it was disturbed by historic exploration activities), if such replacement was approved by WDEQ-LQD and BLM.

The replaced soil thickness would be in accordance with the depths and acreages salvaged during Construction. The replacement would be along the contour, where necessary to prevent soil erosion. To avoid clods, soils would not be replaced when the ground is wet or frozen. The replaced topsoil would be disced to create a proper seed bed. Similar to reclamation of mine units, a small backhoe and grader may be needed for topsoil replacement.

Seed Mix, Reseeding Methods, and Fencing

Vegetation would be reestablished with the approved seed mix, which would adequately support the post-operational land uses, livestock grazing and wildlife habitat, and was approved by the BLM Rawlins Office on January 14, 2010 and WDEQ-LQD (Section RP 4.5.4 of the WDEQ-LQD Permit (LCI, 2011b). If any of the approved seed were unavailable or prohibitive in cost at the time of seeding, other locally adapted and certified seed would be substituted with prior approval of BLM and WDEQ-LQD. On occasion, soil may be stabilized by planting a vigorous annual cover crop of rhizomatous species as directed in WDEQ-LQD Guideline No. 2 (1997), in which case, LCI would seek and receive approval from BLM and WDEQ-LQD before planting such species.

Three methods of seeding, drill, pit and broadcast, would be used. Seeding would be performed as a continuous operation when conditions allow. In general, seeding would be completed during the spring or fall, whichever is the first normal period for favorable planting after the seed bed preparation.

Drill seeding would be the primary method. Areas with little gradient would be seeded with the rows perpendicular to the direction of the prevailing wind. Where necessary to prevent erosion, seeding would be done along the contour. Broadcast seeding would be performed on any steep slopes and drainage areas that may be disturbed in the Permit Area. The seed would be distributed uniformly over the area using a mechanical seed spreader. Immediately after broadcast seeding, the areas would be raked or dragged along the contour. This would cover the seeds with approximately one-quarter inch of soil. Pit seeding would be used in areas in which vegetation re-establishment was particularly difficult because the method allows for sheltering seeds from eolian erosion and capturing moisture in the area of the seed.

When reseeding areas outside fenced mine units or the Plant, vehicular access to reseeded areas would be restricted until vegetation was successfully re-established. Because of the potential for excessive grazing pressure on these areas, revegetation success would be evaluated in each growing season to determine if additional weed control, a cover crop, or other protective measures would be necessary. If such measures were considered necessary, LCI would submit a plan to BLM and WDEQ-LQD.

Revegetation Success

Revegetation would be deemed complete no earlier than the fifth full growing season after seeding and when:

- the revegetation was self-renewing under the site conditions;
- the total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix was at least equal to the

total vegetation cover of perennial species (excluding noxious weed species) of the undisturbed portions of the Permit Area;

- the species diversity and composition were suitable for the post-operational land use; and
- the total vegetation cover and species diversity and composition were quantitatively assessed in accordance with procedures approved by WDEQ-LQD.

Because many of the reclaimed areas would be relatively small in comparison with the Permit Area and because of the similarity of the vegetation communities at the site, LCI would delineate a comparison area in an undisturbed portion of the site at least six months prior to evaluation of revegetation success. In addition, LCI would describe the quantitative methods to be used for comparing the total vegetation cover in the reclaimed and undisturbed areas and for evaluating species diversity and composition. These methods, as well as the size and location of the comparison area, would be submitted to WDEQ-LQD for review and approval at least six months prior to the fifth full growing season.

Financial Assurance

Prior to the start of the Project, LCI would be required to establish and maintain a reclamation performance bond, in an amount approved by NRC, BLM, and WDEQ-LQD, to cover the costs for a third party to complete groundwater restoration, radiological decontamination, facility decommissioning, and surface reclamation. Under order of forfeiture, the bond would be payable to the State of Wyoming or the US Secretary of Interior (under which BLM operates). The bond amount would be reviewed annually by NRC, BLM, and WDEQ-LQD and adjusted to reflect changes in cost and in the Project, including construction and operation activities planned for the next year. Once NRC, BLM, and WDEQ-LQD approved the bond amount, LCI would submit an irrevocable letter of credit or other approved surety instrument to WDEQ-LQD, which is the designated agency for holding the bond. Additional details about the bond are provided in Section 2.1.1.1.8 of the NRC SEIS (2011a) and Section RP 5.0 of the Reclamation Plan in the WDEQ-LQD Permit to Mine (LCI, 2011b). The calculated bond amount for the first year of the Project, including the Plant and a portion of Mine Unit 1, is $6,151,685, as detailed in Table RP-4 of the WDEQ-LQD Permit to Mine.

2.1.6 Schedule

Figure 2.1-8 provides the current estimated chronology of the Project and illustrates the progressive development and restoration of the mine units up to final reclamation. For the purposes of this EIS, and for correlation with the NRC SEIS, the Project is described in three phases: Construction, Operation (Production), and Reclamation, because of the similarities in the activities and impacts. These phases are sequential with respect to the Plant and each mine unit;

however, because of the progressive development of the mine units, there is overlap among the mine units (e.g., the first mine unit is in reclamation when the third mine unit is in development). Therefore, the discussion of the schedule includes the following:

- Construction
    - Initial Plant Construction
    - Mine Unit Development
- Operation (Production)
- Reclamation
    - Mine Unit Restoration and Reclamation
    - Final Plant Reclamation

2.1.6.1 Construction

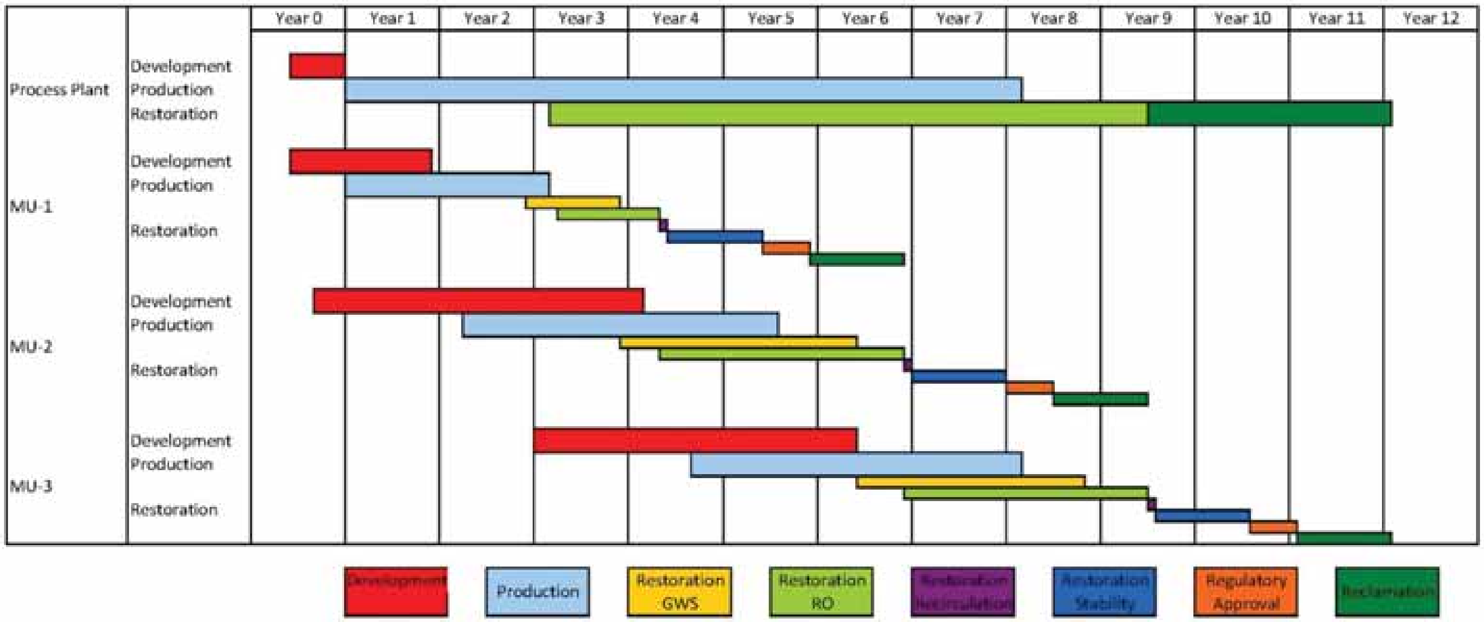
Initial Plant Construction

The major facility construction, including the Plant, access roads, equipment staging areas, and UIC Class I wells would be accomplished during the first year, with the exception of the first deep well that was drilled in 2008.

Mine Unit 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 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 2.1-8** reflects an approximate 24-month plan to complete the development work as follows:

- Monitor Well Installation: Typically 60 to 70 wells, plan two drill rigs for five months;
- Pump Test and Sampling: Allow for three months;
- Mine Unit Application Preparation: Allow for two months;
- Injection/Production Well Installation: Typically, nine header houses per unit, 60 wells per header house, requires ten drill rigs to complete one header house in approximately 40 days, allow for 13 months total; and
- Construction (header houses and pipelines): Allow one month per header house and associated pipelines (final header house completed in Month 24).



Lost Creek ISR Project
Sweetwater County, WY
AATA INTERNATIONAL, INC
Fort Collins, Colorado, USA

FIGURE 2.1-8
Lost Creek Project Development, Production and Restoration Schedule

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No warrenty is made by the BLM for use of the data for purposes not intended by the BLM

2.1.6.2 Operation (Production)

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 of the Project.

- Production Rate: 32 gpm per production well, based on hydrologic results of several formation characterization tests;
- Pore Volumes (PV): The estimated number of PVs processed to achieve economic depletion of the pattern is approximately 60;
- Recovery Percentage: The percentage rate, based on laboratory tests, is 84 to 93 percent recovery rate; however, an 80 percent recovery rate was used for calculations; and
- 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 mg/L U_3O_8 for the purpose of the production model.

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 2.1-8** was developed on the premise that the header houses within a mine unit would be activated in stages and that the final header house would be activated approximately one year after the first. Consequently, each mine unit has an expected production life cycle of two to three years.

The water balance variations for the Project are included in **Figure 2.1-9** through **Figure 2.1-14**. 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 use (**Figure 2.1-11**) to minimum Plant use (**Figure 2.1-14**).

One pore volume (PV) is equivalent to the sum of:

- the volume of water within the pattern area (thickness of the completion interval times surficial pattern area times effective porosity of the sand);
- the volume of water outside of the pattern area affected by the “horizontal flare” of the lixiviant along the outer edge of the pattern area; and
- the volume of water above and below the completion interval affected by the “vertical flare” of lixiviant.

Each mine unit has a unique PV, although the mine units within the Lost Creek Project are anticipated to have similar PVs because of similar hydrogeologic characteristics within the permit area and the project plant capacity. For the Lost Creek Project, the PV of the first mine unit is calculated as 35.6 million gallons (Worksheet 1 in Table RP-4 of the WDEQ-LQD Permit-to-Mine, LCI, 2011b).

2.1.6.3 Reclamation

Mine Unit Restoration and Reclamation

The schedule includes two years for groundwater restoration in each mine unit, based on 0.3 PV of groundwater sweep, 6.0 PV of reverse osmosis, and 1.0 PV of recirculation. 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 RO; and one month for recirculation. The estimated number of pore volumes required for restoration, and in turn, the schedule, are based on experience at other ISR projects in Wyoming. The analogous projects and comparison with the Lost Creek setting are described in Section 2.3.3 of the WDEQ-LQD Permit-to-Mine (LCI, 2011b) and Attachment 6.2-1 of the NRC Technical Report (LCI, 2010).

The schedule also includes one year for surface reclamation of each mine unit. This includes time for the well abandonment, radiological surveys per NRC requirements, removal of surface facilities, and surface preparation and seeding described in **Section 2.1.5**. Revegetation success would be monitored after seeding, and in the fifth full growing season after planting, the vegetation would be compared against the revegetation success criteria (**Section 2.1.5** and Section RP 4.5.5 of the WDEQ-LQD Permit-to-Mine [LCI, 2011b]).

Final Reclamation

The schedule includes two years for decommissioning the Plant equipment, radiological surveys per NRC requirements, removal of the Plant structures, and surface preparation and seeding described in **Section 2.1.5**. Revegetation success would be monitored after seeding, and in the fifth full growing season after planting, the vegetation would be compared against the revegetation success criteria (Section RP 4.5.5 of the WDEQ-LQD Permit-to-Mine (LCI, 2011b).

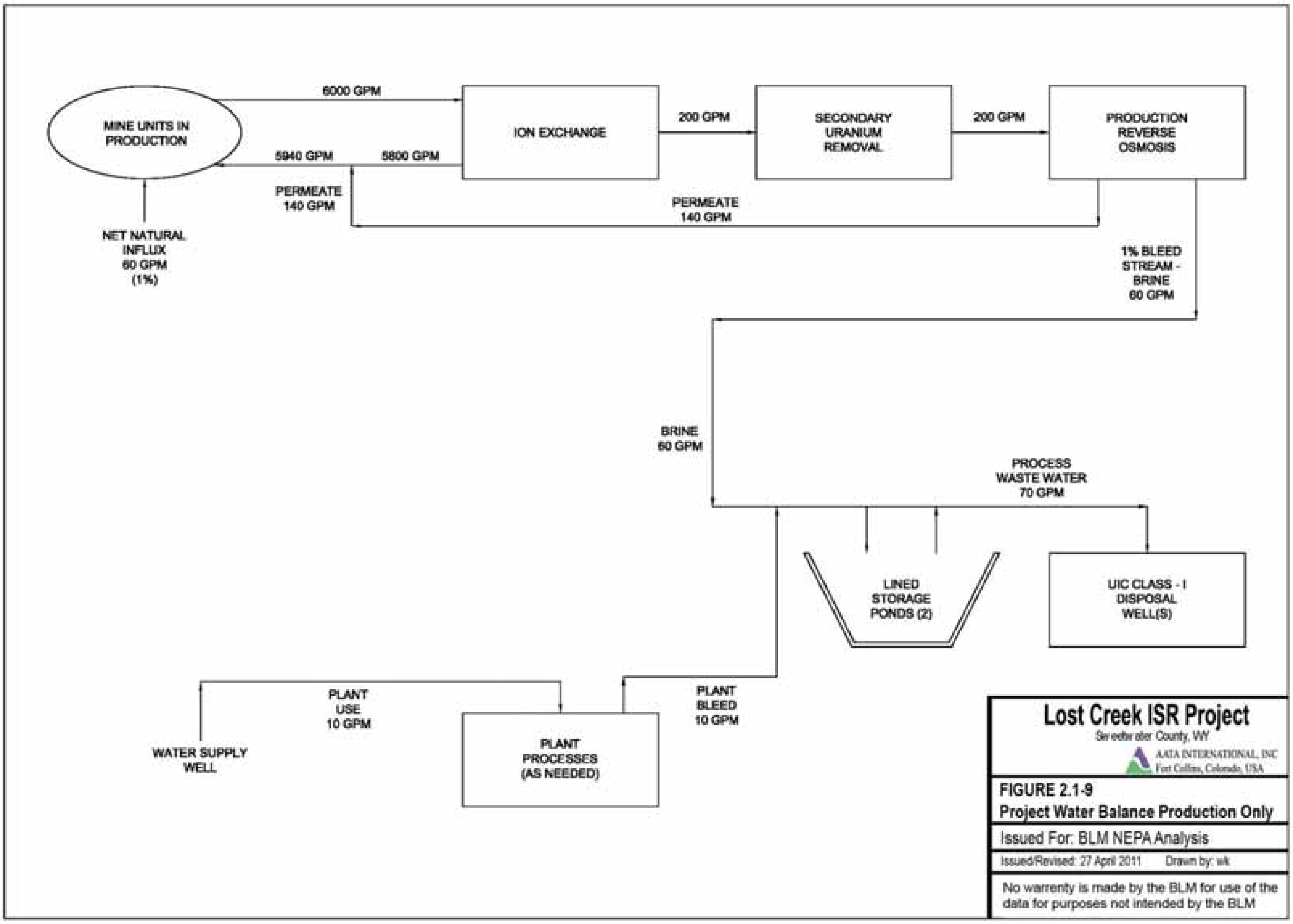

FIGURE 2.1-9
Project Water Balance Production Only

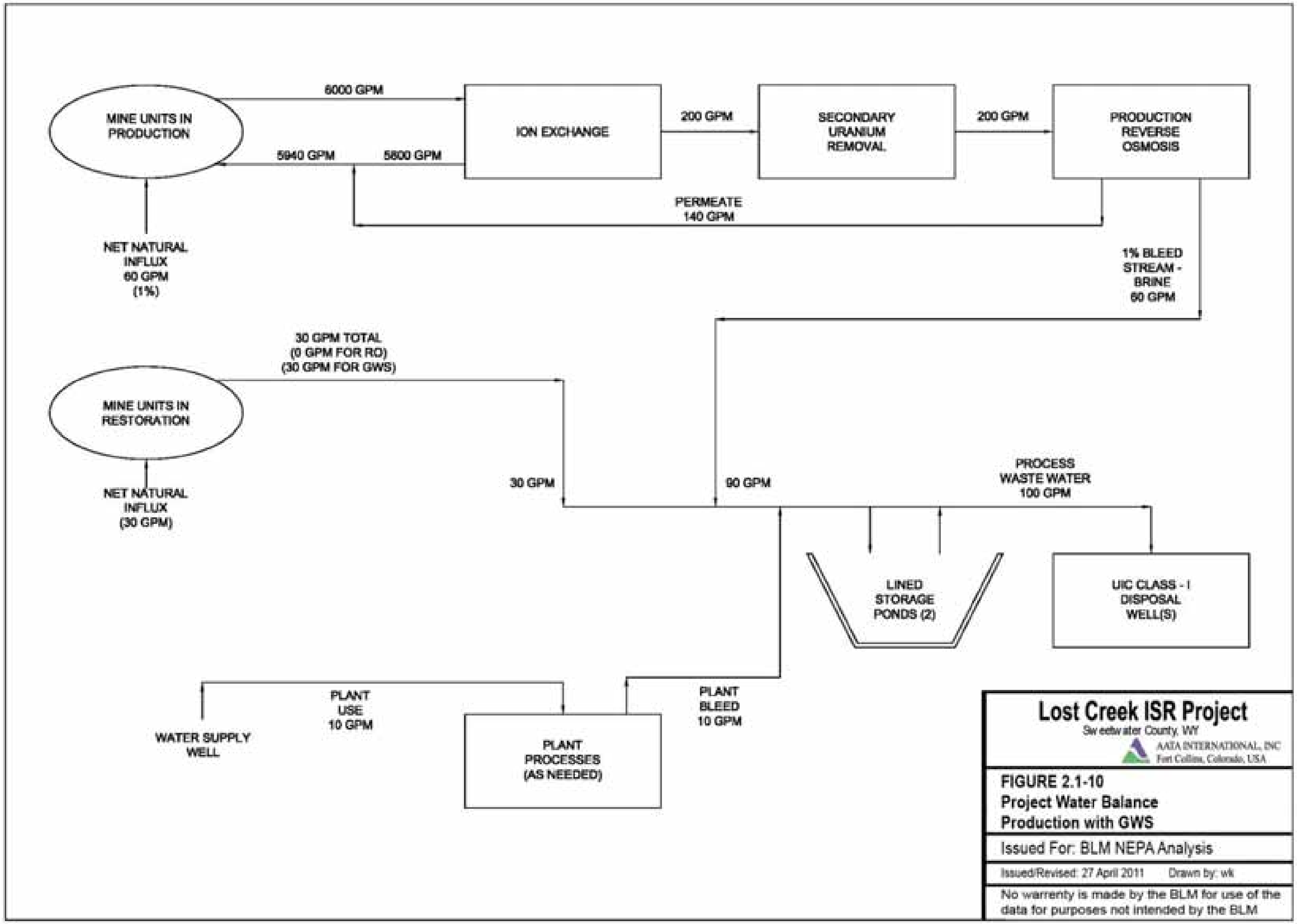

FIGURE 2.1-10
Project Water Balance
Production with GWS

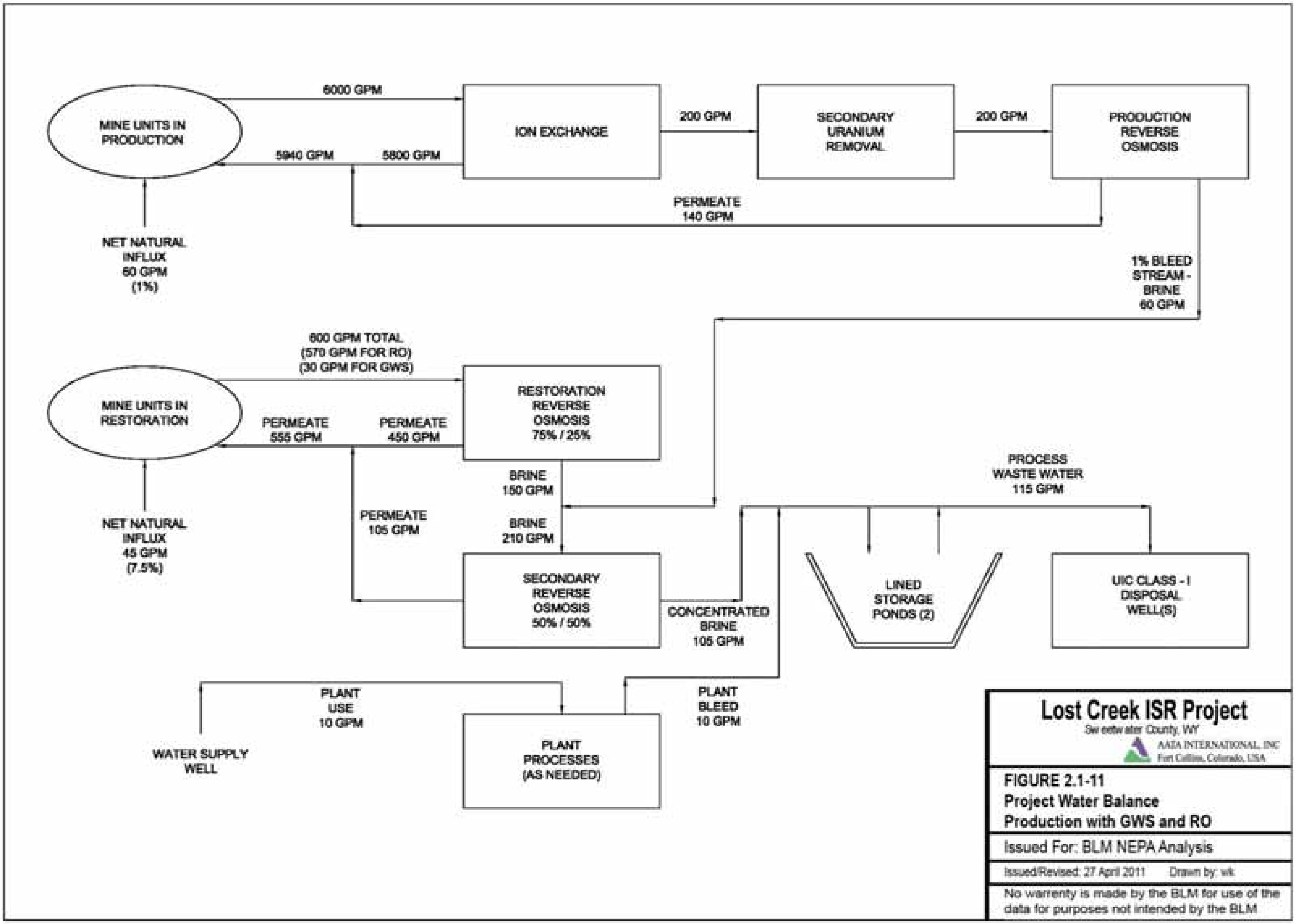

FIGURE 2.1-11
Project Water Balance
Production with GWS and RO

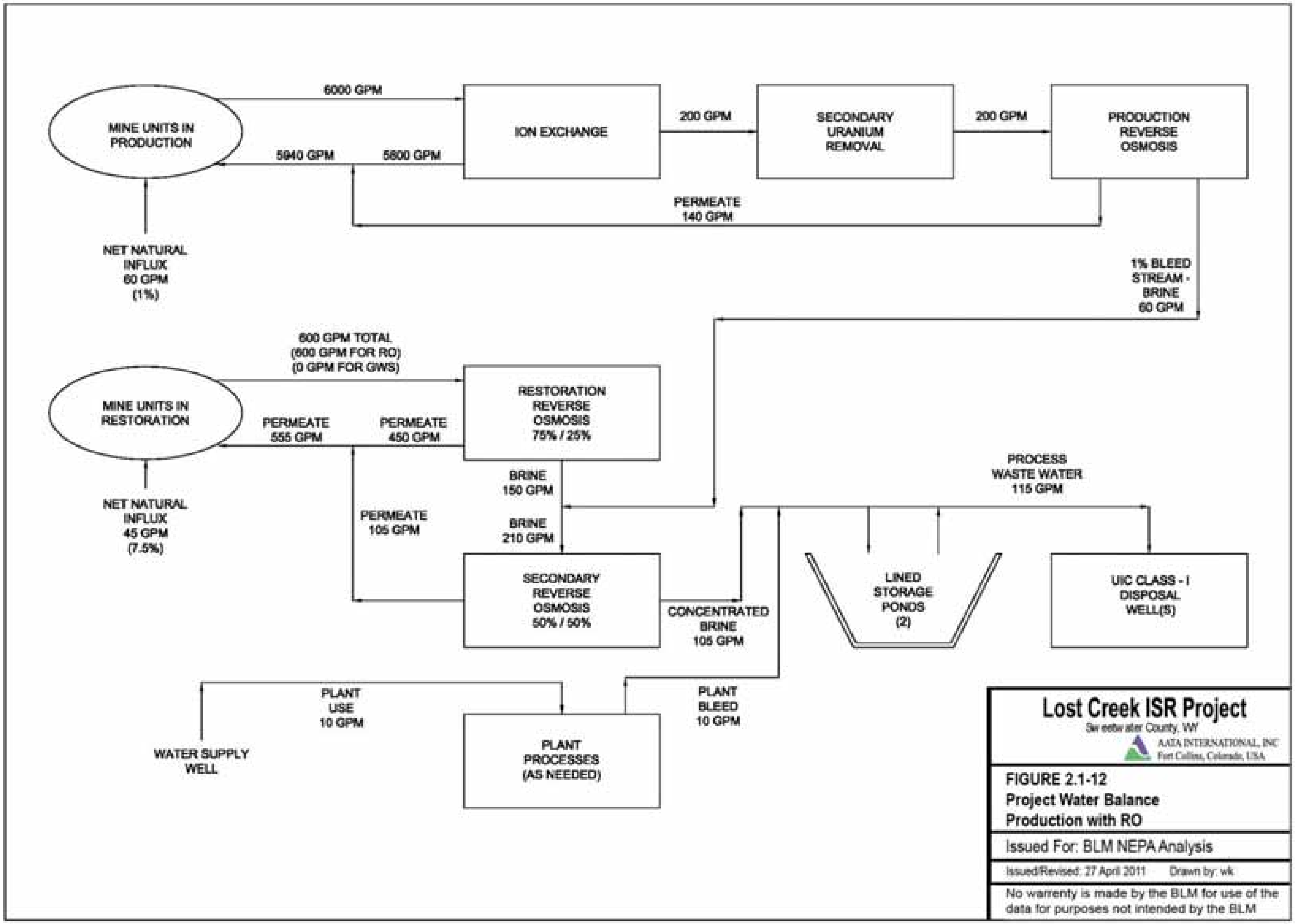

FIGURE 2.1-12
Project Water Balance
Production with RO

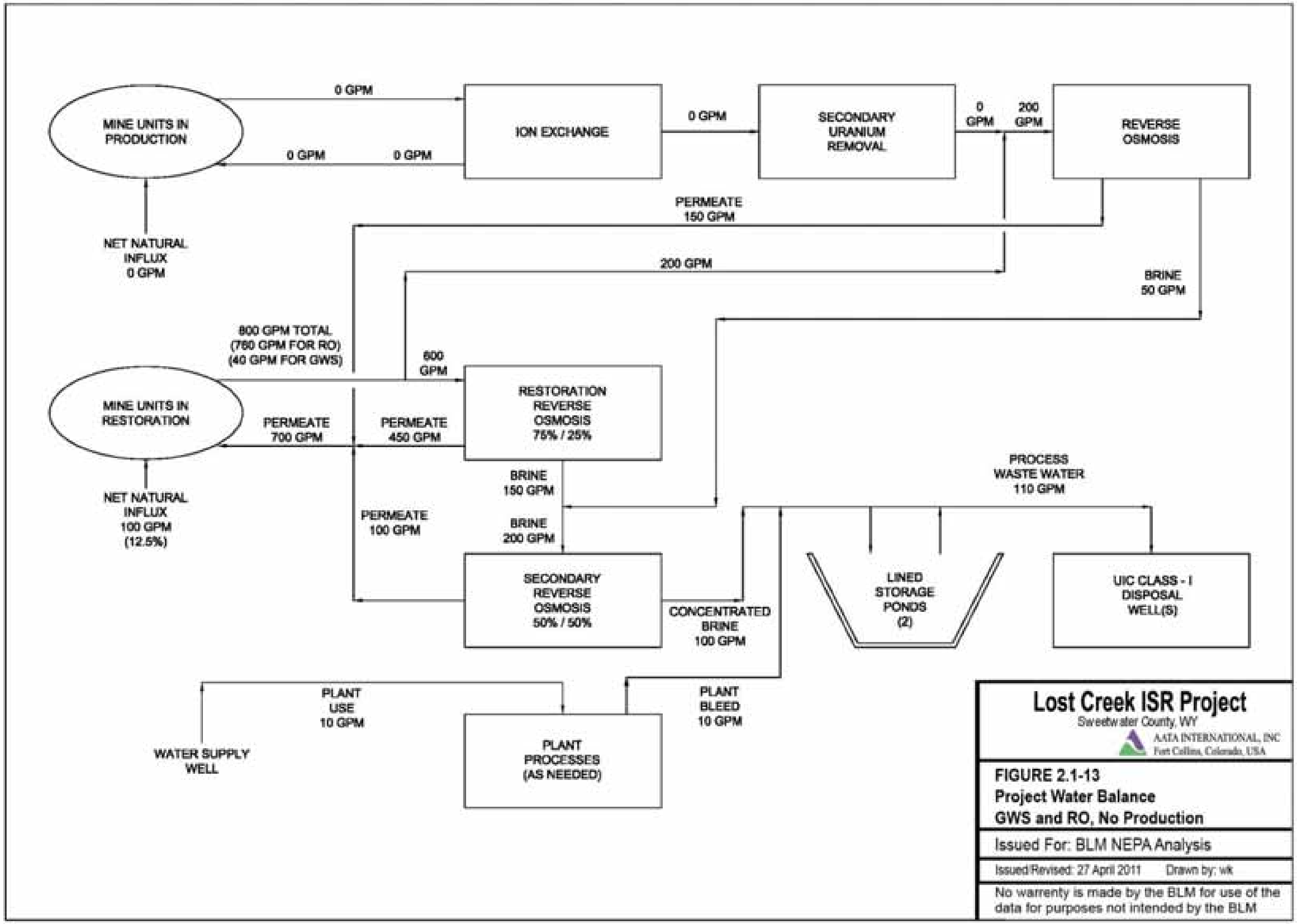

FIGURE 2.1-13
Project Water Balance
GWS and RO, No Production

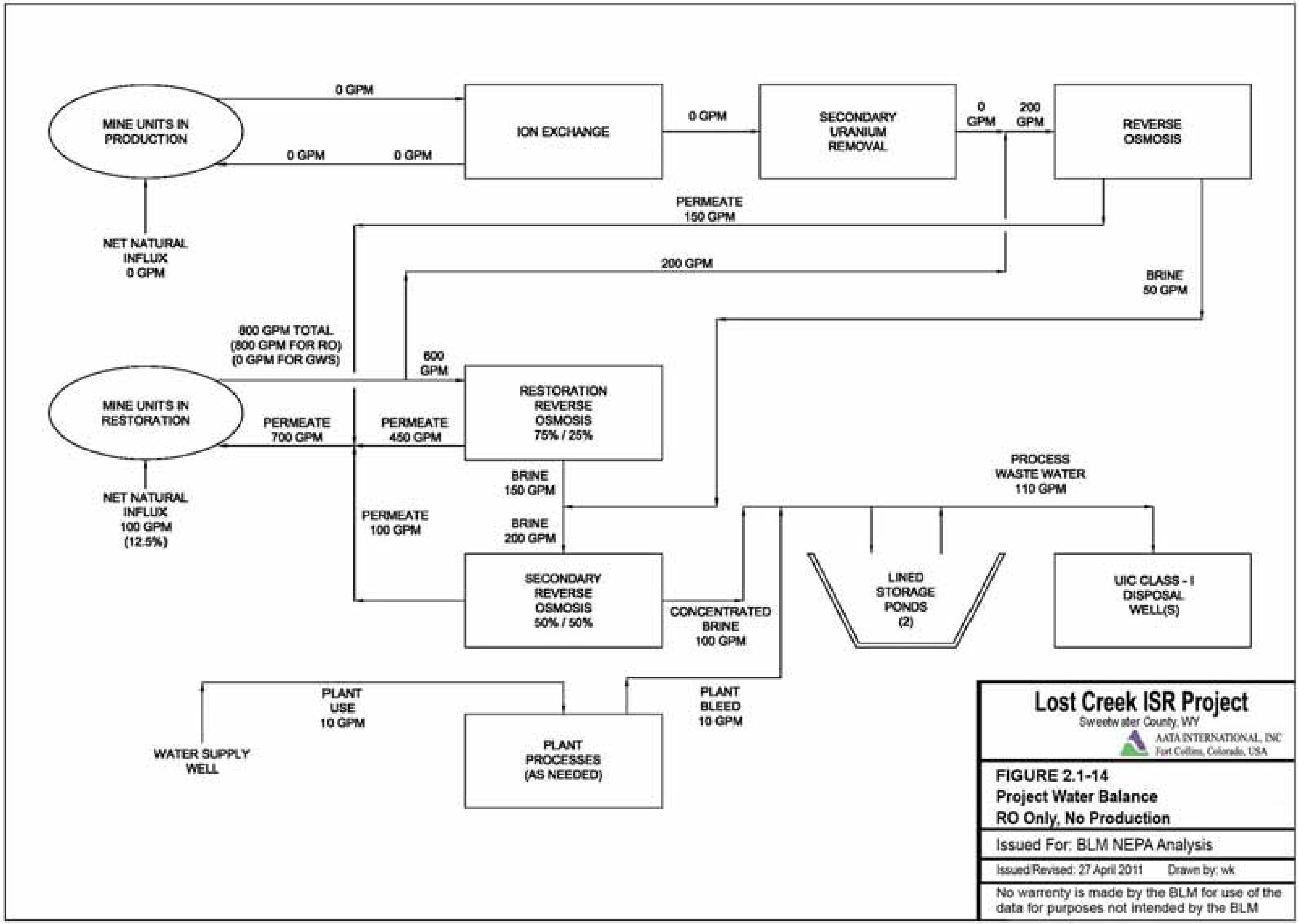

FIGURE 2.1-14
Project Water Balance
RO Only, No Production

2.1.6.4 Schedule Adjustments

The schedule could be affected by various factors which would typically involve adjustments 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 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 the final stage of restoration (stability monitoring). The schedule may also be affected by restrictions to protect wildlife. The current schedule reflects existing restrictions on drilling, and LCI would keep in contact with the BLM and Wyoming Game and Fish Department (WGFD) for updated guidance.

To account for schedule changes, LCI would include in the Annual Report to WDEQ, NRC, and the BLM 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 next year would also be identified. The actual schedule would be compared with the projected schedule, and if it becomes evident that LCI cannot comply with the approved schedule, a request for revision of the schedule would be made, including explanation of the reason(s) for the changes from the approved schedule.

2.1.7 Monitoring

LCI would be required to conduct monitoring related to the Project. These requirements are mandated by various regulations and permits, including: State wildlife protection regulations; air and water quality regulations; and the permits from WDEQ-AQD, WDEQ-LQD, and NRC. In addition to the baseline monitoring required for the permits (**Section 3.0)**, the following would be monitored during the Project:

- air quality;
- archeology and cultural resources;
- equipment performance (e.g., safety, effluent control, mine unit balance, and pipelines)
- groundwater;
- health (radiation-related);
- soils;
- surface water;
- transportation;
- vegetation; and
- wildlife.

Some monitoring would be conducted for the life of the Project, while other monitoring would depend on the phase of the Project. Construction would include the Initial Construction of the Plant and other life-of-mine facilities and the Mine Unit Development, i.e., progressive construction of mine units. Operation would include the productive time of each mine unit and the on-site processing of the product. Reclamation would include the Mine Unit Reclamation, as well as the Final Reclamation of the Project facilities. **Table 2.1-2** outlines the monitoring activity that would occur during each phase of the Project, and additional details for each resource are included in **Section 4.0**.

Table 2.1-2 Project Monitoring (Page 1 of 5)

Monitoring Activity	Description	Project Phases		
		Construction	Operation	Reclamation
Air Quality				
Meteorological Station	Hourly measurements.	X	X	Until Plant is decommissioned.
Dust Control	Daily observations. Additional requirements may be part of WDEQ-AQD permit.	X	X	Until on-site dust-generating activities are finished.
Radiation: Radon Gas and Direct Gamma	Continuous monitoring, quarterly analysis reported to NRC semi-annually.		X	Until mine unit reclamation and plant decommissioning are completed.
Archaeology and Cultural Resources				
Mitigation and Confirmation of Survey	Prior to construction and mine unit development. SHPO evaluation.	X		
Equipment Performance – Basic and Radiation Safety				
Mine Units, Plant, and Waste Areas	Daily walk through.		X	Until daily on-site activities are completed, then only when personnel are on-site.
Equipment Performance – Effluent Control				
Storage Ponds	Daily, weekly, quarterly, and annual inspections/assessments; report leaks to NRC. Additional requirements may be part of EPA NESHAPs permit.		X	Until reclaimed and sludge disposed.
UIC Class I Well(s)	Annual evaluation, report to NRC and WDEQ. Additional reporting requirements may be part of UIC Permit.		X	Until wells are plugged.

Table 2.1-2 Project Monitoring (Page 2 of 5)

Monitoring Activity	Description	Project Phases		
		Construction	Operation	Reclamation
Equipment Performance – Fluid Transfer and Processing				
Pipelines and Process Tanks	Automated with pressure gauges and alarms.		X	Until mine units are restored and processing operations completed.
Equipment Performance – Mine Unit Balance				
Injection and Production Flow Rates and Pressures	Daily measurements and balancing.		X	Until ground water restoration is complete.
Mining Progress	Evaluated annually, report to NRC and WDEQ.		X	X
Equipment Performance – Wells and Pipelines				
Pipeline Integrity	Prior to use.	X		
Mechanical Integrity Testing of Wells	Prior to use.	X		
	Once every five years and after well repair, WDEQ-LQD may require a different monitoring frequency.		X	X
Downhole Injection Pressures	Automated with pressure gauges and alarms.		X	X
Groundwater				
Aquifer Testing and Monitor Well Sampling	Before start-up of each mine unit.	X		
On-Site Baseline Wells	Quarterly reports to NRC and WDEQ-LQD.	X	X	
Excursion Detection Monitoring	Twice per month with additional measurements if excursion is detected.		X	

Table 2.1-2 Project Monitoring (Page 3 of 5)

Monitoring Activity	Description	Project Phases		
		Construction	Operation	Reclamation
Off-Site BLM wells	Quarterly evaluation, report to NRC, BLM, and WDEQ-LQD.		X	Until stability monitoring in last mine unit begins.
Restoration Progress	Daily, weekly, and monthly analyses as needed, report to NRC and WDEQ-LQD.			X
Stability Monitoring	Quarterly for twelve months, report to NRC and WDEQ-LQD.			X
Health (radiation-related)				
Radon	Monthly with increases to weekly under specific conditions.		X	X
Bioassay	Initial and exit sample for all on-site workers and monthly for workers in specified areas.		X	X
Security	Monitoring of fenced areas, visitors, and shipments.		X	X
Soils				
Evaluation of Topsoil Removal Practices		X		
Evaluation of Topsoil Protection Measures	Minimum quarterly evaluations.	X	X	
Radiation	Before and after removal of facilities, report to NRC and BLM.			X
Topsoil Viability	Before reclamation.			X
Replacement Depths	Whenever soil is replaced, report to WDEQ-LQD and BLM.			X

Table 2.1-2 Project Monitoring (Page 4 of 5)

Monitoring Activity	Description	Project Phases		
		Construction	Operation	Reclamation
Surface Water				
Storm Water Runoff Controls	Quarterly evaluation.	X	X	X
Water Quality	Sampling and reporting per WYPDES.	X	X	Until groundwater restoration, mine unit reclamation, and plant decommissioning are all done.
Surface Water	Monitoring only in case of spill or other accidents.		X	X
Transportation				
Transportation Risk	Records of shipments, driver training, vehicle safety inspections, and maintenance work will be kept.		X	X
Road Conditions	Minimum quarterly inspections.		X	X
Fuel Storage	Minimum weekly inspections.		X	X
Vegetation				
Weed Control	Minimum annual evaluation, conduct following BLM guidance for weed control.	X	X	X
Revegetation Success	Annual evaluation until five seasons after successful reclamation of each disturbed area, report to BLM; Sample during the first growing season five years after reseeding, report to WDEQ-LQD.			X

Table 2.1-2 Project Monitoring (Page 5 of 5)

Monitoring Activity	Description	Project Phases		
		Construction	Operation	Reclamation
Wildlife				
Timing Restrictions	Confirm restrictions with BLM, USFWS, and WGF before development and construction activities.	X		
Raptor Nests	Survey known nests annually. Survey new nests every five years.	X	X	X
Sage Grouse Leks	Survey known leks annually. Survey new leks every five years.	X	X	X
All Species	Annual summary of accidents reported.	X	X	X
All Species[1]	Annual Wildlife Monitoring Report submitted to BLM, WGFD.	X	X	X
All Species	Evidence of possible wildlife exposure to toxic chemicals.	X	X	X
Sensitive Species	Mortality of sensitive species.	X	X	X
All Species	Large die-offs.	X	X	X
Incidents				
All incidents	Reported to BLM.	X	X	X

1. All species to be covered in the required report can be found in Section 4.9 of the EIS.