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4.0 ENVIRONMENTAL PROTECTION MEASURES, MONITORING, AND IMPACTS

This section describes the direct and indirect environmental impact of the Proposed Action and alternatives. Direct and indirect impacts are disclosed in Section 4.0 and the cumulative impact analysis is discussed later in Section 5.0. Each resource section begins with a summary of the agency-required measures and LCI's project design commitments necessary to comply with all federal and State environmental statutory and regulatory requirements. A description of the monitoring protocols for each resource follows the agency and LCI required measures summary. References to the sources of the required protection measures, such as the NRC SEIS and license or the WDEQ-LQD Permit to Mine (**Section 1.4**), are cited as well. The impact significance criteria and the impacts are then presented. The impacts from the Proposed Action are evaluated first. The impacts from the No Action Alternative and the Other Alternatives are then evaluated.

Mitigation measures, residual impacts, irreversible and irretrievable commitments of resources, and the relationship between short-term uses and long-term productivity are separate subsections at the end of **Section 4.0**.

4.1 Resource Impact Evaluations

The evaluation of impacts from the Proposed Action is, for the most part, organized by resource, e.g., vegetation, and by phase of the Proposed Action, e.g., construction. For more effective evaluation of impacts for some resources, e.g., environmental justice, the evaluation of impacts may be organized somewhat differently.

The resources are presented in the same order as in **Section 3.0**. As discussed in detail in **Section 2.1.1**, three phases of the Project are defined: Construction; Operation; and Reclamation. Construction applies to the initial major facility construction, e.g., the Plant, access roads, and the five UIC Class I deep wells. For the purposes of this evaluation, it has been assumed that all of the equipment staging areas and deep wells would be installed at the beginning of the Project, although this would probably not be the case. The first deep well was installed in 2008 to provide the necessary subsurface information on the feasibility of the wells, and fewer than five deep wells will probably be needed. Construction also includes Mine Unit Development, e.g., the drilling, testing, and installation of each mine unit, which would occur throughout the life of the Project. The facilities being constructed during the Mine Unit Development, e.g., header houses, are smaller than those in the initial Construction. Because of the similarities of impacts from exploration and delineation drilling, exploration

drilling is included under Mine Unit Development, although it may occur outside a designated mine unit. Operation includes the production of ore from the mine units, and Reclamation includes the reclamation of each mine unit, as well as the Final Reclamation of the major facilities, such as the Plant. As noted in **Section 2.1**, the operation and reclamation of the mine units would progress sequentially.

The Other Alternatives for the Project are described in detail in **Section 2.3**, of which two were chosen for additional evaluation: Not Fencing the Pattern Areas and Drying Yellowcake On-Site. Environmental and social impacts were evaluated and presented in this section for these alternatives. In large part, the impacts of the Other Alternatives differ little from those of the Proposed Action.

For the impact evaluations, it has been assumed that in addition to the permits and licenses already acquired (**Table 1.4-2**), LCI would acquire any additional necessary federal, state and local permits/licenses and approvals for the Project, and the requirements of those permits would be met. It has also been assumed that LCI's committed environmental and social management measures, including those described in **Section 2.1** and the agency-required and LCI committed measures and monitoring measures described in this section are fully and properly implemented. For comparison and easier reference, the findings from the NRC SEIS are included for each resource.

4.1.1 Impact Significance

For each resource, the criteria used to gauge the significance of the impact are discussed. In many cases, the criteria are based on quantitative regulatory requirements and scientific documentation. In other cases, the criteria may be more qualitative. The vulnerability of a given resource and perceptions about resource impacts are also considered.

4.1.2 Impact Scale

For each resource, a different scale is necessary for substantive evaluation of direct and indirect impacts. For example, vegetation impacts can be evaluated within the vicinity of the site because of the similarity of the vegetation types in the area. However, the socioeconomic impacts must be evaluated over a much larger area, e.g., 100 miles, because of the limited number of population centers in this part of Wyoming. In some cases, e.g., for noise, the impacts on-site and off-site have been differentiated. Another consideration in the impact scale is the geographic setting, e.g., inside or outside the Basin.

4.1.3 Impact Duration

For all resources, unless specific exceptions are stated, 'short-term' impacts are those that would occur over a five-year period or less, in some cases, only over a

period of weeks. The 'long-term' impacts are those that would exceed five years. Impacts that could affect future usage of the site are considered as residual impacts.

4.2 Land Use

4.2.1 Agency-Required Measures

The existing land uses, all of which may be affected by the Project, are: livestock grazing, wildlife habit, dispersed recreation, mineral and energy development, and infrastructure. The planned post-operational use of the Permit Area is livestock grazing and wildlife habitat. Since the disturbed land would be reclaimed after the Operation phase, the Project is compatible with the planned future use. The Project would conform to the land use regulations of Carbon and Sweetwater Counties in Wyoming as well as the RMPs of the BLM-Rawlins and Lander Field Offices (BLM, 2008a and 1987).

The required environmental protection measures are summarized below from Sections OP 2.5, OP 2.9, OP 3.5, RP 3.3, and RP 4.5 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Section 7.5.2 of the NRC Technical Report (LCI, 2010), Sections 2.1.1.1.2.1, 2.1.1.1.4.4, 2.1.1.1.4.5, and 2.1.1.1.5, and 6.2.2 of the NRC SEIS (NRC, 2011a), and Conditions 11.6 and 12.13 of the NRC License (NRC, 2011b).

Livestock Grazing and Wildlife Habitat

The primary protection measures are to: limit disturbance wherever possible; locate new disturbance on old, unreclaimed disturbance wherever possible (e.g., new roads following old two-tracks); locate disturbance in upland areas, rather than the less common lowland areas; and reclaim the disturbance as soon as possible in a manner that would support the post-mining land uses. More protection measures related to specific resources or activities are discussed in the sections on those resources or activities. For example, increased dust from Construction activities could make forage along the access roads less palatable. Required measures to reduce dust (and other traffic-related impacts) are discussed in more detail in **Sections 4.3.1** (Transportation) and **4.3.11** (Air Quality) and would include wetting unpaved roads and establishing speed limits on unpaved roads. Similarly, seeding inactive Construction areas to limit erosion and re-establish vegetation cover is discussed in **Section 4.8.1** (Vegetation).

Dispersed Recreation

The primary protection measure is to limit access, only to the extent necessary to protect the health and safety of the public. More protection measures related to specific resources or activities related to dispersed recreation are discussed in the sections on those resources or activities. For example, required measures to limit visual impacts are discussed in **Section 4.14**.

Mineral and Energy Development

To avoid interference among mineral and energy development projects, it is anticipated that any development in the Permit Area, other than uranium, would either be delayed for the duration of the Project or intermixed within the overall Permit Area. However, there are no known minerals (other than uranium), or oil, gas or coal resources in the Permit Area proposed for mining or development. To minimize potential interference with future subsurface activities, all the Project drill holes and wells would be abandoned in accordance with applicable requirements. The abandonment requirements for the drill holes and mine unit and water supply wells are listed in Sections OP 2.12 and RP 3.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b), and the requirements for the UIC Class I wells are in Attachment J of the WDEQ-WQD application, which is included in Attachment ADJ-2 of the WDEQ-LQD Permit to Mine. In addition, notice of the presence of the abandoned wells is also required via a deed notice and/or individual well markers (WDEQ-LQD NonCoal Rules, Chapter 11, Section 8(h) [WDEQ, 2005b]).

Infrastructure

The only junctions with the regional infrastructure are where the Permit Area access roads tie into existing roads and where the transmission line to the Plant ties into the existing power line along the western boundary of the Permit Area. Required measures for road construction and installation of the transmission line are discussed under the resource heading that could be impacted (e.g., surface water or wildlife).

4.2.2 Monitoring of Land Use Impacts

No monitoring of land use impacts is currently planned.

4.2.3 Impact Significance Criteria

Interference with existing or planned land uses within or near the Permit Area is the impact significance criterion for land use.

4.2.4 Land Use Impacts from the Proposed Action

The existing land uses, all of which may be affected by the Project, are: livestock grazing, wildlife habit, dispersed recreation, mineral` and energy development, and infrastructure. There may be some limits to these land uses in portions of the Permit Area during the Project, but they would not be precluded from occurring.

4.2.4.1 Livestock Grazing

Livestock grazing, the predominant land use within the Permit Area, would be directly affected by the Project as a result of fencing that affects livestock movement and reduces available grazing area. As noted in **Section 3.1**, affected grazing allotments within the Permit Area include: 0.7 percent of the Stewart Creek grazing allotment, 0.7 percent of the Cyclone Rim grazing allotment, and 0.2 percent of the Green Mountain grazing allotment. For the 4,254 acre Permit Area, the total AUMs for the Permit Area is as much as 285 AUMs of cattle grazing in the Stewart Creek and Cyclone Rim allotments and as much as 125 AUMs of grazing in the Green Mountain allotment. If year-round grazing were allowed in the Permit Area, the Stewart Creek and Cyclone Rim allotments would provide year-round forage for the equivalent of 25 cattle; the Green Mountain allotment would provide year-round forage for the equivalent of 11 cattle. However, as outlined below, only a portion of the grazing allotments within the Permit Area would be precluded from livestock grazing.

Construction

In order to ensure the health and safety of the cattle, fences would be constructed to limit access to livestock grazing in parts of the Permit Area. Restricted access to the Plant (including the Storage Ponds) and active mine unit pattern areas provide a beneficial impact to cattle and rangeland. Fencing ensures not only the health and safety of cattle currently using the land, but also provides for the proper reclamation of rangeland.

If all of the proposed disturbance areas of the Project were fenced at once, 345 acres (eight percent) of the 4,254-acre Permit Area would be removed from livestock grazing. Therefore, the AUMs of the Permit Area would decrease by 34 AUMs from 410 AUMs to 376 AUMs (reducing the number of livestock that may be supported by year-round forage from 36 to 31 cattle). However, the number of directly impacted AUMs is a conservative estimate because the affected acreage at any time should be less than 345 acres due to the development and reclamation of the mine units in succession. The BLM calculated cattle production would produce $65.07 per AUM of total economic impact, which includes both direct and secondary returns (BLM, 2004a). Using this figure, and depending on the allotment terms, livestock production on the grazing allotments within the Permit Area that may be impacted by the Project has a potential value of about $2,215 per year for cattle (34 AUMs x $65.07/AUM). This assumes all the cattle would be sold; however, some of the cows are generally kept for breeding.

Fencing would also create an obstacle to livestock movement. The greatest potential obstacle would be fencing of all the mine unit pattern areas at once, presuming the pattern areas in the mine units were continuous. Fencing of all the pattern areas at once would create an oblong obstacle with the greatest length of about 2.5 miles. Livestock would need to travel around the fencing.

Some AUMs may be indirectly affected due to the surface disturbance from Construction activities that generate dust and noise, which could affect land use outside of the 345-acre disturbed area. Less than one percent of the three grazing allotments may be directly impacted; therefore, the temporary exclusion of livestock grazing is not expected to have a notable impact on livestock grazing. Impacts to livestock grazing during Construction would be confined to less than 345 acres at any given time due to the sequential nature of the ISR operation and ongoing reclamation.

Section 4.2.1.1 of the NRC SEIS summarizes the impacts the Construction phase could have on livestock grazing. These impacts include fencing that restricts grazing activities; incidental kills from vehicle accidents; and fugitive dust that could settle on plants making them undesirable for grazing purposes. The SEIS summarizes that because of the relatively small portion of land affected and the management measures that would be put in place to prevent vehicle-related livestock deaths, that the actual impact on livestock grazing would be minimal (NRC, 2011a).

Operation

Direct and indirect impacts from Operation activities would be similar to Construction impacts regarding access restrictions for livestock due to the existing infrastructure. The primary difference between Operation and Construction impacts would be the timing and magnitude of disturbance. Operation activities are estimated to occur for about seven years, versus the relatively short Construction period of less than one year. During the Operation phase, the primary changes to land use would be the expansion of mine units. This expansion would have similar direct and indirect impacts as those of Construction. Sequentially moving active operations from one mine unit to the next would reduce the impact of the activities.

In the NRC SEIS, Section 4.2.1.2 discusses the impact the Operation phase may have on livestock grazing. It is described as similar to the Construction phase, with potential problems with fugitive dust, vehicle-related livestock deaths, and restriction to livestock management activities being of potential concern, but likely leading to only minimal impacts (NRC, 2011a).

Reclamation

Direct and indirect impacts from Reclamation activities on livestock grazing are expected to be similar to Construction and Operation impacts due to the temporary increase in land-disturbing activities from dismantling, removing and disposing of facilities and equipment, restoring roads, and replacing soil. Fences, which restrict livestock movement, would remain in place until vegetation is established. The sequential nature of the individual mine units and the ongoing

Mine Unit Restoration and Reclamation would help minimize impacts. The land would be reclaimed to support livestock grazing.

Sections 4.2.1.3 and 4.2.1.4 of the NRC SEIS describe the potential impacts on livestock grazing during the reclamation phase. These impacts would be similar to the Construction phase, but with the emphasis that after the land is disturbed, it would be returned back to a condition that would support livestock grazing and increase the grazing land back to its original size (NRC, 2011a).

4.2.4.2 Wildlife Habitat

General impacts to wildlife habitat are discussed in the following section. A complete evaluation of impacts to vegetation and habitat and to specific wildlife species is included in **Sections 4.8 and 4.9**.

Construction

Impacts to wildlife habitat generally result from activities affecting food sources (i.e., forage and prey), water availability, available habitat, and loss of effectiveness of migration corridors. Impacts to wildlife habitat would most likely occur during the Construction phase of the Project due to the increased surface disturbance. The Project, along with the associated infrastructure, is expected to disturb a total of 345 acres of vegetation, or about eight percent of the total Permit Area, throughout the duration of the Project. However, the area of impacted vegetation at any one time should be less than eight percent due to the sequential nature of the Mine Unit Development and Production as well as ongoing Restoration and Reclamation. This is a very small percentage of the north central portion of the Great Divide Basin with similar ecological conditions (Chapman et al, 2004).

Impacts to forage would occur during Construction as the result of stripping topsoil and vegetation to construct the Plant, roads, and other infrastructure. Since the affected area is small when compared with surrounding habitat, wildlife would likely avoid the Permit Area and use surrounding lands for sustenance and habitat. Increased dust from the Construction activities could also adversely affect available and desirable forage within the Permit Area and surrounding land.

Water resources for wildlife consumption would not likely be impacted during the Construction phase. The increased noise level from Construction activities may adversely affect the occurrence of wildlife and deter them from the area. It is also possible that restricted, fenced areas within the Permit Area would fragment wildlife habitat. However, the size of the Permit Area is minor in comparison to the surrounding identical habitat areas, to which wildlife would be able to exist uninhibitedly. It is expected that the direct effects to wildlife habitat during Construction for each mine unit would be small, short-term and confined to

certain areas due to the sequential nature of the ISR operation and ongoing reclamation.

Section 4.2.1.1 of the NRC SEIS summarizes that the impact of the land disturbance is insignificant, given that there is an expanse of undisturbed land that can serve the same function as the small portion of disturbed land (NRC, 2011a).

Operation

Direct and indirect impacts to wildlife habitat occurring during the Operation phase would be similar to those in the Construction phase. However, since there would be less surface disturbance activities during the Operation phase, fewer impacts on vegetation and wildlife habitat are expected. Additional impacts may occur, most likely to water resources for wildlife. The Storage Ponds that would intermittently contain water would be fenced to restrict wildlife access in order to ensure the health and safety of these animals.

The NRC SEIS concludes that the land inaccessible to wildlife because of mining operations is a small portion of the region, and therefore, wildlife habitat would not be significantly impacted (NRC, 2011a).

Reclamation

Direct and indirect impacts from Reclamation activities on wildlife habitat are expected to be similar to Construction and Operation impacts due to the temporary increase in land-disturbing activities from dismantling, removing and disposing of facilities and equipment, restoring roads, and replacing soil. Fences, which limit access to Project lands, would remain in place until vegetation is established. The sequential nature of the individual mine units and the ongoing Mine Unit Restoration and Reclamation would help minimize impacts. The land would be reclaimed to support wildlife habitat.

As with Construction and Operation, the NRC SEIS discussion of impacts due to Reclamation would be minimal, with a return to conditions that would support a variety of land uses, including wildlife habitat (NRC, 2011a).

4.2.4.3 Dispersed Recreation

Construction

Impacts to dispersed recreation during Construction would be negligible due to the availability of equivalent surrounding land and the small area of impact. To protect the health and safety of the public, recreationists (including hunters) would have restricted access – albeit minimal – to areas within the Permit Area that were previously available for general use. The Plant, mine units and other

related infrastructure would be fenced during the Construction, Operation and Reclamation phases. Though the general public would have restricted access to the Permit Area, recreationists would continue to have access to the general area surrounding the Project via existing roads (Wamsutter-Crooks Gap Road and Sooner Road)) for the duration of the Project. Traffic on these roads may be increased due to the additional use of the roads by vehicles bringing supplies and labor to the Permit Area during Construction. While the additional volume of traffic is not expected to affect recreational access, the increased volume of traffic is expected to reduce the quality of the recreational experience in the area.

Section 4.2.1.1 of the NRC SEIS states that while recreational activity would be limited near the construction areas, this represents a small percentage of the total land of the area, and the overall impact on recreational activities is insignificant (NRC, 2011a).

Operation

As with the Construction phase, impacts to dispersed recreation during the Operation phase would be negligible due to continued access to the general area via existing roads.

The NRC SEIS (Section 4.2.1.2) states that the Operation phase would have a similar influence on recreational activities as in the Construction phase (NRC, 2011a).

Reclamation

As with the Construction and Operation phases, impacts to dispersed recreation during Reclamation would be negligible due to continued access to the general area via existing roads and the relatively small restricted area of the Project.

The NRC SEIS (Sections 4.2.1.3 and 4.2.1.4) states that the Reclamation phase would have a similar influence on recreational activities as in the Construction phase (NRC, 2011a).

4.2.4.4 Mineral and Energy Development

Construction

In order to reduce the cumulative effects of mineral and energy development projects in the region, it is anticipated that future mineral rights for resources in the Permit Area, other than uranium, would either be delayed for the duration of the Project or intermixed within the overall Permit area. However, there are no known minerals (other than uranium), or oil, gas or coal resources in the Permit Area proposed for mining or development. Thus, the direct and indirect impacts

of the Project to minerals and energy development are negligible. If potential projects were to arise, it is expected that coexistence and conflicts would be negotiated and agreed upon between the different mineral rights owners, surface owners, and land management agencies.

The NRC, in Section 4.2.1.1 of the SEIS, acknowledges that other mining activities would not be able to occur while the project is underway. However, it also states that there are no current projects or potential projects to mine coal, oil, or gas, and as a result any significant impacts to other mining or resource development projects are unlikely (NRC, 2011a).

Operation

Impacts to mineral and energy development would be similar throughout the Construction, Operation and Reclamation phases of the Project.

The NRC, in Section 4.2.1.2 of the SEIS, concludes the Operation phase would have similar limitations on mineral and energy development as in the Construction phase (NRC, 2011a).

Reclamation

Impacts to mineral and energy development would be similar throughout the Construction, Operation and Reclamation phases of the Project.

The NRC, in Section 4.2.1.3 of the SEIS, concludes the Reclamation phase would have similar limitations on mineral and energy development as in the Construction phase (NRC, 2011a).

4.2.4.5 Infrastructure

Construction, Operation, and Reclamation

As mentioned above, about 345 acres of the 4,254 acres within the Permit Area would be disturbed by the construction of facilities such as access roads, utility corridors, the Plant, Storage Ponds, wells and mine units. However, decommissioning, removal, and surface reclamation is required for all these facilities, so they would not become part of the regional infrastructure unless there were a specific request by the landowner (the BLM or State of Wyoming) and approval was obtained from the BLM and WDEQ-LQD to leave the facilities in place to improve post-operational access or land use.

The only junctions with the regional infrastructure are where the Permit Area access roads tie into existing roads and where the transmission line to the Plant ties into the existing power line along the western boundary of the Permit Area.

Required measures for road construction and installation of the transmission line are discussed by the resources that could be impacted (e.g., surface water or wildlife).

4.2.5 Land Use Impacts from Other Alternatives

4.2.5.1 No Action Alternative

Under the No Action Alternative, there would be no change in current uses.

4.2.5.2 Other Action Alternatives

Not Fencing the Pattern Areas would reduce the impacts of the Project on all existing land uses, except minerals and energy development. Without fencing, livestock, wildlife, and recreationists would not be physically precluded from the mine unit pattern areas. However, access to such areas could be hazardous or harmful to livestock, wildlife, and recreationists. Additionally, Not Fencing the Pattern Areas would decrease the Project's infrastructure.

With the exception of infrastructure, the short-term land use impacts from Drying Yellowcake On-Site would not be appreciably different than those from the Proposed Action. During Construction, an on-site dryer may slightly increase the use of roads in the Project Area due to the increased material transport and construction activity necessary to build the dryer. However, during Operation, use of a dryer would result in fewer shipments from the site due to the difference in volume between yellowcake slurry and dried yellowcake. Therefore, traffic necessary for the transport of the shipments and use of the roads would also be decreased.

4.3 Transportation

4.3.1 Agency Required Measures

The required environmental protection measures are summarized below from Sections OP 2.6 and RP 3.2 and 4.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 2.1.1.1.2.3 and 2.1.1.1.5.4 of the NRC SEIS (NRC, 2011a).

4.3.1.1 Road Installation or Improvement

The Operations Plan in the WDEQ-LQD Permit to Mine (LCI, 2011b) establishes a series of steps for route selection, road design, and construction practices to help ensure the roads are located to minimize disturbance and are appropriate for the traffic load. Roads would be built in accordance with BLM guidance found in "Engineering: Road Standards: Excerpts from the BLM Manual, Section 9113" (1996a) and erosion would be mitigated according to the SWPPP (Attachment ADJ-3 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

4.3.1.2 Road Maintenance

Maintenance costs for the county roads could accrue to both Carbon and Sweetwater Counties, although most Project revenues would be generated in Sweetwater County. LCI is working with the Counties to develop agreements for maintenance of roads accessing the Permit Area.

If not already done prior to BLM approval of the proposed action, LCI would prepare and submit a Road Use Maintenance Agreement for Sweetwater County review and approval. The Agreement would comply with the standards and conditions of the Sweetwater County Public Works Director, the Sweetwater County Attorney's Office, and the Sweetwater County Board of County Commissioners, and would address roadway maintenance, surfacing, dust control, weight limits, traffic, snow removal, improvements, and related topics. In addition, LCI would obtain the necessary Access Permit or License from the Sweetwater County Department of Engineering for any crossing, access to, or use of a Sweetwater County Road right-of-way.

4.3.1.3 Road Removal

Per the requirements of the Reclamation Plan in the WDEQ-LQD Permit to Mine (LCI, 2011b), removal of roads is required upon Project completion. If a landowner specifically requests that a road (or structure) be left in place, then it is generally possible to revise the Permit to accommodate that request. However, the existing Permit language specifies road removal, and the reclamation bond for the WDEQ-LQD Permit to Mine includes costs for road removal. 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. The roads would then be reclaimed through preparation of the seed bed and reseeding, in accordance with the Permit requirements.

4.3.1.4 Safety

In the application for NRC licensing, LCI submitted the transportation logistics to the NRC, who determined that the transportation plan and associated safety measures were adequate. All transportation activities associated with the project would adhere to existing transportation regulations, including those found in 10 CFR Part 71 (NRC, 2004) and 49 CFR 171-180 (USDOT, 2005). An emergency response manual would be available in the event of an accident involving vehicles transporting radioactive materials. Any non-radioactive chemical spills would be reported to the State environmental agency, USEPA, and USDOT. Additionally, several measures would be taken in order to reduce the potential for accidents. These include:

- All delivery truck drivers would hold appropriate licenses and certifications, and submit to a mandatory drug testing program;
- All delivery trucks used to transport Project materials would carry the certifications of the relevant safety inspections;
- Speed limits would be at 30 miles per hour or less, and an active driver safety and accident avoidance program would be carried out;
- On-site and local roads would be plowed, maintained, and improved as appropriate; and
- An internal report would be filed in the case of a near-miss or accident, and drivers would be briefed on how to avoid similar future incidents.

4.3.2 Transportation Monitoring

Records of on-site road maintenance would be kept along with records of shipping and receiving goods, driver training, and truck safety certifications. Inspections would also be performed quarterly, at a minimum, to examine the condition of the road surface and culverts to maintain the quality of the road for safe transportation. On-site fuel storage tanks would be examined weekly to check for leakage and spills from the tank to reduce any impacts that could be associated with such chemical leakage. LCI would also install traffic counters on the smaller, improved surface roads for which no data currently exists to help determine Greater sage-grouse impacts, as described in Attachment OP-6 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

4.3.3 Impact Significance Criteria

Transportation impacts are evaluated on the relative increase in traffic levels and whether the increase would degrade safety conditions. The impacts of the transportation on specific resources are evaluated in the respective resource sections (e.g., the impacts on wildlife are discussed in the **Section 4.9**).

4.3.4 Transportation Impacts from the Proposed Action

Potential impacts to transportation could occur throughout all phases of the Project. **Table 4.3-1** includes an estimate of the number and size of vehicles that would be needed during the life of the Project. It is anticipated that traffic would usually be equally divided among the three primary routes to the Permit Area (**Figures 4.3-1** and **4.3-2**):

- From Rawlins via US 287 to the Minerals Exploration Road and Sooner Road;
- From Casper via WY 220 to the Bairoil Road and Sooner Road; and
- From Rock Springs via I-80 to the Wamsutter Crooks Gap Road.

Traffic could also come from Lander via US 287 to the Wamsutter Crooks Gap Road, but this was assumed to be a less-used route.

Transportation could be affected by the Proposed Action due to increased traffic on existing roads and, in turn, potential increases in traffic-related accidents. However, with the required road construction and maintenance practices, transportation conditions both outside and inside the Permit Area are not anticipated to result in any different traffic accident rates than are typical for Wyoming. Specific conditions during Construction, Operation, and Reclamation are discussed in the following subsections.

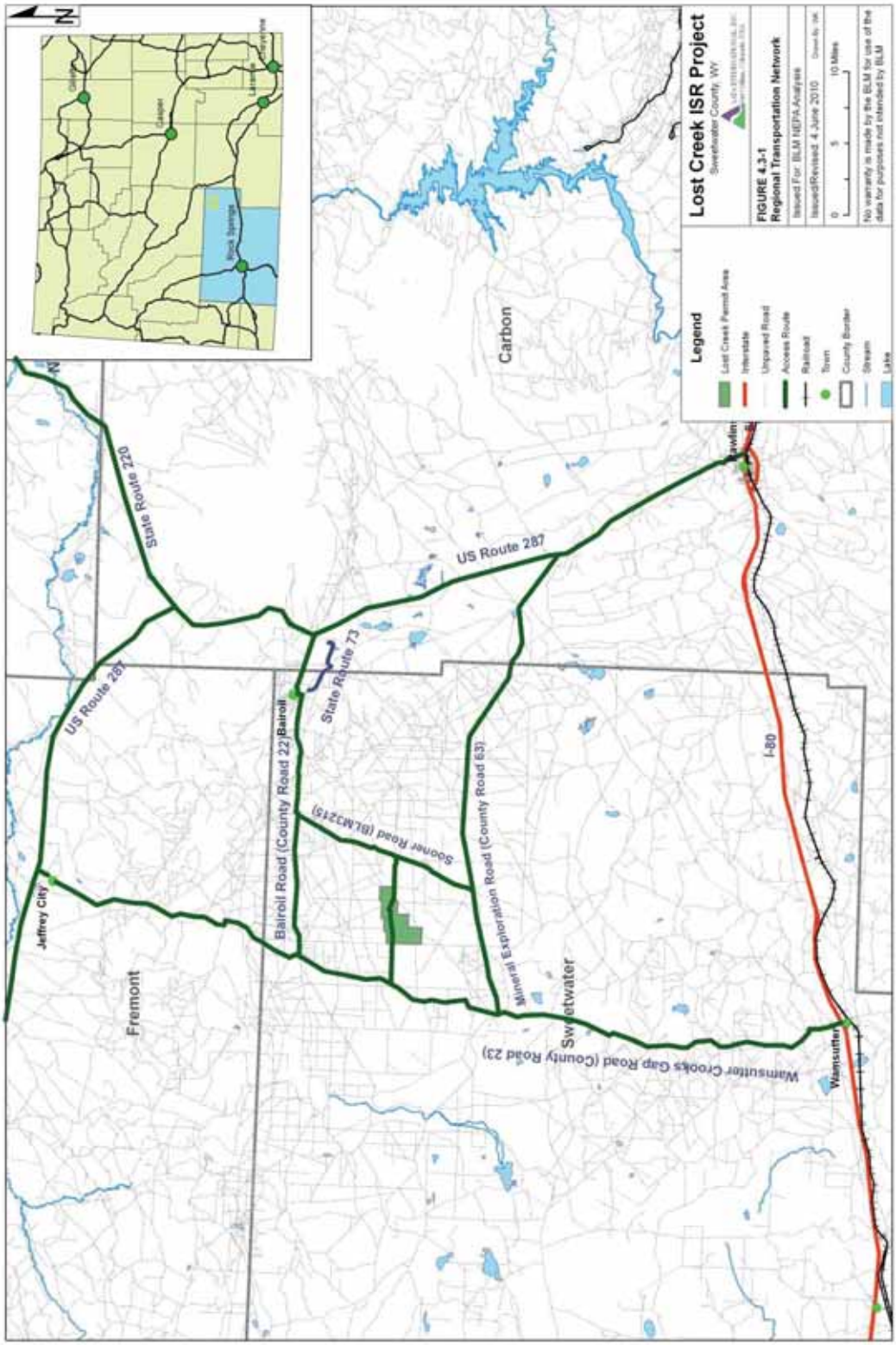
Table 4.3-1 Estimated Number of Vehicles On-Site and Traveling To/From the Site (Page 1 of 2)

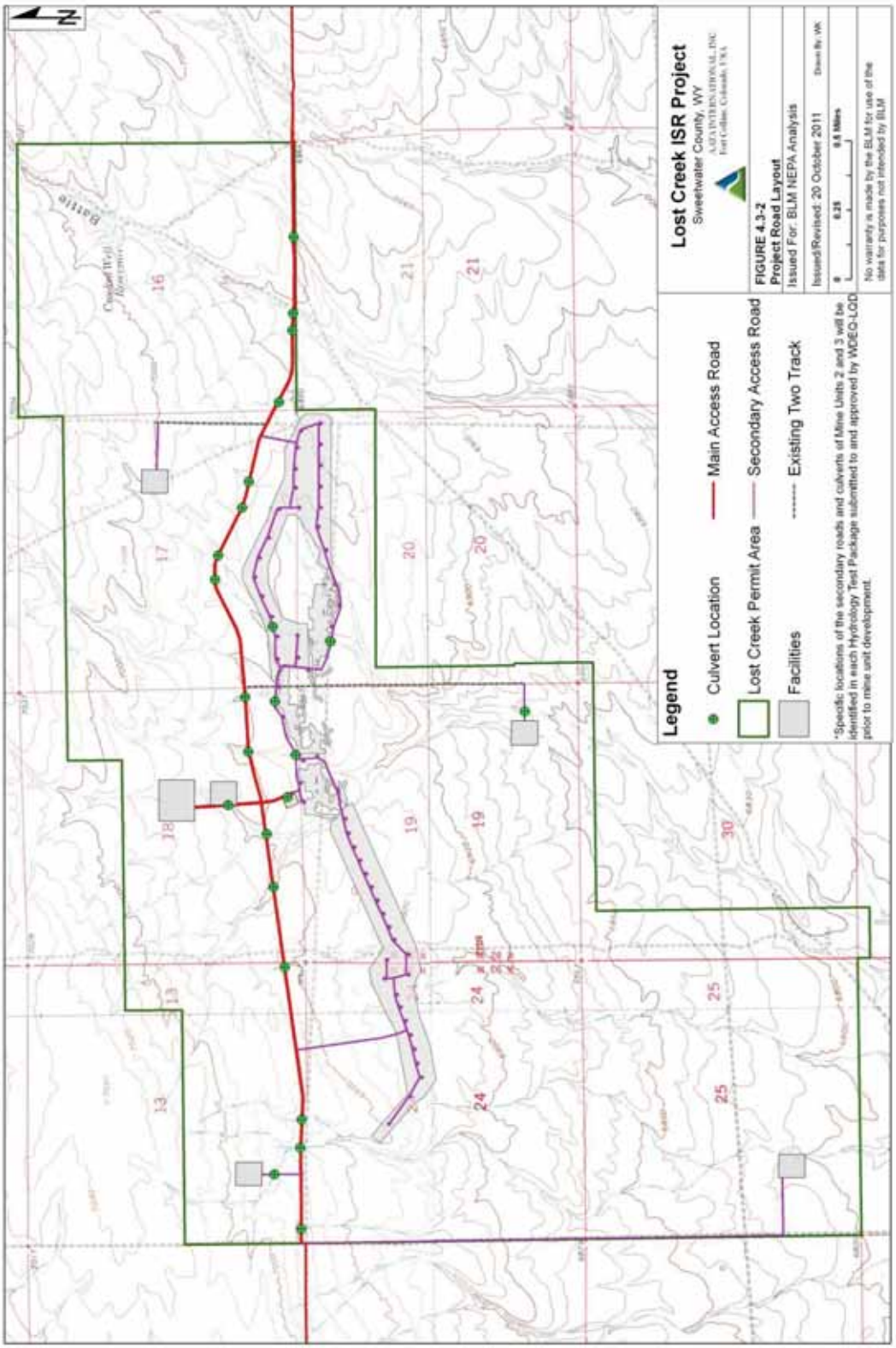
	Remaining On-Site for More than a Week		To/From Site	
	Lighter Vehicles	Heavier Equipment	Lighter Vehicles	Heavier Equipment
Construction				
Initial Construction				
LCI and Contractor Personnel Vehicles [1]	--	--	32 sport utility vehicles (SUVs) or pickups per day	--
Equipment, Supplies, and Waste Hauling	--	--	1 to 2 SUVs, vans, or pickups per week	2 to 5 tractor/trailers per week
LCI and Contractor Mobile Equipment used On-Site	1 forklift; 1 backhoe	1 scraper; 1 front-end loader	--	--
Mine Unit Development				
LCI and Contractor Personnel Vehicles [1]	24 SUVs or pickups	--	15 SUVs, vans, or pickups	--
Equipment, Supplies, and Waste Hauling				1 to 2 tractor/trailers per week
LCI and Contractor Mobile Equipment used On-Site	1 ATV; 3 forklifts; 2 backhoes; 1 MIT truck 3 geophysical logging trucks; 8 trailers for misc. equipment; 6 cementers; 1 pulling unit	10 1500-class drill rigs; 12 80-100-barrel water trucks; 1 tractor/trailer w/ 2 other trailers; 1 grader	--	--

Table 4.3-1 Estimated Number of Vehicles On-Site and Traveling To/From the Site (Page 2 of 2)

	Remaining On-Site for More than a Week		To/From Site	
	Lighter Vehicles	Heavier Equipment	Lighter Vehicles	Heavier Equipment
Operation				
LCI and Contractor Personnel Vehicles		--	1 to 2 SUVs, vans, or pickups	--
Equipment, Supplies, and Waste Hauling	--	--	1 to 2 SUVs, vans, or pickups per week	1 to 2 tractor/ trailers per week
Product Shipment	--	--	--	1 tractor/trailer per week
LCI and Contractor Mobile Equipment used On-Site	1 ATV; 1 MIT truck; 2 forklifts; 8 trailers for misc. equipment	--	1 to 2 SUVs, vans, or pickups per week	--
Reclamation				
Mine Unit Reclamation				
LCI and Contractor Personnel Vehicles [1]	8 SUVs or pickups	--	2 SUVs, vans, or pickups	--
LCI and Contractor Mobile Equipment used On-Site	1 ATV; 3 forklifts; 2 backhoes; 8 trailers for misc. equipment; 6 cementers; 1 pulling unit	2 RO units; 1 1500-class drill rig; 1 80-100-barrel water truck; 1 tractor/trailer w/ 2 other trailers; 1 grader	1 to 2 SUVs, vans, or pickups per week	--
Final Reclamation				
LCI and Contractor Personnel Vehicles	--	--	10 SUVs, vans, or pickups	--
Equipment, Supplies, and Waste Hauling	--	--	--	1-5 tractor/trailer per week
LCI and Contractor Mobile Equipment used On-Site	1 forklift; 1 backhoe	1 front-end loader	--	--

[1] It should be noted that there would be a temporal overlap between several of the on-site activities, and some vehicles and equipment may be working on more than one activity at the same time. For example, a mine unit may be under development while another mine unit is in reclamation, so the number of personnel vehicles would be less than the sum of the number of vehicles for each activity. The highest number of vehicles traveling to and from the site per day is anticipated to be 33 SUVs, vans, or pickups during Initial Construction. Carpooling not required but is natural consequence of distance and will be encouraged.


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.3-1
Regional Transportation Network
Legend
Lost Creek Permit Area
Interstate
Unpaved Road
Access Route
Railroad
Town
County Border
Stream
Lake
Carbon
Fremont
Sweetwater
Jeffrey City
Bairoil
Wamsutter
US Route 287
State Route 220
State Route 73
Bairoil Road (County Road 22)
Sooner Road (BLM3215)
Mineral Exploration Road (County Road 63)
Wamsutter Crooks Gap Road (County Road 23)
I-80


N
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.3-2
Project Road Layout
Issued For: BLM NEPA Analysis
Issued/Revised: 20 October 2011
Drawn By: WK
0
0.25
0.5 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Culvert Location
Lost Creek Permit Area
Facilities
Main Access Road
Secondary Access Road
Existing Two Track
*Specific locations of the secondary roads and culverts of Mine Units 2 and 3 will be identified in each Hydrology Test Package submitted to and approved by WDEQ-LQD prior to mine unit development.
Battle
Creek Trail
16
17
18
13
21
20
19
24
25
30

4.3.4.1 Construction

Improvements to the existing East and West Access Roads would be necessary in the earliest stages of Construction to provide adequate access for personnel, equipment, and materials. The equipment and materials would be general construction materials and the ISR-specific equipment (e.g., ion exchange resin tanks). Most of the initial Construction activities would be concentrated at the Plant, although installation of secondary roads to the deep wells would be necessary prior to drilling of the wells. It is anticipated that the deliveries of larger equipment (e.g., tanks) would come in by rail and then by truck on the Wamsutter Crooks Gap Road and that the rest of the traffic to/from the Permit Area would be equally divided among the three routes to the site.

Comparison of existing and additional traffic volume (**Tables 3.2-1** and **4.3-1**) indicates the increased volume during initial Construction would not be noticeable on any of the major transportation routes. The increased traffic volume might be noticeable on WY 73, on which the volume would increase by five to ten percent during the seven months of initial Construction.

During Construction for Mine Unit Development, secondary access roads would be built to connect the header houses within a mine unit and connect the mine unit to the Plant. Two-track roads would provide access to the wells in the monitor ring, with local improvements if needed to prevent erosion (e.g., gravel surface to prevent creation of a mud hole in a low spot). These roads would remain in place until removed and reclaimed during Mine Unit Reclamation. On-site traffic during the Mine Unit Development would include movement of equipment and associated personnel, such as moving rigs from well to well during pattern installation.

Section 4.3.1.1 of the NRC SEIS describes the changes in transportation expected during the Construction phase of the Lost Creek ISR project, including transportation of workers and materials to and from the site. Potential impacts included in this analysis are dust, emissions, noise, increased traffic on main roads, and the potential for accidents. However, the increase in traffic is expected to be small, therefore making the potential impacts small as well (NRC, 2011a).

4.3.4.2 Operation

Maintenance of the East and West Access Roads would continue throughout the Operation phase. During the Operation phase, the overall volume of traffic would decline (**Table 4.3-1**). The number of vehicles used by personnel commuting to and from the Permit Area during the Operation phase is estimated to be about half that during Construction. As noted in the table, some equipment would be brought to the site and then remain on-site for the duration of the Project. Other

equipment and materials would be transported to and from the Project on a regular basis, including shipments of:

- Supplies to the Plant, including potable water, office supplies, CO_2, oxygen, diesel fuel, gasoline, salt, soda ash, sulfuric acid, hydrogen peroxide and drilling mud. Most of these supplies would be delivered to the Plant, although some supplies would be delivered to the staging areas for use in the mine units;
- Shipments of yellowcake slurry from the Plant to a toll drying facility; and
- Shipments of waste material to be disposed of off-site.

On-site traffic during the Operation phase would include regular, periodic movement of personnel, such as travel around an operational monitor ring for sampling once every two weeks.

The NRC SEIS describes the changes in transportation expected during the Operation phase of the Lost Creek ISR project in Section 4.3.1.2. These impacts include transportation of workers and materials to and from the site, particularly the radioactive materials the result from the process. Potential impacts included in this analysis are dust, emissions, noise, increased traffic on main roads, and the potential for accidents, specifically involving vehicles transporting the radioactive materials. However, due to low increase in traffic and the management practices put in place to provide safe transport, the potential impacts are expected to be minimal (NRC, 2011a).

4.3.4.3 Reclamation

During reclamation of each mine unit, all of the secondary and tertiary roads associated with that mine unit would be removed and reclaimed, unless needed for access to another mine unit. During Reclamation, all remaining on-site roads would be removed and reclaimed; although before the on-site roads are reclaimed, the surface management agency (primarily BLM), would be consulted and given the option to retain the roads established for the Project. The impacts on traffic during the Reclamation of the Project are expected to be similar to those incurred during Construction, although the overall volume would be less. In addition, rather than the majority of truck traffic consisting of deliveries to the site, the majority of the truck traffic would consist of removal of materials from the site either for reuse, recycling, or disposal.

The NRC SEIS (Sections 4.3.1.3 and 4.3.1.4) addresses transportation during the reclamation phase by recognizing that there would be more larger trucks used during decommissioning, but the relative impacts to transportation in the area would be insignificant on main roads and minimal on smaller roads (NRC, 2011a).

4.3.5 Transportation Impacts from Other Alternatives

4.3.5.1 No Action Alternative

Under the No Action alternative, current access, uses, and maintenance would continue.

4.3.5.2 Other Action Alternatives

The impacts of other alternatives (Not Fencing the Pattern Areas and Drying Yellowcake On-Site) on transportation would be similar to those for the Proposed Action. If the pattern areas were not fenced, the potential for personnel to cut across open areas could increase; however, the measures for topsoil and vegetation protection (**Sections 4.5** and **4.8**) are intended to reduce this potential with or without the pattern area fences. If a dryer were installed on-site, the number of shipments of yellowcake would be reduced from about one shipment every five days to about one shipment every 15 days. There would be a corresponding decrease in impacts, although the overall effect would be minimal.

4.4 Geology

4.4.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 3.3 through 3.6, and RP 3.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 2.1.1.1.2.1 and 2.1.1.1.5.5 of the NRC SEIS (NRC, 2011a), and Condition 10.5 the NRC License (NRC, 2011b).

To prevent unanticipated impacts to the subsurface materials, wells would be constructed in accordance with appropriate designs for their use, tested at required intervals, and operated in accordance with calculated injection pressures. These construction and operation requirements are included in Sections OP 3.3, 3.4, and 3.6 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

With respect to future subsurface activities, all the Project wells would be abandoned in accordance with applicable requirements. The abandonment requirements for the mine unit and water supply wells are listed in Section RP 3.1 of the WDEQ-LQD Permit to Mine, and the requirements for the UIC Class I wells are in Attachment J of the WDEQ-WQD application, which is included in Attachment ADJ-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b). In addition, notice of the presence of the abandoned wells is also required via a deed notice and/or individual well markers (WDEQ-LQD NonCoal Rules, Chapter 11, Section 8(h) [WDEQ, 2005b]).

To prevent unanticipated impacts from geologic conditions, in particular earthquakes, facilities would be constructed on appropriately prepared surfaces and in accordance with applicable building codes. Pressure monitoring, leak detection, and similar measures would provide information of adverse effects from any ground movement, and automatic shut-offs would allow for prevention and minimization of leaks. (This equipment is described in detail in Sections OP 3.5 and 3.6 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

4.4.2 Monitoring of Geologic Impacts

To ensure formation fracture pressures are not exceeded, injection pressures and flow rates for the mine unit production and injection wells would be monitored as detailed in Section OP 3.6 of the WDEQ-LQD Permit to Mine and reported in the Annual Report submitted to NRC and WDEQ. Similarly, injection pressure, flow rate, and annulus pressure in the UIC Class I wells would also be monitored and reported in accordance with the requirements of the UIC Class I Permit, and an evaluation of the well performance would be included in the Annual Report submitted to NRC and WDEQ.

Should an earthquake of unusual intensity occur, a program of well testing, such as MITs or using down-hole cameras, could be implemented to ensure subsurface damage to the wells had not occurred.

4.4.3 Impact Significance Criteria

The criteria used to evaluate impacts to geology, e.g., subsidence, are the likelihood of an impact occurring, and, if it did occur, what the magnitude and consequences would be. In addition, the impacts from geologic conditions, i.e., geologic hazards such as earthquakes, on the Project were evaluated.

4.4.4 Geologic Impacts from the Proposed Action

The potential impacts to geology from the Proposed Action are limited to impacts during Construction and Operation. Impacts from geologic conditions could occur throughout the life of the Project.

4.4.4.1 Construction

Initial Construction

There are no bedrock outcrops in the Permit Area, and drilling logs indicate that bedrock is a few feet below the surface. Earth moving during Construction would not disturb bedrock formations at depth, e.g., pipeline burial depths and key cuts for the pond embankments are less than six feet. Based on the results from geotechnical borings completed in the vicinity of the Plant, no extraordinary measures are needed to stabilize building foundations. The results of the geotechnical drilling and recommendations and requirements for building site preparation are included in Attachment OP-7 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

The deep well in the southwest corner of the Permit Area (**Figure 1.2-3**) was installed in 2008 to provide the necessary subsurface data to determine the feasibility of using deep wells for waste disposal. Based on the information obtained from that well, well completions in the target interval of the Fort Union Formation would not impact the subsurface geologic conditions. In particular, hydraulic fracture treatments are not considered necessary to provide sufficient injection capacity. (Impacts to the water quantity and quality in the Fort Union Formation are discussed in **Section 4.7**.) With respect to geologic hazards, no unanticipated conditions, such as an unknown fault, were discovered during drilling of the deep well.

An earthquake could potentially damage a facility, such as a building, under construction because the structural integrity of the facility would be less during construction than when completed. However, given the relatively low probability

of an earthquake of sufficient magnitude to cause damage (**Section 3.3**), this is an unlikely scenario.

The above assessment is in general agreement with that in the NRC SEIS. (In the NRC SEIS, geology and soils impacts are included in the same section; this was not done in this EIS because of the importance of topsoil salvage and protection to ensure adequate surface reclamation.) Section 4.4.1.1 of the NRC SEIS, states that no rock matrix would be altered during this project; therefore, there would be little to no subsidence, and the overall impact of the Construction phase is minimal (NRC, 2011a).

Mine Unit Development

Impacts on geology during Mine Unit Development would be the result of drilling to further delineate the ore body and to install wells within the mine units. Drill pit and trench excavation would not impact the geology because the pits would be relatively shallow (ten feet deep or less). Drilling would have a direct albeit minor impact on the geology due to the removal of subsurface materials as a result of the drill bit cutting action. However, the amount of material removed from the subsurface formations (sandstones, siltstones, and shales) would not be sufficient to impact the structural integrity of the formations. In addition, pressures used during drilling are not sufficient to adversely impact subsurface conditions.

A beneficial impact of Mine Unit Development, which would occur during aquifer testing (and is one of the purposes of the aquifer testing), would be location of improperly abandoned wells from previous exploration. Efforts are made before Mine Unit Development to locate old drill holes, but records of all prior drilling locations may not exist or it may not be possible to locate all of the old drilling locations to check abandonment methods. If an improperly abandoned drill hole is found during aquifer testing, it would be abandoned in accordance with the permit requirements. Additional information is included in Section D5.2.4.1 in Appendix D5 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

4.4.4.2 Operation

Potential impacts of the Operation phase to the subsurface geologic conditions are discussed below. No impacts from geologic hazards are anticipated during Operation, other than the existing potential for earthquakes.

Future Resource Development

Removal of uranium from the target sandstones would result in a permanent change to the composition of these sandstones, which is a direct and permanent impact to the geology of the Permit Area. However, the impacts would not

preclude recovering other minerals that might be discovered in economic quantities within the Permit Area in the future.

Injection and Production Rates and Pressures

In the uranium production formation, no significant matrix compression or ground subsidence from injection or pumping of fluids is expected. Injection pressures are calculated to ensure fracture formation pressures are not exceeded, and pumping rates are balanced with injection rates and are calculated to be sustainable. The net withdrawal of fluid (bleed) would typically be one percent or less. Once groundwater restoration is complete, groundwater levels would approximate pre-operational levels.

Theoretically, changes to the aquifer pressure may impact the transmissivity (e.g., resistance to flow) of the Fault. The pressure of the produced aquifer would be increased during Mine Unit Operation and Restoration activities; however, this pressure would be balanced by the production and recovery wells. It is very unlikely that the planned ISR operations would reactivate the Fault, and extremely unlikely that any earthquakes would be generated. Documented cases where fluid withdrawal or injection has impacted fault transmissivity or resulted in earthquakes have occurred when the change in reservoir pressure was on the order of 1,000 to 5,000 psi or higher. Operations at the Permit Area are expected to induce much lower pressure changes, in the range of 50 to 150 psi.

In the deeper formation in which the Class I wells would be completed, injection pressures are also calculated to ensure fracture formation pressures are not exceeded. As with the shallower uranium production formation, the pressure changes would be less than those in the documented cases of earthquakes or changes in fault transmissivity.

Matrix Effects

The uranium mobilization and recovery process in the target sandstones does not result in the removal of rock matrix or structure. Rather, the lixiviant mobilizes uranium that was deposited within the sandstone long after the sands were deposited and lithified (Section 2.1.2 of the NRC GEIS [NRC and WDEQ, 2009]). The lixiviant is selected to optimize dissolution of the uranium mineral coatings on sediment grains in the target sandstones and minimize potential interference with the host formation (Section 2.4.1.1, NRC GEIS [NRC and WDEQ, 2009]). This assessment is in agreement with that in Section 4.4.1.2 of the NRC SEIS (NRC, 2011a).

4.4.4.3 Reclamation

No impacts would occur to the geology of the Permit Area during Mine Unit Restoration or Reclamation. The wells in the mine units would be abandoned, but

the pressures used for well abandonment are similar to those for well construction. This assessment is in agreement with that in Section 4.4.1.3 of the NRC SEIS (NRC, 2011a).

During Final Reclamation, decommissioning, facility removal, topsoil placement and revegetation would occur. These activities would have no impact on the geology in the Permit Area. Abandonment of the deep wells would be done in accordance with the UIC Class I Permit.

4.4.5 Geologic Impacts from Other Alternatives

4.4.5.1 No-Action Alternative

Under the No-Action Alternative, the Project would not go forward and there would be no changes to the geologic conditions in the Permit Area or in the surrounding region. Existing land use activities that could potentially impact the geology (such as mineral and oil and gas drilling) would still occur. Existing wells would be plugged but this would not have an additional impact on the geology.

4.4.5.2 Not Fencing the Pattern Areas

Under this alternative, the pattern areas would not be fenced. This alternative would have no impacts on the geology. Geologic hazards would not impact this alternative.

4.4.5.3 Drying Yellowcake On-Site

This alternative would have no impact on geology. The dryer would be within the Plant, so the measures taken to prevent impacts from geologic hazards on the on-site facilities, e.g., construction in accordance with appropriate building codes, would be in place, as well as applicable procedures for spill control should unanticipated damage occur.

4.5 Soils

4.5.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 2.5, OP 2.9, OP 3.5, RP 3.3, and RP 4.5 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Section 7.5.2 of the NRC Technical Report (LCI, 2010), Sections 2.1.1.1.2.1, 2.1.1.1.4.4, 2.1.1.1.4.5, 2.1.1.1.5, and 6.2.2 of the NRC SEIS (NRC, 2011a), and Conditions 11.6 and 12.13 of the NRC License (NRC, 2011b).

The following measures would be put in place to minimize the amount of topsoil disturbed (**Table 4.5-1**), ensure suitable material is used to replace the same depth of material after removal, and minimize erosion and compaction of soils.

4.5.1.1 Disturbance Minimization

Site selection for all facilities would take into account the protection of environmental features, such as vegetation and topsoil, as well as safety, cost, and efficiency of operation (Section OP 2.5.2.2 of the WDEQ-LQD Permit to Mine [LCI, 2011b]). Topsoil would be removed in situations where it cannot be protected from loss of the soil resource unless it is removed, such as underneath buildings; topsoil would also be removed from a monitor well road (or portion of the road) if the road must be upgraded to maintain its integrity.

Topsoil would not be stripped from areas where there is minor disturbance, such as light-use-roads, fences, and monitoring stations (such as the meteorological station (**Section 3.10**). In the pattern areas and in the monitor well ring, topsoil would not be removed except at the excavated mud pits, unless it is determined that use of a portable mud pit and disposal of the drill cuttings at an alternate location would be preferable.

4.5.1.2 Appropriate Excavation and Storage

Topsoil removal would be supervised by a qualified person using detailed soil survey data, which would be field checked. Based on the detailed soil surveys and field experience to date, the upper materials that would be salvaged can be readily distinguished from the lower materials. Topsoil surveys and anticipated stripping depths for areas of the Plant, supporting facilities, and Mine Unit 1 are included in **Section 3.4**. Surveys for future mine units would be included as part of the Hydrologic Plan and Report for each unit (**Section 2.1.1**). As a field check along roadways and pipelines, LCI would dig pits at intervals where changes in stripping depths are anticipated to help ensure the most productive portion of the soil profile is salvaged.

Excavated soils would be stockpiled or windrowed to protect them from wind and water erosion and from impacts due to site activities, e.g., traffic. All long-term topsoil stockpiles would be labeled and inspected periodically. These stockpiles would be sloped on all sides to a slope of no greater than 3:1 and would be reseeded with the approved permanent seed mixture (**Table 4.8-1)**, minus shrub specie(s), at the next appropriate season after the stockpile is created. As an alternative, the topsoil stockpile 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. A seed drill would be used to the extent possible, however, when slopes dictate, seed may be broadcast and racked in by hand. Topsoil stockpiles would 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 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Other measures, including toe ditches, would also be used to minimize wind and water erosion. (Additional information on short-term and long-term topsoil stockpile protection is included in Section OP 2.5 of the WDEQ-LQD Permit to Mine [LCI, 2011b].)

Excavated soils would be replaced at the location from which they were excavated; unless, the area from which the soils were excavated is approved for a different post-mine land use (e.g., the landowner 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 is approved by WDEQ-LQD.

Prior to replacement of soils from long-term stockpiles, the soils would be sampled for fertility and the sampling results compared to the baseline results. If necessary based on the sampling results, soil amendments or changes to the soil reapplication or seeding practices would be proposed to the BLM and WDEQ-LQD ensure the topsoil is sufficiently productive for successful revegetation.

Replaced soil thicknesses would correspond to depths and acreages salvaged during Construction. The replacement would be along 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. (Section RP 4.5.3 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

4.5.1.3 Erosion and Compaction Minimization

Soil loss from wind erosion would be controlled by removing vegetation only where necessary, and by techniques that may include surfacing roads with gravel, limiting traffic speeds, watering unpaved roads, spreading soil binding agents, mulching, inclusion of wind breaks, and timely reclamation. Soil loss from water erosion would be reduced by timely reclamation, installing drainage controls and sediment trapping structures, and reseeding and installing water bars across reclaimed areas.

To stabilize soils and support the ecosystem, vegetation would be established at disturbed areas as soon as conditions allow. For short-term disturbances during the life of the Project, such as pipeline installation, the temporary or permanent seed mix may be used, depending on the time of seeding and the erosion risk. For Reclamation, the permanent seed mix would be used. The permanent seed mix 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). The temporary seed mix would be a rigorous certified weed-free annual cover crop, such as sterile rye grass or millet.

The negative effects on soil properties resulting from the high volume and degree of constant activity at the Permit Area would be minimized where possible. Soils compacted during construction and operational activities would be disced and seeded as early as possible following use. Vehicular traffic would be minimized and restricted to specific routes. In particular, traffic routes would be established within mine units. This would reduce the occurrence of compacted soils.

4.5.1.4 Soil Contamination Prevention

Tank containments would be designed to prevent releases to soil from tank failure. Pipelines would be buried five to six feet below ground surface (i.e., below the frost line) and constructed of a corrosion-free HDPE material. Mine unit and pipeline flow and pressure would be continuously monitored during Operation to ensure timely detection of any releases from pipeline breaks or ruptures. An automatic shutdown system would be installed to limit the volume of such releases. To minimize potential impacts from accidental spills, LCI would develop and implement a Spill Prevention, Control, and Countermeasure (SPCC) plan. The SPCC plan would include directions on spill prevention inspection, accidental discharge reporting procedures, spill response, and cleanup measures.

Prevention and remediation of accidental releases, which could potentially contaminate soils, would be enacted as described in Section OP 2.9 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Measures would be taken to ensure the operational safety and integrity of pipelines, fittings, valves, tanks, wells, buildings, Storage Ponds, and fuel storage areas. Additional practices for the minimization of spills are described in Section 7.5.2 of the NRC Technical Report (LCI, 2010).

4.5.2 Monitoring of Soil Impacts

Regular inspection of topsoil removal practices, erosion controls, topsoil stockpiles, reapplication practices, and reclamation/revegetation status would be conducted to ensure that soil protection measures are working properly.

4.5.3 Impact Significance Criteria

The criteria used to evaluate soil impacts are both quantitative and qualitative. For evaluating soil disturbance, the amount of topsoil that would be disturbed has been estimated, and the actual disturbance would be evaluated against that estimate to ensure it is not substantially exceeded. In order to adequately restore soil, it would be necessary to assess that the same depth of material is placed after removal. Furthermore, the material used to replace the disturbed soils would need to be suitable, viable topsoil in order to ensure vegetative success after reclamation. Finally, success in stabilizing topsoil and minimizing erosion would be evaluated.

4.5.4 Soil Impacts from the Proposed Action

Total short-term and long-term acreage of soil disturbance and amounts of removal and stockpiling of topsoil were estimated for the life of the Project. For purposes of topsoil removal, short-term was defined as a few days to a few months, while long-term was defined as the duration of the Project. Long-term disturbances would occur with the construction of buildings, which would exist for the life of the Project, e.g., under the Plant, and the area would only be reseeded during Final Reclamation, after the facilities are removed and topsoil replaced. Short-term disturbance would occur in areas where topsoil would be removed, but topsoil would be replaced shortly after the disturbance, and the area would be reseeded to reestablish vegetation for erosion control (e.g., pipeline installation during Mine Unit Development and pipeline removal during Mine Unit Reclamation).

Table 4.5-1 shows the estimated acreage for topsoil stripping and vegetation disturbance. The location of the soils with respect to Project infrastructure can be seen in **Figure 3.4-1**. It was estimated that a total of approximately 72 acres and 231,295 cubic yards of topsoil could potentially be removed and stockpiled on a short-term basis and a total of approximately 103 acres and 332,238 cubic yards of topsoil could potentially be removed and stockpiled on a long-term basis (**Table 4.5-1**). However, as outlined below, this soil disturbance is progressive, i.e., it does not all occur in the Initial Construction phase.

Soils could also have the potential to erode if improper construction or excavation design were enacted. Also, the possibility of spills could potentially cause soil contamination; however, both of these impacts are expected to be minimized by the protective measures in place (**Section 4.5.1**).

Table 4.5-1 Vegetation and Topsoil Disturbance (Page 1 of 4)

Facilities[1]	Term of Disturbance [2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area within Disturbance from which Topsoil to be Removed (acres)		Topsoil Salvage [3] (cubic yards)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
PLANT	**LT**	**8.80**	**3.70**	**5.10**	**3.70**	**5.10**	**28,366**	Map area is 12.5 acres (5.3 acres of Lowland & 7.2 acres of Upland Big Sagebrush); however, only about 70% (8.8 acres) will have vegetation removed & topsoil stripped. As a conservative estimate, all of the Lowland Big Sagebrush was included in the disturbance (Figure 3.7-1). Topsoil stockpile in the NE portion of the Plant site.
STAGING AREAS								
Permanent	LT	1.50	1.50	0.00	1.50	0.00	4,835	Permanent staging area is in Upland Big Sagebrush. Topsoil stockpile NE of the area. Potential staging areas, if needed, will be similarly located.
Potential	ST	1.50	1.50	0.00	1.50	0.00	4,835	
Potential	ST	1.50	1.50	0.00	1.50	0.00	4,835	
TOTAL - STAGING AREAS		**4.50**	**4.50**	**0.00**	**4.50**	**0.00**	**14,505**	
DEEP WELLS								
Drilling pad and mud pits	ST	15.00	11.57	3.43	11.57	3.43	48,352	Topsoil stockpiles adjacent to pads. [4]
Well House	LT	5.00	5.00	0.00	5.00	0.00	16,117	Topsoil stockpiles adjacent to well houses. [4]
TOTAL - DEEP WELLS		**20.00**	**16.57**	**3.43**	**16.57**	**3.43**	**64,469**	
PIPELINES (outside patterns) [5]								
Trunkline	ST	11.13	10.04	1.09	10.04	1.09	35,877	Trunkline includes pipeline along Access Road and to Plant. Along all pipelines, topsoil will be wind-rowed adjacent to pipelines (separate from deeper material).
Pipelines to Deep Wells	ST	4.07	3.46	0.61	3.46	0.61	13,119	
Mine Unit 1	ST	1.32	0.99	0.33	0.99	0.33	4,255	
Mine Unit 2	ST	1.39	1.27	0.12	1.27	0.12	4,481	
Mine Unit 3	ST	0.89	0.81	0.08	0.81	0.08	2,869	
TOTAL - PIPELINES		**18.80**	**16.57**	**2.23**	**16.57**	**2.23**	**60,601**	

Table 4.5-1 Vegetation and Topsoil Disturbance (Page 2 of 4)

Facilities[1]	Term of Disturbance [2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area within Disturbance from which Topsoil to be Removed (acres)		Topsoil Salvage [3] (cubic yards)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
DRILL PADS (outside patterns) [6]								
Exploration Holes	ST	11.75	9.09	2.66	9.09	2.66	37,875	On the order of 470 exploration holes are planned. As a conservative estimate, the highest proportion of Lowland to Upland acreage in a mine unit (Mine Unit 1) was used to estimate the proportion for the exploration holes.
Monitoring Wells (mostly monitor well ring - Figure 2.1-4)								
Mine Unit 1	ST	0.70	0.55	0.15	0.55	0.15	2,256	The estimated number of monitor wells for Mine Units 2 and 3 is based on the number for Mine Unit 1.
Mine Unit 2	ST	0.88	0.69	0.19	0.69	0.19	2,837	
Mine Unit 3	ST	0.83	0.65	0.18	0.65	0.18	2,675	
TOTAL - DRILL PADS		**14.16**	**10.98**	**3.18**	**10.98**	**3.18**	**45,644**	
ROADS [7]								
Access Road within main Permit Area	**LT**	**17.17**	**15.07**	**2.10**	**15.07**	**2.10**	**55,346**	Topsoil will be stockpiled at intervals adjacent to the roads.
Access Road east & west of main Permit Area	**LT**	**19.13**	**16.79**	**2.34**	**16.79**	**2.34**	**61,664**	Topsoil will be stockpiled at intervals adjacent to the roads.
Secondary Roads								
Roads to Deep Wells	LT	8.96	7.98	0.98	7.98	0.98	28,882	Topsoil stockpile for road to each well will be
Mine Unit 1	LT	0.34	0.34	0	0.34	0	1,096	Topsoil will be stockpiled at intervals adjacent to the roads.
Mine Unit 2	LT	0.89	0.89	0	0.89	0	2,869	
Mine Unit 3	LT	0	0	0	0	0	0	Mine Unit 1 and Mine Unit 3 share the secondary road outside the pattern area.
Total for Secondary Roads		**10.19**	**9.21**	**0.98**	**9.21**	**0.98**	**32,847**	
Two-Track Roads								
Mine Unit 1	LT	2.78	2.28	0.5	2.28	0.5	8,961	
Mine Unit 2	LT	3.57	2.94	0.63	2.94	0.63	11,508	
Mine Unit 3	LT	3.09	2.76	0.33	2.76	0.33	9,960	
Total for Two-Track Roads		**9.44**	**7.98**	**1.46**	**7.98**	**1.46**	**30,429**	
TOTAL - ROADS		**55.93**	**49.05**	**6.88**	**49.05**	**6.88**	**180,287**	

Table 4.5-1 Vegetation and Topsoil Disturbance (Page 3 of 4)

Facilities[1]	Term of Disturbance [2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area within Disturbance from which Topsoil to be Removed (acres)		Topsoil Salvage [3] (cubic yards)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
PATTERNS (Figure 2.1-5)								
Delineation Holes [8]	LT	--	--	--	17.55	5.14	73,140	On the order of 300 delineation holes will be drilled per mine unit. Because vegetaion disturbance is assumed to be 100% within the pattern area and is accounted for by individual mine unit, delineation holes do not include vegetation disturbance. As a conservative estimate, the highest proportion of Lowland to Upland acreage in a mine unit (Mine Unit 1) was used to estimate the proportion for the delineation holes.
Mine Unit 1	4.4% LT	38.05	29.43	8.62	1.29	0.38	5,397	Vegetation disturbance within the pattern area is expected to be 100% of that area. Long-term (LT) topsoil disturbance, e.g., underneath header houses, is estimated to be 4.4% of the pattern area, and short-term (ST) topsoil disturbance for mud pits and pipe trenches, is estimated to be 10% of the pattern area. Topsoil removal for mud pits is about 40% of the total ST disturbance and the removal for trenches is about 60% of the total ST disturbance (Figure OP-6b, WDEQ-LQD Permit to Mine [LCI, 2011b]). Stockpiles will be located to minimize soil transport; LT stockpiles will be adjacent to the header houses; ST stockpiles will be adjacent to the feature (e.g., mud pit) or wind-rowed (e.g., pipeline trench).
	10% ST				2.94	0.86	12,265	
Mine Unit 2	4.4% LT	86.34	74.44	11.90	3.28	0.52	12,246	
	10% ST				7.44	1.19	27,831	
Mine Unit 3	4.4% LT	83.55	75.14	8.41	3.31	0.37	11,850	
	10% ST				7.51	0.84	26,932	
TOTAL - PATTERNS		**207.94**	**179.01**	**28.93**	**43.33**	**9.31**	**169,660**	

Table 4.5-1 Vegetation and Topsoil Disturbance (Page 4 of 4)

Facilities[1]	Term of Disturbance [2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area within Disturbance from which Topsoil to be Removed (acres)		Topsoil Salvage [3] (cubic yards)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
TOTAL DISTURBANCE [9]	LT - Topsoil	--	--	--	84.68	18.39	332,238	
	ST - Topsoil	--	--	--	60.02	11.73	231,295	
	Vegetation	330.13 [9]	280.38	49.75	--	--	--	

[1] Facility locations are shown on Figure 1.2-3.

[2] LT = Long Term topsoil stockpile, i.e., duration of project. ST = Short Term topsoil stockpile, i.e., a few days to a few months.

[3] Recommended topsoil stripping depths were 24 inches or less (Sections 3.4.3 and 3.4.4). For estimating topsoil salvage volumes, a topsoil depth of 24 inches was used so topsoil stockpile volumes (& associated footprints) would represent the maximum.

[4] Well WDW1 (SW corner of Permit Area) was the original exploration well drilled in 2008 & the area has been reclaimed.

[5] The width of disturbance associated with the pipelines was assumed to be: 46 feet for the trunklines; 10 feet for the pipelines to the deep wells; and 10 feet for the pipelines to the mine units. These assumed widths are sufficient to account for the pipeline trench and laydown of topsoil and subsoil.

[6] Each drill pad, whether for exploration or delineation, is assigned a total disturbance of 33 feet by 33 feet which equates to 0.025 acres. This area accounts for the area of the mud pit, topsoil and subsoil piles, and disturbance to vegetation created during reclamation efforts.

[7] Two track roads are assumed to be 8 feet 8 inches wide, secondary roads 20 feet wide, and primary access roads 32 feet wide. The assumed widths of the primary and secondary roads are slightly wider than planned (Figure 2.1-6).

[8] Delineation drilling within the pattern area will be on a 100-foot grid. Depending on geologic interpretation of the delineation hole information, the holes may or may not correspond to subsequent production or injection well locations. As a conservative estimate, it is assmed that none of the hole and well locations coincide. Based on a total of 900 holes (300 holes per mine unit) and a drill pad area of 0.025 acres, a total of about 22.5 acres of topsoil will be stripped for the entire mine. Disturbance to topsoil is about 4 acres for every 37 acres of mine unit (about 160 holes per 37 acres of mine unit).

[9] No credit is taken for pre-existing disturbance although areas of existing disturbance will be used when available, e.g., roads follow existing two-tracks where possible. Based on available information, an additional 15 acres would be disturbed for Mine Unit Development in the KM Horizon because the underlying KM Horizon ore body footprint is similar to the HJ Horizon. Therefore, the total disturbance area is 345 acres (330 acres for the Initial Construction and Mine Unit Development in the HJ Horizon and 15 acres for the Mine Unit Development in the KM Horizon). A more detailed assessment of the surface disturbance related to development of the KM Horizon would be available when LCI submits a permit revision to WDEQ-LQD.

4.5.4.1 Construction

During Initial Construction, principal impacts on soils would result from earth-moving activities associated with construction and excavation of the Plant, staging areas, the five deep wells and associated pipelines (some of which might not be installed or installed later), the trunkline (which would actually be constructed in stages as the mine units are brought on-line); and the access road improvements.

The soil impacts depend on the number of acres disturbed, the type of disturbance, and the time period of disturbance. The amount of long-term topsoil removal and stockpiling during Initial Construction is on the order of 61 acres and 195,210 cubic yards. The amount of short-term topsoil removal and stockpiling during Initial Construction is on the order of 33 acres and 107,018 cubic yards (**Table 4.5-1**).

During Mine Unit Development, surface disturbance would result from activities related to development of new mine units, which includes drilling of injection, production and monitor wells, and construction of pipelines, header houses and necessary access roads. The impacts would be similar to those discussed above, but the facilities being constructed would be smaller, e.g., header houses, and the facilities would be in place for the life of the mine unit, but not the life of the Project. For the purpose of determining the acres of soil disturbance during Construction, the mine unit facilities are listed below and in **Table 4.5-1**:

- pipelines outside the pattern areas;
- drill pads outside the pattern areas (This includes exploration holes and the monitor well rings. The MU1 monitor wells were installed in 2006 to 2008 to obtain the necessary subsurface information for permitting the Project. The surface disturbance associated with those wells is still included in this estimate.);
- secondary and two-track roads to and within the mine units; and
- pattern areas.

The amount of long-term topsoil removal and stockpiling during the Mine Unit Development phase for the HJ Horizon is on the order of 43 acres and 137,027 cubic yards. The amount of short-term topsoil removal and stockpiling during Mine Unit Development is on the order of 39 acres and 124,276 cubic yards.

Based on available information, the underlying KM Horizon ore body footprint is similar to the HJ Horizon. Therefore, existing roads and pipelines could be used to develop the KM Horizon, but additional drilling for monitoring wells and the KM pattern area would be needed. The additional area is estimated to be 15 acres, and assuming topsoil removal would be needed for all of that 15 acres, the increased topsoil volume would be about 48,400 cubic yards (**Table 4.5-1**). A

more detailed assessment of the projected surface disturbance related to development of the KM Horizon would be available when LCI submits a permit revision to WDEQ-LQD.

Facility development would displace topsoil, which would adversely affect the structure and microbial activity of the soil. Loss of vegetation would expose soils and could result in a loss of organic matter in the soil. Excavation would cause mixing of soil layers and breakdown of the soil structure. Removal and stockpiling of soils for reclamation would result in mixing of soil profiles and loss of soil structure. However, measures would be taken to ensure that soils are properly excavated and stored to maintain topsoil integrity (**Section 4.5.1**).

Construction activities have the potential to compact soils. While soils sensitive to compaction, such as clay loams, do not exist in the Permit Area, the intense volume and degree of constant activity could damage soil properties and cause compaction. Compaction of the soil could decrease pore space and cause a loss of soil structure as well. This would result in a reduction of natural soil productivity.

Wind erosion is also a potential concern at the Permit Area. Most of the soils in the Permit Area have a significant percentage of silt, which has been shown to be directly related to dust emissions from unpaved roads. Vehicular traffic on these unpaved roads and construction presents the greatest threat to soils with potential for wind erosion. Traffic in the Permit Area, however, would be restricted (**Section 4.5.1**), which would minimize erosion and compaction impacts.

Water erosion is not a large concern at the Permit Area due to very low (flat) surface slopes, limited amount of precipitation and the lack of perennial and intermittent streams. However, removal of vegetation for any activity exposes soils to increased erosion. Excavation could break down soil aggregates, increasing runoff and gully formation. These impacts would be minimized by appropriate drainage designs and excavation techniques (**Section 4.5.1**).

Saline soils are very susceptible to soil loss caused by development. Saline soils are not common within the Permit Area. Only one of the 28 soil samples collected from the Permit Area was slightly saline.

Surface spillage of fuels, lubricants and other chemicals used during Construction could occur at the Permit Area. If not remediated quickly, these materials have the potential to adversely impact soil resources. Proper preventative and protective practices would help minimize these risks (**Section 4.5.1**).

The NRC SEIS (Section 4.4) concludes that most impacts to the soil would occur during the Construction phase, when new infrastructure is being constructed and soil is being moved. Due to the small nature of the disturbed soils (less than one percent of the total project area), the impacts to the soil are expected to be minimal (NRC, 2011a).

4.5.4.2 Operation

During the Operation phase, there would be little, if any, new disturbance. Wind and water erosion due to loss of vegetation, as well as soil compaction and loss of soil structure would still occur, but at a slightly smaller scale compared with those in the Construction phase. Protective measures (**Section 4.5.1**) would be followed during the Operation phase as well, thus, minimizing these impacts.

Surface spillage of process materials (such as barren and pregnant solutions, as well as effluents), fuels, lubricants and other chemicals used during Project operations could occur in the Permit Area, which, if not remediated quickly, has the potential to adversely impact soil resources. However, as mentioned in the Construction discussion above, proper preventative and protective practices would help minimize these risks (**Section 4.5.1**).

Section 4.4.1.2 of the NRC SEIS discusses that the potential for leaks, spills, or pipeline breaks could contaminate the soils. However, with the response and protective measures in place, there would likely be no long-term impacts to the soil (NRC, 2011a).

4.5.4.3 Reclamation

Impacts on soil from Reclamation are minimal. During Mine Unit Reclamation, disturbance would again occur during some activities, e.g., when wells are abandoned and pipelines are removed from reseeded areas. This ‘re-disturbance’ of the same areas is not counted twice in the assessment of the acres disturbed. During Final Reclamation, short-term, limited impacts could result from dismantling process facilities and associated structures, removing buried piping, and plugging and abandoning wells. Disruption and/or displacement of existing soils would be relatively slight.

While there may be some short-term impacts as reclamation is in progress, the objective of these activities is to return the Permit Area to pre-mining land use. Reclamation of disturbed areas (especially long-term disturbance areas) would improve soil quality in the Permit Area and offset any adverse impacts.

Sections 4.4.1.3 and 4.4.1.4 of the NRC SEIS discuss the potential impacts to the soil as a result of this project. Similar to Construction, there is soil excavation and replacement, however, the purpose of reclamation is to return the land surface to its previous condition. Similar to the Operation phase, there is a concern for soil contamination. Due to protective measures and the small scale of the disturbed land, impacts to the soil during Reclamation are expected to be minimal (NRC, 2011a).

4.5.5 Soil Impacts from Other Alternatives

4.5.5.1 No Action Alternative

The No Action Alternative would result in no change to existing soil conditions at the Permit Area or in the region. Surface disturbance would be avoided and the area would retain its soil characteristics for the region. Existing land use activities (livestock grazing, wildlife habitat, dispersed recreation, minerals and energy development, and infrastructure) that impact the soils of the Permit Area would still occur.

4.5.5.2 Not Fencing the Pattern Areas

There would be only a slight reduction in the soil disturbance if the fences around the patterns areas were not constructed. However, the protective measures in the pattern areas, specifically reseeding, to reduce erosion risks and maintain topsoil viability, would be adversely impacted as the new vegetation growth in the reseeded areas would be preferred by livestock and wild horses and less likely to take root efficiently.

4.5.5.3 Drying Yellowcake On-Site

This alternative would have no impact on soil resources at the Permit Area, as the dryer would be within the existing Plant footprint.

4.6 Surface Water

The proposed mine units are in confined aquifers several hundred feet below ground surface, and there is no known hydraulic connection between the surface of the Permit Area and those aquifers (**Section 3.6**). Therefore, the discussion of hydrologic impacts is separated on the basis of surface water impacts and groundwater impacts.

4.6.1 Agency-Required Measures

Environmental protection measures to address potential impacts to surface water quality include measures to reduce sediment transport and measures to prevent and remediate spills and leaks. The required environmental protection measures are summarized below from Sections OP 2.9, OP 2.11.1, OP 3.5, Attachments OP-2 & OP-4, and Sections RP 3.0 and 4.0 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Sections 4.2.5.5, 5.7.1.4, and 5.7.6.6 of the NRC Technical Report (LCI, 2010), and Sections 2.1.1.1.2.3 and 2.1.1.1.5.4, 6.2.2, 6.2.4, 6.3.2, and 6.3.3 of the NRC SEIS (NRC, 2011a).

Based on the BLM review of the agency-required measures, a BLM management action was added. The BLM would require that surface disturbing activities be avoided within 100 feet of the inner gorge of ephemeral channels. Exceptions to this would be granted by the BLM based on an environmental analysis and site-specific engineering and mitigation plans and only those actions within areas that cannot be avoided and that provide protection for the resource identified would be approved.

4.6.1.1 Measures Related to Sediment Transport

The primary measures to address surface water quality impacts related to sediment transport would include:

- limiting soil compaction and removal and protecting excavated topsoil and subsurface material from erosion in accordance with Standard Operating Procedures (SOPs) and the Spill Prevention Control and Countermeasures (SPCC) Plan;
- ensuring that runoff from disturbed areas meets WYPDES permit guidelines for stormwater management and sediment reduction;
- minimizing well or other facility installation within/near the ephemeral channels; and
- completing appropriate reclamation practices in a timely manner.

No unstable surface areas, including areas so defined in the Rawlins RMP (landslides, slopes of greater than 25 percent, slumps, and areas exhibiting soil

creep) are present within the Permit Area. Similarly, no 100-year floodplains, perennial waters, springs, wetlands, or riparian areas are present within the Permit Area. Ephemeral areas within 100 feet of the inner gorge of ephemeral channels may be affected by the Project. The road routes and well locations within a mine unit cannot be specifically delineated until the locations of the monitor well ring and pattern area within the mine unit are selected based on the delineation of the ore body during exploration drilling. If potential travel routes or well locations within a mine unit are near ephemeral channels, the BLM hydrologist would be contacted to determine if additional protection measures, other than those listed in this EIS are necessary. Plans for drainage diversion around the Plant, road culverts, and other protection measures are included in Attachment OP-4, Figure OP-3c, and related text in Section 2.5, 2.6, and 2.11.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

Protection from Compaction/Erosion

During well development and pump testing, extracted groundwater would be discharged to the surface under the provisions of a general WYPDES permit, in a manner that mitigates erosion, or would be reused in the drilling process. Soil compaction during drilling and pipeline installation can be limited by using existing roads to the extent possible. Once a drill site, pipeline route, or facility location has been selected, topsoil and subsurface materials would be removed and protected in accordance with established procedures to prevent erosion and movement of sediment into drainages. To the extent practical, pipe and power line installation would occur alongside access roads to limit the overall disturbance footprint. When the road is not the shortest path, the utilities would follow the most direct path available. Vegetation buffers would be maintained between the disturbed area and the drainage whenever possible. The compaction/erosion protection measures are described in greater detail in the Section OP 2.5 and 1.22.1.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b). In addition, runoff would be diverted away from exposed soils. There are several practices that would mitigate impacts to surface water and ephemeral drainages, including use of silt fences, earth dikes, drainage swales, sediment traps, check dams, straw bales, construction of water contour bars, application of rip rap, grading and contouring, temporary or permanent sediment basins, temporary seeding, permanent seeding, mulching, use of geotextiles, sod stabilization, vegetative buffer strips, and preservation of mature vegetation, WDEQ-LQD Permit to Mine (Sections OP 2.5 and OP 2.11.1.1) (LCI, 2011b).

Runoff Control

The physical presence of small facilities (e.g., header houses) are not expected to significantly change peak surface water flows because of the relatively flat topography of the drainages at the sites, the low regional precipitation, the absorptive capacity of the soils, and the small area of disturbance relative to the large drainage area within and adjacent to the Permit Area. However, in areas

where larger structures (such as the office building and parking lot) may affect surface water drainage patterns, diversion ditches and engineered culverts would be used to prevent erosion and to control runoff. The drainage control plan for the Plant and the road and culvert designs are included in Attachment OP-4 and Section OP-2.6 of the WDEQ-LQD Permit to Mine, respectively (LCI, 2011b). In areas where runoff is concentrated, energy dissipaters may be used to slow the flow of runoff to minimize erosion and sediment loading in the runoff.

No paved areas are currently planned for the Permit Area. However, if any areas are paved, storm water runoff from those areas would be collected by a storm water system. The storm water would be temporarily retained in a detention basin to reduce the amounts of oils and other pollutants from entering surface water and ephemeral drainages. These detention ponds would be designed to control the release of storm water runoff at a rate equal to or slightly less than that of the pre-exploration period.

The SWPPP (Large Construction General Permit WYR10-0000) would also be implemented in accordance with WYPDES requirements. Drainage plans and culvert designs are included in the WDEQ-LQD Permit to Mine (e.g., Section OP 2.6 and Attachment OP-4) (LCI, 2011b).

Well Placement

In very rare instances, it may be necessary to install wells in or near an ephemeral channel. This would only be done with the authorization of the BLM. If approved, the following measures would be implemented to minimize potential impacts to the channel. Also see drainage plans and culvert designs included in the WDEQ-LQD Permit to Mine (e.g., Section OP 2.6 and Attachment OP-4) (LCI, 2011b):

- installation would be conducted during the dry season;
- drilling fluid and residual cuttings in the mud pit would be emptied and cleaned upon the completion of the installation; and
- wellheads would be designed to withstand storm water flows using exterior protection measures. (Protection measures may include barriers surrounding the wellhead, protective steel casing, cement blocks or other means to protect the wellhead from damage that may be caused by runoff.)

Reclamation

After short-term disturbances during Construction and Mine Unit Development, such as pipeline installation, the disturbed areas would be revegetated with either a temporary seed mix or with the permanent seed mix (**Sections 4.5** and **4.8**). The specific reclamation practices are detailed in the WDEQ-LQD Permit to Mine (e.g., Sections OP 2.5 and RP 4.5) (LCI, 2011b).

4.6.1.2 Measures Related to Spills and Leaks

These environmental protection measures include: selection of appropriate materials for pipelines, wellheads, and tanks; proper installation and testing of those materials prior to use; and inspection and maintenance. Piping and associated fittings would only be constructed of materials that are chemically compatible, able to withstand the expected operating pressures, and compatible with ambient conditions. Piping would also be buried at sufficient depth (48 TO 72 inches below surface) to prevent freezing or pressure impacts from the surface. Pipelines and wellheads would be pressure checked before being placed into operation and after significant repairs. Automated monitoring would be installed so any significant change in flow or pressure is detected and operators are notified. Berms, including perimeter and internal berms, would be in place to control the movement of spills. Each operating mine unit would be inspected at least once per day, and the entire Plant also would be inspected at least daily when operating. Should a spill or leak occur, remediation and reporting procedures have also been developed. The protection measures are described in greater detail in the WDEQ-LQD Permit to Mine (e.g., Sections OP 2.9, OP 3.5, and OP 4.4 and Attachment OP-2) (LCI, 2011b) and with more focus on radiological concerns in the NRC Technical Report (e.g., Sections 4.2.5.5, 5.7.1.4, and 5.7.6.6) (LCI, 2010).

4.6.2 Monitoring of Surface Water Impacts

The drainages throughout the Permit Area are ephemeral and flow only in response to spring runoff or occasional strong thunderstorms. Because of the limited flows, and lack of anticipated impacts, continued surface water sampling is not planned except as necessary in response to a specific concern, such as a spill.

4.6.3 Impact Significance Criteria

The factors identified in the Rawlins RMP were used to assess the significance of surface water impacts on the environment (BLM, 2008c).

- Degradation of water quality beyond the designated use of the receiving waterbody, or other violations of federal or state water quality standards, or negatively impacting a waterbody listed on the State 303d list of Impaired or Threatened Waterbodies.
- Unmitigated loss of wetlands or wetland function (EO 11990 and EO 11988) or activities that would degrade wetland/riparian areas such that, as a minimum physical state, proper functioning condition and Standards for Healthy Rangelands (USDI-BLM 1997) are not being maintained.
- Streamflow characteristics of perennial streams are altered such that established uses by the public and by federal, state, and local

agencies for fisheries and wildlife and for livestock, recreational, municipal, and industrial uses are affected.

- The alteration of stream channel geometry or gradient by accelerated runoff and erosion (e.g., undesirable aggradation, degradation, or side cutting) beyond what would be expected by natural processes.

The WDEQ-WQD and LQD criteria were also used to assess the significance of surface water impacts on the environment.

4.6.4 Surface Water Impacts from the Proposed Action

Because of the limited quantity of surface water within the Permit Area and the operational measures that would be taken to avoid impacts to the surface water, no impacts are anticipated. However, potential impacts outlined are presented to better illustrate the need for the protection measures described in **Section 4.6.1**. The nature and scale of the potential impacts that the Project will have on surface water are very similar through all of the three phases (i.e., Construction, Operation and Reclamation) of the Project. The surface water impact evaluation is, therefore, organized by water quantity (including water use) and water quality.

4.6.4.1 Surface Water Quantity and Use

As noted in **Section 3.5**, perennial or intermittent streams do not exist within the Permit Area or on adjacent lands; and there are no surface water use permits inside or within two miles of the Permit Area. There are however, ephemeral drainages within the Permit Area, which may be affected by erosion. Erosion controls would be in place to minimize this impact (**Section 4.6.1**).

4.6.4.2 Surface Water Quality

Potential impacts to the surface water quality in the ephemeral drainages in the Permit Area relate to increased sediment transport and spills and leaks.

Sediment Transport

The primary surface disturbances associated with ISR operations occur with well drilling, pipeline installations, road and facility construction and reclamation activities. These disturbances generally involve relatively small areas and have short-term impacts, as defined in **Section 4.1.3**. The larger areas of surface disturbance, such as the Plant, would require the diversion of stormwater runoff, and culverts would need to be installed under some roads. Without the required protection measures, the disturbances and diversions could result in adverse impacts, especially at places where relief is high, due to increased erosion potential from surface water runoff and/or due to transport of sediment. Because

of the low relief across the Permit Area, the ephemeral nature of the drainages, and limited precipitation and runoff, the primary areas of concern for sediment accumulation are low spots along the roads and drainages where runoff accumulates.

Activities associated with drilling, pipeline installations, and road and mine unit construction reduce vegetation cover and soil compaction from heavy machinery and frequent traffic. Without vegetation, topsoil is vulnerable to erosion from storm events. Soil compaction can result in decreased infiltration rates and increased surface runoff, which can increase peak flows and further increase surface erosion. Roads to and from the drill sites can become preferential pathways for surface water runoff due to compaction and rut depressions. Although soil would be stripped from specific areas, such as drill pits and the Plant, and stockpiled for replacement during Reclamation, improperly protected stockpiles can also erode, increasing sediment loads in surface water runoff. During Reclamation, activities, such as discing to loosen compacted soil, could result in increased sedimentation to surface water runoff if the increased erosion potential were not considered, e.g., discing across the direction of flow.

The NRC SEIS states that the changes to sediment transport can come from the construction activities and vehicular traffic. However, due to the topography of the area and the lack of annual surface water, the overall impact on surface water quality would be minimal, similar to the assessment in Section 4.6.2 of this EIS (NRC, 2011a).

Spills and Leaks

Surface water runoff could be impacted due to a spill or leak from wellheads, pipelines, or tanks in use during Construction, Operation, or Reclamation. The most common accidental release from ISR operations is from breaks, leaks, or separations in the piping that transfers mining fluids to and from 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. Spill and leak prevention measures would be outlined in the plan for Spill Prevention Control and Countermeasures (SPCC).

The NRC SEIS addresses spills and leaks to surface water in Section 5.1.1. The NRC states that the protection and clean-up measures are such that impacts to surface waters would be minimal (NRC, 2011a).

4.6.5 Surface Water Impacts from Other Alternatives

The No Action Alternative would not generate any additional impacts to the existing surface water resources.

The Proposed Action includes fencing the pattern area in each mine unit. If the pattern areas were not fenced, the potential for soil erosion and subsequent sediment in runoff could be slightly increased because of grazing in the pattern areas. There would also be a substantial increase in the risk of spills and leaks because of livestock damage to wellheads and pipelines.

No significant differences are expected between the potential impacts from the Proposed Action and the other alternatives (Drying Yellowcake On-Site).

4.7 Groundwater

As described in **Section 3.6**, groundwater occurs within the Battle Spring Formation in a series of relatively flat-lying sandstones. Five distinct uranium-bearing sandstones have been identified in the Permit Area and include, from the shallowest to the deepest, the BC, DE, FG, HJ, and KM Horizons. The horizons consist of very fine- to coarse-grained arkosic sandstone separated by layers of shale, mudstone and siltstone. Groundwater occurs in confined aquifers several hundred feet below the ground surface; and there is no known hydraulic connection between the surface of the Permit Area and those aquifers. The DE Horizon is the first aquifer within the Permit Area, the top of which ranges from 100 to 200 ft bgs. The depth to the groundwater in the DE Horizon ranges from 155 feet to over 257 feet. The BC Horizon overlying the DE Horizon is unsaturated and separated from the DE Horizon by shale. The HJ Horizon is the primary target for the Project and it ranges from 300 to 450 ft bgs.

4.7.1 Agency-Required Measures

The required environmental protection measures are summarized below from: Sections OP 2.9, 2.11, and 3.0, Attachments OP-2, OP-7, & OP-8, and Sections RP 1.0 and 2.0 of the WDEQ-LQD Permit to Mine (LCI, 2011b); Sections 2.1.1.1.2.4.1 through 2.1.1.1.2.4.3, 2.1.1.1.3.1.1 through 2.1.1.1.3.1.3, 2.1.1.1.4, 6.2.5, and 6.3.1 of the NRC SEIS (NRC, 2011a); and Conditions 10.1, 10.5, 10.7 through 10.13, 11.1, 11.3 through 11.6, 12.4, 12.7, and 12.15 of the NRC License (NRC, 2011b). References to specific subsections of the WDEQ-LQD Permit to Mine are also included. Based on the BLM review of the agency-required measures, one management action was added. To provide additional monitoring data on Stabilization (**Section 4.7.1.1**) for on-going reviews of regulatory requirements (EPA, 2011b), at least two additional stability monitoring samples would be collected, once every three months over a six-month period, after the initial stability period.

The discussion of required measures is separated on the basis of on-site and off-site measures because of the different concerns. On-site, the concerns are related to conducting Mine Unit Operation and Reclamation as efficiently as possible and emphasizing water quality monitoring. Off-site, the concern is related to the extent to which on-site groundwater extraction would draw down water levels in the four off-site BLM wells.

Although not a direct protective measure, the requirement that LCI post a bond for site reclamation, including groundwater restoration, provides an assurance that the restoration and reclamation activities can be conducted by the permitting and licensing agencies should LCI not fulfill its obligations. The bond amount is detailed in Table RP-4 of the WDEQ-LQD Permit to Mine (LCI, 2011b). The

BLM has access to that bond, if necessary, for site reclamation on public lands administered by the BLM.

4.7.1.1 On-Site Required Measures

Permit Area

Water from the supply wells would be used as efficiently as possible, and regular maintenance would be conducted to check for leaks in the distribution system and make the necessary repairs. Procedures and training for spill prevention and, if necessary, remediation would reduce the possibility of a spill or other accidental release that could impact groundwater.

Storage Ponds

To mitigate the likelihood of pond failure, the two Storage Ponds would be designed and built to NRC standards using impermeable synthetic liners. A leak detection system would also be installed, and all ponds would be inspected on a regular basis. In the event that a problem is detected, the contents of any given pond can be transferred to another pond while repairs are made. The proposed pond design and operation is discussed in greater detail in **Section 2.1.2.2**.

In the event of a detected leak in a Storage Pond, corrective actions would include lowering the pond level and locating the leak to allow repairs. Impacts to groundwater from a leak associated with the Storage Ponds are remote, since the outer pond liner is designed to prevent a release of the pond contents, and the depth to the in the DE Horizon. However if a leak went undetected and the contaminated water reached the groundwater in the DE Horizon the impact to groundwater would be high and long-term. All pond leaks, causes, and corrective actions would be reported to NRC and WDEQ.

With respect to potential overflow of a pond, operating procedures would require that pond levels be closely monitored as part of the daily inspection. Process flow to the ponds would be minimal in comparison to the pond capacity, thus facilitating diversion to another pond if necessary. In addition, sufficient freeboard would be maintained on the Storage Ponds to allow for a significant addition of rainwater with no threat of overflow. Finally, the dikes and berms around the Storage Ponds would channel runoff away from the Storage Ponds.

Pipelines and Related Equipment

Groundwater impacts from a spill of injection or production solutions from a header house or associated piping are unlikely due to the depth to groundwater. In addition, any impacts can be prevented by proper design, construction, and testing. Pipelines would generally be buried from 48 to 72 inches below the

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 would be constructed of HDPE with butt-welded joints or the equivalent. All pipelines and related equipment that would be under pressure during Operation would be pressure tested before use. In addition, pressures in the pipelines and related equipment are monitored to ensure pressure drops or surges do not occur, which could indicate a leak or the potential for well or formation damage. Sections OP 3.5 and 3.6.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b) contains additional information about leak detection and pressure monitoring measures in the mine units.

Mine Units

The measures to address impacts from ISR begin before the mine units are installed and continues through operation and groundwater restoration. The measures include a variety of actions and techniques, including aquifer testing, mechanical integrity testing, and reverse osmosis treatment after mining, as outlined below.

Before Construction (Baseline Data)

A critical initial measure is to ensure the hydrogeologic conditions in a mine unit are well understood. Exploration and delineation drilling, geophysical logging, and aquifer testing are conducted to ensure undetected high permeability strata, geologic faults, improperly abandoned exploration drill holes, and/or discontinuous confining units that could allow movement of the lixiviant out of the ore zone are identified prior to mine unit operations. Appropriate actions, such as additional drill hole abandonment and/or additional monitoring, can then be taken to address such conditions. In older ISR operations, this preliminary measure was not necessarily conducted as stringently as today. Regulatory review of the plans for, and results of, baseline data collection for each mine unit is also required through the Hydrologic Test Plan and Report (**Section 2.1.2.3**).

Mechanical integrity testing of wells and piping prior to use also reduces the possibility of groundwater impacts. The aquifer testing of the mine unit monitor well system also demonstrates that the wells in the monitor well ring can efficiently detect excursions and that an excursion can be recovered within a specified time.

During Operation

Mechanical integrity testing continues during operation, and the schedule for monitoring (**Section 4.7.2**) and actions to be taken should an excursion occur are specified in the WDEQ-LQD Permit to Mine and NRC License. For an ISR operation, the key to efficient mining and reduction of any potential impacts is the balance of production and injection within the pattern area. The design of the

Project addresses instrumentation and monitoring systems (and review of the information from those systems) ensures that the water balance throughout the mine units and Plant are working as planned (Sections OP 3.5, 3.6, and 4.0 and Attachment OP-2 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).
If an excursion occurs, appropriate corrective actions would be instituted including: conducting a preliminary investigation to determine the probable cause; adjusting production and/or injection rates in the vicinity of the excursion to generate an effective net process bleed and forming a hydraulic gradient toward the production zone; pumping individual wells to enhance recovery of the ISR solution, and suspending injection into the pattern area near the excursion, thereby increasing the overall bleed rate and the recovery of the ISR solution. Section OP 3.6.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b) provides more detail on excursion response, including evaluation of the ability to control an excursion.

During Restoration

The groundwater restoration techniques, including the more traditional techniques of sweep, reverse osmosis (RO), and recirculation, and ones that may be used, including groundwater transfer, reductant addition, and biorestoration, are designed to mitigate groundwater quality impacts from ISR by returning the water quality to the uses for which it was suitable before ISR and to applicable standards, in accordance with federal and state regulatory requirements. Timely application of the restoration techniques and planned monitoring also mitigate groundwater quality impacts from ISR and from the restoration activities by establishing that the restoration techniques are working as planned and determining if adjustments needed.

Of the restoration techniques, groundwater sweep has the most impact on water levels, and to mitigate those impacts, use of alternate techniques, such as groundwater transfer, would be used where possible and if they prove as effective. During Restoration, the water level changes from would be evaluated to minimize interference among the mine units. The vast majority (e.g., on the order of 99 percent) of groundwater used during Restoration would be treated and re-injected. The highest rate of groundwater withdrawal would be on the order of 100 gpm.

After it has been determined that uranium recovery is complete in a given mine unit the lixiviant injection ceases and the groundwater restoration begins. The objective of restoration and reclamation is to return the affected groundwater to the pre-operational class-of-use in accordance with WDEQ-WQD requirements on the basis of baseline water quality data. Active restoration would take between 18 to 36 months for each mine unit followed by stability monitoring and regulatory approval (**Section 2.1.6.3**).

Groundwater Sweep

During groundwater sweep, water is pumped from the mine unit without offsetting with water injection. This pumping creates 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. The affected water in the edge patterns of the mine unit is also drawn back into more central portions of the pattern area, making the later restoration phases more efficient.

Groundwater produced during sweep would contain uranium and other constituents mobilized during production. Initial concentrations of the constituents would be similar to those during the later stages of production. With enough pumping, constituent concentrations would decline gradually, reflecting the influx of baseline quality water. The groundwater produced during sweep is treated through the restoration plant ion exchange circuit to capture uranium and then either treated with reverse osmosis or pumped directly to disposal.

Reverse Osmosis Treatment

RO with permeate injection is used following the groundwater sweep phase. This treatment is most effective in returning the concentrations of total dissolved solids and trace metals and the aquifer pH to baseline values.

During this restoration phase, uranium in the groundwater is removed by passing the water through an ion exchange circuit. The ion exchange resins remove the majority of the soluble uranium in recovered solutions and yield chloride, sulfate or bicarbonate ions in the place of the uranium compounds. The chemistry of the ion exchange circuit used in the restoration is identical to the chemistry of the ion exchange circuit used in the production circuit. Ion exchange resins preferentially remove the uranyl dicarbonate and/or uranyl tricarbonate compounds from the solution. Chloride, sulfate and/or bicarbonate compounds are displaced from the resin and set into the solution.

After ion exchange, other chemical constituents in the groundwater including TDS and trace metals, such as arsenic, molybdenum, selenium, and/or vanadium, are removed by passing the water through an RO system. The RO process yields two fluids: clean water (permeate) that can be reinjected into the aquifer; and concentrated water (brine) that cannot be reinjected directly. Water sent to the RO system usually requires some pre-treatment to prevent fouling of the membranes. Commonly, the pH is lowered by addition of sulfuric or hydrochloric acid and antiscalant additives may be used. These additives (along with the sulfate and/or chloride ions of the acid) are rejected in the RO unit and become part of the brine. Therefore, the additives do not become part of the permeate which would be injected into the restoration aquifer. After reverse osmosis, the permeate may be depressurized to release entrained gasses. This process commonly results in a pH increase as carbon dioxide is typically present in the permeate and readily released at atmospheric pressure. Sodium hydroxide may also be added to increase the pH of the permeate stream prior to injection.

Groundwater Transfer

Groundwater transfer (or exchange) involves moving groundwater between a mine unit in restoration and another mine unit where uranium production is beginning. Both mine units will first have received approval for UIC Class III injection. The transferred groundwater may undergo treatment using one or more of the permit-approved processes (such as ion exchange, chemical pH adjustment, and/or reverse osmosis) prior to injection. Groundwater transfer is generally used to replace operationally-affected waters in the restoration mine unit with baseline quality water from the production mine unit. The operationally-affected waters from the restoration mine unit are then used as the basis for the lixiviant in the production mine unit. Because water is transferred (or exchanged) between mine units at equal rates, the transfer typically does not generate liquid effluents and has the benefit of reducing groundwater consumption. This technique has been successfully used at one other ISR operation, and if the opportunity arises to use the technique at the Lost Creek Project, it is projected that the transfer will involve between zero and two pore volumes.

Reductant

If reductant is added to the injection stream during the RO, it would scavenge oxygen and reduce the oxidation-reduction potential (Eh) of the aquifer. During ISR operations, certain trace elements are oxidized. By adding a reductant, the Eh of the aquifer is theoretically lowered, thereby decreasing the solubility of these elements. As warranted, hydrogen sulfide, sodium sulfide, or a similar compound may be added as a reductant. LCI is more likely to use sodium sulfide as a reductant due to the chemical safety issues associated with proper handling of hydrogen sulfide. A comprehensive safety plan regarding reductant use would be prepared for regulatory review prior to implementation.

Biorestoration

Biological reductants may be evaluated as experimental technology, if site conditions are suitable for this restoration technology; however, no biorestoration will be conducted without prior regulatory approval.

Recirculation

At the completion of RO in a mine unit, recirculation would be initiated. Recirculation consists of pumping from the mine unit and re-injecting the commingled solution (untreated) into the aquifer it came from. Recirculating solution is intended to homogenize the overall groundwater conditions. It is anticipated that one pore volume of groundwater would be recirculated.

Stabilization

Upon completion of restoration and notification of WDEQ, a stabilization monitoring program would begin in which the pattern monitor wells used to evaluate restoration success would be sampled. Each pattern monitor well would be sampled at the beginning of stabilization and once every three months for a

period of 12 months, for a total of five samples, and analyzed for the parameters listed in Table RP-1b of the WDEQ-LQD Permit to Mine (LCI, 2011b).

The stability period would be a minimum of 12 months. Following the end of the 12-month stability period, LCI would perform a regression analysis on each monitored constituent within the pattern monitor wells. This statistical method would assist in determining if the concentration of a given constituent exhibits a significantly increasing trend during the stability period. The regression analysis would be performed in accordance with Chapter 17 on trend analyses in the EPA guidance document, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance" (EPA, 2009). If the statistical analysis indicates the results are stable, at least two additional samples would be collected, once every three months over a six-month period, to provide data for on-going reviews of regulatory requirements (EPA, 2011).

If a constituent exhibits a strongly increasing trend (or in the case of pH a strongly increasing or decreasing trend), the action that LCI would take to resolve this situation would depend on the constituent and the status of the restored groundwater system. As stated in the EPA guidance document, statistical analysis provides a "workable decision framework". However, due to the complexity of the aqueous geochemical groundwater systems involved, these statistical techniques should not be relied on as the sole determinant when evaluating the effectiveness of groundwater restoration. Therefore LCI would consider which constituent(s) is showing an increasing trend in concentration and base the decision on further action on the status of the mining zone groundwater geochemistry. These actions may include extending the stability period or LCI may return to a previous phase of active restoration. The phase of active restoration that would be used would be determined by the constituent and the process required to decrease its concentration.

During stability monitoring, all overlying, underlying and perimeter monitor wells would be analyzed for all UCL parameters once every two months. If groundwater restoration has not been successful and an excursion occurs during stabilization, then the sampling would revert to weekly for affected monitor wells until the excursion is resolved.

If the analytical results continue to meet the appropriate standards for the mine unit and do not exhibit significant increasing trends, LCI would submit supporting documentation to the regulatory agencies that the restoration parameters have remained at or below the restoration standards and request that the mine unit be declared restored.

UIC Class I Wells

Addressing impacts of the Class I wells begins before the wells are installed and continues through operation and reclamation. The initial measures include

evaluating the target formation for hydrologic properties, characteristics of the formation fluids, compatibility of injected and formation fluids. The results of these evaluations are included in the WDEQ-WQD UIC Class I Permit, a copy of which is included in the WDEQ-LQD Permit (Attachment ADJ-2, LCI, 2011b).

Regularly scheduled inspections and maintenance, recording and reviewing monitoring results, and personnel training to follow established procedures for proper operation of the overall disposal system would reduce the possibility of damage to a well from overpressuring or other action that could affect the well performance. These requirements are also outlined in the Class I Permit, as are well abandonment and financial surety requirements.

4.7.1.2 Off-Site Required Measures

The water levels in four BLM stock wells within one mile of the Permit Area boundary could be impacted due to the drawdowns associated with groundwater withdrawal during Mine Unit Operation and Reclamation. If significant impacts to those wells are observed (e.g., water levels drop to a point that impairs the usefulness of the wells), the following measures would be considered:

- lowering the pump level in the wells;
- deepening the wells; and
- replacing the wells with new wells completed in deeper sands that are not impacted by the Project.

4.7.2 Groundwater Monitoring

Similar to the discussion of agency-required measures, the discussion of groundwater monitoring is separated on the basis of on-site and off-site monitoring because of the different concerns. On-site, the concerns are related to ensuring that Mine Unit Operation and Reclamation are conducted as efficiently as possible, and emphasize monitoring of water levels and water quality, in addition to pattern balancing. The monitoring is also intended to ensure excursions do not occur, or if they do occur, they are controlled as quickly as possible to prevent movement of lixiviant and production fluid outside of the monitor well ring. Off-site, the concern is related to the extent to which on-site groundwater extraction, particularly during the first phase of restoration, would draw down water levels in off-site wells.

4.7.2.1 On-Site Groundwater Monitoring

Permit Area

Water level measurements would be taken quarterly in the 27 wells that were used to establish baseline conditions within the Permit Area as described in **Section**

3.6.4.2. Other samples may be collected from these wells, depending on the development of mine units near or encompassing the wells.

Storage Ponds

To help ensure shallow groundwater is not impacted by the two Storage Ponds, which are part of the waste treatment and handling system, the Storage Ponds would be designed, inspected and monitored in accordance with NRC Regulatory Guide 3.11 (2008). The Storage Ponds, associated inspection schedule and monitoring system, and corrective actions that would be taken in case a leak is detected, are briefly described in detail in Sections 3.0 and 5.0 of the NRC Technical Report (LCI, 2010). In addition to installation of a leak detection system as the Storage Ponds are constructed, four wells would provide additional monitoring capability. The monitor wells would be drilled to the first shale below the surface. Three of the four wells have already been installed and groundwater was not encountered in the wells above the first significant aquitard. The wells would be checked prior to operation to determine if groundwater exists and, if it does exist, the quality of the groundwater. If groundwater does exist, it would be sampled on a quarterly basis for conductance, alkalinity, sodium, and sulfate (NRC Technical Report [LCI, 2010]).

Pipelines and Related Equipment

Flow through the pipelines would be monitored and would be at a relatively low pressure. Sensors wired to automatic alarms and pipeline shutoffs would be installed to detect significant changes in flow rates or pressures in the pipelines and tanks to help prevent significant releases. All the Plant equipment is specified and designed for the life of the Project, and equipment for the mine units is similarly designed. Visual inspection of pipelines and related facilities 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.

Mine Units

In addition to the baseline monitoring already conducted for the Permit Area, extensive groundwater monitoring would be conducted on a mine unit basis prior to, during and following production to identify any potential impacts to water resources of the area. This monitoring is summarized below and described in more detail in Section OP 3.6 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 5.7.8.2 and 6.2 of the NRC Technical Report (LCI, 2010).

Prior to use of any of the monitoring, production, or injection wells, the mechanical integrity of the well would be tested. MITs would also be conducted at specified intervals thereafter and after well repairs (Section OP 3.4 of the WDEQ-LQD Permit to Mine [LCI, 2011b]). The purpose of this monitoring is to ensure that fluids in the well cannot migrate into sands other than the one(s) in which the well is completed.

Mine unit monitoring, prior to production, provided information on aquifer characteristics needed to refine anticipated operating parameters, such as pumping rates and monitor well spacing, and baseline water quality, needed to establish excursion indicators and restoration criteria. The WDEQ-LQD MU1 documents (LCI, 2011b) includes the results of the aquifer testing and baseline water quality for that mine unit, and similar detail would be provided for the other mine units.

The mine unit monitoring during Mine Unit Operation has two purposes: to ensure the operations are being conducted as efficiently as possible to prevent an excursion; and to detect any excursions that might occur. During ISR operations, water levels would be routinely measured in the production zone and overlying and underlying aquifers. Sudden changes in water levels within the production zone may indicate that the mine unit flow system is out of balance. Flow rates would be adjusted to correct this situation. Increases in water levels in the overlying aquifer or underlying aquifers may be an indication of fluid migration from the production zone. Adjustments to well flow rates or complete shut-down of individual wells may be required to correct this situation. Increases in water levels in the overlying aquifer may also be an indication of casing failure in a production, injection or monitor well. Isolation and shut down of individual wells can be used to determine the well causing the water level increases. These monitoring procedures and the operational procedures to address any concerns found during monitoring are described in detail in Attachment OP-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

LCI would monitor for lateral movement of lixiviant using a horizontal excursion monitoring system. This system consists of a ring of monitor wells completed in the same aquifer and zone as the injection and production wells (**Figure 2.1-4**). It is anticipated that monitor wells would be installed about 500 feet from the mine unit boundary and appropriately spaced (approximately 500 feet apart) to detect an excursion in a timely manner based on the hydrologic characteristics of each mine unit. Monitor wells would be sampled semi-monthly for approved excursion indicators, commonly called Upper Control Limits (UCLs).

Selection of UCLs is based on background water quality, lixiviant characteristics, and parameters that move quickly through the aquifer. For example, chloride is often a UCL parameter because it moves quickly, in contrast with uranium which generally reacts with the aquifer material and, as a result, moves more slowly in the groundwater. WDEQ-LQD Guideline No. 4 (2000a) specifies procedures for selecting UCL parameters and calculating the UCL concentrations that would indicate an excursion had occurred. If an excursion is detected, specific requirements for monitoring and controlling the excursion are included in Section OP 3.6.4.3 of the WDEQ-LQD Permit to Mine (LCI, 2011b) per the WDEQ-LQD NonCoal Rules, Chapter 11, Sections 12 and 13.

LCI would also monitor for vertical excursions in the overlying and underlying aquifers using shallow and deep monitor wells, respectively. Per existing state

and federal guidance, these wells would be located within the mine unit boundary at a density of about one well per four acres, depending on the hydrologic characteristics of each mine unit. Shallow and deep monitor wells would be sampled semi-monthly for approved UCLs. Section 5.2 of the WDEQ-LQD MU1 documents (LCI, 2011b) includes the results of UCL calculations for that mine unit, and similar detail would be provided for the other mine units.

The emphasis of monitoring during groundwater restoration is to ensure the groundwater quality is restored to the specified criteria determined from the baseline sampling and that the quality remains stable (Section RP 2.4 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

UIC Class I Wells

These wells are part of the waste treatment and handling system and would be much deeper than any mine unit. Mechanical integrity testing of these wells is required prior to use, and periodically thereafter, and monitoring injection rates, pressures, and injectate quality is also required, in accordance with the WDEQ-WQD Permit, which is included in Attachment ADJ-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b). These wells are briefly described in **Section 2.1.2.4** and Sections 3.0 and 5.7 of the NRC Technical Report (LCI, 2010).

4.7.2.2 Off-Site Groundwater Monitoring

The operational BLM stock wells near the Permit Area (**Figure 3.6-15**) would be sampled on a quarterly basis with BLM's consent. At a minimum, the samples would be analyzed for U-nat and Ra-226. Water level data would be collected before sampling if the wellhead design allows access. LCI would also correspond with BLM to ensure that the stock reservoirs and wells are not impacted in a manner that restricts their intended use.

4.7.3 Impact Significance Criteria

The BLM and WDEQ criteria used to evaluate groundwater impacts include both qualitative and quantitative assessment of changes in groundwater quantity and quality during the Project. The quantitative assessments include calculation of anticipated drawdowns in water levels and comparison of operational and restored water quality to baseline conditions.
The BLM Groundwater Impact Significant Criteria are as follows:

- The natural flow or level of groundwater to existing local springs, seeps, flowing artesian wells, or permitted water supply wells is interrupted or reduced to the point beneficial uses cannot be maintained.
- Groundwater quality in any aquifer is degraded such that it can no longer be classified for its current and potential use(s).

WDEQ-LQD requires an assessment of impacts that may reasonably be expected as a result of the mining operation to water resources and water rights, which includes assessment of the areal extent of drawdown, usually to the extent of the five-foot drawdown contour, potential effects on existing water rights, and water quality changes (WDEQ-LQD, 2005a and b). WDEQ-WQD has criteria for evaluating potential water uses based on water quality (WDEQ-WQD Rules, Chapter 8, Table I). The requirements for restoration of groundwater quality after ISR, which apply throughout the mine units, are specified in WDEQ-LQD NonCoal Rules (Chapter 11, Section 5) and are based on restoring the quality to the uses for which it was suitable prior to mining, as established by WDEQ-WQD (Section RP 2.2 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

To establish requirements for restoration of groundwater quality after ISR, the NRC may allow a somewhat different approach than WDEQ-LQD in that the use of Alternate Concentration Limits (ACLs) may be approved. Depending on the baseline water quality in the Permit Area, the production zone generally must be reclassified and exempted per the water use classifications of WDEQ and the aquifer exemption provisions of the EPA UIC regulations. The ACLs, if approved by NRC, would apply at the exemption boundary.

4.7.4 Differentiation of Impacts to Groundwater - Consumption and Quality

Potential impacts to groundwater could occur during all phases of the Project (Construction, Operation, and Reclamation). The impacts are from both groundwater consumption and changes to groundwater quality. The impacts related to groundwater consumption are summarized in **Table 4.7-1** and **Section 4.7.4.1**, and the impacts related to groundwater quality are summarized in **Table 4.7-2** and **Section 4.7.4.2**.

Detailed discussion of the potential impacts to groundwater is provided in the following sections for each phase of the Project (**Section 4.7.5** – Construction, **Section 4.7.6** – Operation, and **Section 4.7.7** – Reclamation). For each phase, the discussion is organized on the basis of the facility or activity that could cause the impact or be impacted. Specifically, the discussion is separated on the basis of the overall Permit Area, pipelines, related equipment, the Storage Ponds, the mine units, the UIC Class I wells, and off-site wells. Impacts from the No Action Alternative and the Other Action Alternatives are evaluated in **Section 4.7.8**.

Table 4.7-1 Summary of Consumptive Water Use Impacts

Consumptive Water Use Impacts	Potentially Affected Aquifer	Purpose	ISR Phase	Type of Impact	Affected Area	Frequency	Groundwater Impact
2 FG wells, 1 HJ well, 3 KM wells, 1 N well (35 gpm)	FG, HJ, KM, N	Dust Control	Construction, Operations, Reclamation	Direct/Drawdown	Well Vicinity	Life of Mine as needed	Moderate
		Plant Process					
		Drilling Fluids for Well Drilling & Abandonment					
		Employee Use					
Drill-Stem Tests	Ft. Union Fm	UIC Class I Deep Injection Wells	Construction	Direct/Drawdown	Well head	Once	Negligible
Aquifer Testing	HJ	Determine effectivness of Spacing for Horizontal Excursion Monitoring Wells	Construction	Direct/Drawdown	Well head	Short Term[1]	Minor
	LFG, UKM	Vertical Excursion Monitoring Wells					
	HJ	Production/ Injection Wells					
Well Development	LFG,HJ, UKM	Clear out drilling fluids	Construction	Direct/Drawdown	Localized	Short Term[1]	Negligible
Well Purging/Sampling	LFG,HJ, UKM	Mine Unit Baseline for UCL Calculations & Groundwater Restoration Criteria	Construction (Mine Unit Development Stage)	Direct/Drawdown	Localized	Short Term[1]	Negligible
Mine Unit Wells	HJ	Production	Operations	Direct/Drawdown	Mine Unit	Long Term[2]	Moderate
Mine Unit Wells	LFG, HJ, UKM	Aquifer Restoration	Reclamation	Direct/Drawdown	Mine Unit	Short Term[1]	Moderate

1 - Short Term impacts would occur over a five-year period or less

2 - Long Term impacts would occur over a period longer than five years

Table 4.7-2 Summary of Water Quality Impacts

Water Quality Impacts	Potentially Affected Aquifer	ISR Phase	Type of Impact	Affected Area	Impact Duraton	Groundwater Impact
Spills of hazardous liquids (fuels, lubricants)	DE	Construction, Operations, Reclamation	Indirect	Localized	Short Term[1] to Long Term	None to minor
Pipeline Leaks	DE		Indirect	Mine Unit	Short Term[1]	None to minor
Mine Unit Well Leaks	DE,FG, HJ, Km		Direct/Indirect	Mine Unit	Short Term[1]	Negligible to minor
Aquifer Testing (discharge to surface)	DE	Construction	Indirect	Localized	Short Term[1]	None to minor
Storage Pond Leaks	DE	Operations	Indirect	Localized	Short Term[1]	None to minor
Deep Injection Well Leaks	Ft Union, Battle Springs	Operations	Direct/Indirect	Localized	Short Term[1]	Minor
Mine Unit Wells	LFG, HJ, UKM	Operation/Reclamation	Direct	Mine Unit	Long Term[2]	High

1 - Short Term impacts would occur over a five-year period or less
2 - Long Term impacts would occur over a period longer than five years

4.7.4.1 Groundwater Consumption

Groundwater extraction is a key component of ISR production and aquifer restoration. As discussed in **Section 2.1**, during production, most of the extracted groundwater is re-injected into the mine units. Mine units would be operated with a 0.5 to 1.5 percent bleed for two to three and a half years depending on the mine unit. The bleed would create an inward hydraulic gradient to the mine unit. This bleed rate at a maximum scenario of 1.5 percent would produce a volume of 90 gpm of liquid waste (47,304,000 gallons per year). This accounts for the majority of the groundwater consumptive use during Mine Unit Operation. LCI proposes to manage the liquid waste through the UIC Class I well(s). The water balance for the life of the Project is summarized in **Section 2.1.6.2**, including **Figures 2.1-9** through **2.1-14**, and discussed in more detail in Section OP 3.6.3.1 (Figures OP-5a through 5f) of the WDEQ-LQD Permit to Mine (LCI, 2011b).

During aquifer restoration, the primary methods include groundwater sweep (GWS) and reverse osmosis (RO). Other methods, including groundwater transfer, RO with permeate reinjection, or reductant addition may also be used. **Section 4.7.1.1** of this EIS and Section RP 2.3 of the WDEQ-LQD Permit to Mine provides additional detail on these methods, including volume calculations. During groundwater sweep, groundwater is initially extracted without re-injection to hydraulically capture water impacted by production and to draw ambient, baseline-quality water into the mine unit from the surrounding aquifer. During this sweep, an inward hydraulic gradient is created causing an influx of baseline quality native groundwater into the unit, thereby flushing any residual lixiviant from areas affected by the horizontal and vertical spreading (flare) of the lixiviant during mining. This sweep accounts for the largest consumptive use of groundwater during the Project.

Following the sweep, groundwater is extracted and treated using RO. RO is a water treatment process that works by forcing a solution from a region of high solute concentration through a semipermeable membrane to a region of low solute concentration by applying a pressure in excess of the osmotic pressure. This treatment is most effective in returning the concentrations of total dissolved solids and trace metals and the aquifer pH to baseline values. The bulk of the treated water is re-injected into the affected aquifer to improve water quality, but a bleed rate is maintained, which would result in continued groundwater consumption, although at a much reduced rate compared to sweep.

4.7.4.2 Groundwater Quality

LCI has committed to return the groundwater to the pre-operational class-of-use in accordance with WDEQ statutes and regulations. Best Practicable Technology (BPT), as defined in the Wyoming Statutes, would be used during restoration.

The uranium deposits underlying the Permit Area are primarily roll front deposits in fluvial sandstones. The uranium was deposited when oxidized groundwater containing the uranium entered reducing conditions in the subsurface aquifers. ISR operations essentially reverse the natural processes that deposited the uranium. During operations, barren lixiviant would enter the formation through the injection wells and flow to the production wells. Lixiviant is a liquid medium used to selectively extract (or leach) uranium from ore bodies. This liquid medium typically contains an oxidant such as oxygen and/or hydrogen peroxide mixed with sodium carbonate or carbon dioxide. For the Lost Creek Project, carbonate lixiviant would be made from varying concentrations and combinations of sodium carbonate, sodium bicarbonate, carbon dioxide, oxygen, and/or hydrogen peroxide and antiscalant added to the native groundwater. The combined carbonate/bicarbonate concentration in the injected solution typically would be maintained at less than five grams per liter (g/L), and the hydrogen peroxide and/or oxygen concentration typically would be less than one g/L. These limits help reduce the possibility of “gas lock” in the formation, which reduces ISR efficiency (LCI, 2011b). Section D5.2.3, OP1.2, and OP3.1 of the WDEQ-LQD Permit to Mine provide additional information on the ore deposition and geochemistry.

Injection wells introduce the carbonate lixiviant into the mineralized zone to oxidize the reduced uranium and to complex it with bicarbonates. Pumping from production wells draws the lixiviant through the mineralized zone, oxidizing additional ore between the injection and production wells. In turn, groundwater restoration essentially reverses the effects of the oxidation during ISR operations and re-establishes the reducing conditions that were present prior to Mine Unit Operation. During the groundwater sweep the affected water in the edge patterns of the mine unit is also drawn back into more central portions of the pattern area, making the later restoration phases more efficient. Groundwater produced during the sweep phase would contain uranium and other constituents including total dissolved solids (TDS) and trace metals such as arsenic, molybdenum, selenium, and/or vanadium mobilized during production. The initial concentrations of the constituents would be similar to those during the later stages of production. With enough pumping, the constituent concentrations would decline gradually, reflecting the influx of baseline quality water. The water produced during groundwater sweep is treated through the restoration plant ion exchange circuit to capture uranium and then either treated with reverse osmosis or pumped directly to disposal (LCI, 2011b).

4.7.5 Construction

The Construction phase includes both the Initial Construction of the Plant and other life-of-mine facilities and the progressive Mine Unit Development. Initial Construction is expected to last for approximately seven months, and activities include building access roads, utility corridors, the Plant, the Storage Ponds, pipelines, and drilling and installation of the UIC Class I injection wells. Mine unit development has been included in the Construction Phase although it is progressive (one mine unit may be in development while another is in operation).

Section 4.5.2 in the NRC SEIS summarizes the potential impacts to water resources. Groundwater is expected to be influenced during the construction phase by the installation of wells, roads, and pipelines; and the usage of groundwater during construction. Due to the various BMPs in place, no significant impacts to the groundwater are expected. Additionally, groundwater would only be used for limited purposes, reducing the quantity being drawn out of the ground.

4.7.5.1 Permit Area, Storage Ponds, Pipelines and Related Equipment

Impacts to groundwater during Construction would primarily be from consumptive use of groundwater and changes in water quality. Groundwater consumptive use would primarily be for dust control, drilling, and employee use (e.g. showers and toilets). Groundwater quality could be impacted from spills of solvents, lubricants or other materials, and the introduction of drilling fluids. The impacts to groundwater would be direct and on a short-term basis at specific locations within the Permit Area, such as the Plant and utility corridors.

Groundwater for dust control, drilling, aquifer testing, and employee use would be pumped from the water supply wells during the Construction phase. Two wells would be installed in the FG Horizon, one well in the HJ Horizon, three wells in the KM Horizon, and one well in the N Horizon. Groundwater, estimated at a maximum of 35 gpm, would be pumped from the seven water supply wells to meet the needs of the Project. The wells would be located away from the ore body and the water quality would be tested prior to use.

The FG aquifer occurs at depths ranging from 250 to 275 ft bgs and is approximately 100 feet thick. It is hydrologically separated from the DE aquifer and the HJ aquifer. The top of the HJ aquifer ranges from approximately 300 to 450 ft bgs and ranges in thickness from 100 to 160 feet. It is hydrologically separated from the FG aquifer by the Lost Creek Shale and from the underlying KM aquifer by the Sagebrush Shale. The top of the KM aquifer ranges from 450 to 600 ft bgs and is about 100 feet thick. It is hydrologically separated from the HJ aquifer and the underlying L Horizon. Minor drawdown could occur as the groundwater is withdrawn from the water supply wells. However, because of the

relatively small volume of water withdrawn relative to the water supply available in the aquifers, only minor short-term drawdown impacts are expected.

The volume of water for dust control, drilling and employee use would be limited. For the life of the Project, a very conservative calculation of the drawdown from pumping of the water supply wells is less than five feet in the FG, KM and N Horizons at distances greater than three miles from the center of the Permit Area; therefore, the drawdown would be much less during the seven months of Construction. The calculation and associated assumptions, e.g., no recharge and continuous pumping for the life of the Project, are discussed in Section OP 3.6.3.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

The potential volume of stored fuels and lubricants in the Permit Area is expected to be small and any leaks or spills would be cleaned up immediately to prevent soil contamination and infiltration to the groundwater in accordance with the SPCC Plan.

Water for construction of the Storage Ponds (e.g., for compaction and dust suppression) would come from the water supply wells. There is a possibility that groundwater could be impacted during installation of the monitor wells for the Storage Ponds, although the volume of water required for drilling is not expected to create any drawdown. Four wells are required by NRC and WDEQ, and three of the four have been installed to demonstrate the absence of groundwater above the DE Horizon. Groundwater quality could be impacted from spill of fuels or lubricants during construction of the Storage Ponds, but any spills would be cleaned up immediately to prevent soil contamination and infiltration to the groundwater in accordance with the SWPPP. In addition, the Storage Ponds would be constructed in accordance with NRC and WSEO standards.

4.7.5.2 Mine Units

The schedule for Mine Unit Development is generally three plus years for each mine unit. It includes installing monitoring wells, injection wells, and production wells, well development, well sampling, aquifer testing, pipeline installation and construction of the header houses and installation of mine unit piping.

Groundwater levels would be affected during the life of each mine unit. The primary consumptive impact to groundwater would occur during Mine Unit Operation and Reclamation, which are described in more detail below. However, during Mine Unit Development, prior to Operation, all of the wells must be drilled, developed, tested, and sampled. On an individual well basis, none of these development processes require extensive consumption of water, and even in aggregate, the influence is negligible compared with Mine Unit Operation and Reclamation. However, the processes do represent a definable impact, if measurable only during the short-term (e.g., during the multi-day aquifer test of a new monitor well ring).

During Mine Unit Development, groundwater would be recovered from well installation activities, including drilling, well development, sample collection and aquifer testing. The groundwater is "native" groundwater that has not been exposed to any ISR process or chemicals. This "native" groundwater would be discharged to the surface under the provisions of a general WYPDES permit or reused in the drilling process. The surface discharge permits would mitigate impacts to the Permit Area aquifers by limiting the discharge volume and prescribing concentration limits to discharged waters. In addition, Alternate Sediment Control Measures (ASCMs) as described in the WDEQ/LQD Guideline 15 would be used for erosion and sediment control. No impacts to groundwater are anticipated due to the relatively small volume of water discharged at any given time.

Drilling fluids would consist of "native" groundwater and may contain bentonite based muds, polymers, inert lost circulation material, and minor amounts of soda ash. Hazardous chemicals would not be used in the drilling mud. The drilling fluids would be contained in drill pits during the drilling; and the drill pits would be backfilled with subsoil either after the drilling fluid has evaporated or to prevent displacement of the drilling fluid. Because of the relatively small quantities of water used for drilling and the nature of the drilling fluid, no impacts to groundwater are anticipated. LCI has estimated that 10 drill rigs per week would be used during the drilling phase of the project and each rig would use approximately 3,400 gallons of water per day.

Groundwater would be pumped for sample collection and aquifer characterization prior to Mine Unit Operation or from portions of the Permit Area not affected by ISR operations. This "native" groundwater has not been exposed to any ISR process or chemicals. During sample collection and aquifer testing, the water would be discharged to the surface in accordance with WYPDES permits or would be reused in the drilling process. The surface discharge permits would mitigate impacts to the Permit Area aquifers by limiting discharge volumes and concentration limits and ASCMs would be used for erosion and sediment control. It is not anticipated that withdrawal of groundwater from the water supply wells would cause significant drawdown based on the duration of the Mine Unit Development stage. Because of the relatively small quantities of water discharged and the implementation of BMPs (as described in the Operations Plan of the WDEQ Permit to Mine), impacts on water quality would be insignificant.

Non-hazardous drilling fluids, as described above, would be limited and would be contained in drill pits to minimize the area of potential soil contamination and to enhance evaporation. Fluid leakage from drill pits or spills of drilling mud during well installation activities should not have any impacts on groundwater, due on the depth of the groundwater and the low-permeability mudstone/shale overlying the DE aquifer. During drilling the procedures detailed in the Operations Plan of the WDEQ Permit to Mine (LCI 2011b) would be implemented to prevent, identify, and correct any impacts to groundwater in the event of spills. In the

unlikely event that the drilling fluid does migrate down to the groundwater in the DE Horizon there would be a minor long-term impact to the groundwater quality.

For wells drilled in active mine units, the groundwater generated during well development and aquifer testing would be treated as 11(e)(2) byproduct material. This affected groundwater would be disposed of on-site through a system of Storage Ponds and UIC Class I wells. Procedures for the Prevention and Remediation of Accidental Releases are discussed in the Operations Plan of the WDEQ Permit to Mine (LCI, 2011b). Because of the controlled on-site disposal procedures, no impacts to groundwater from the liquid waste are anticipated. If a release does occur and if the 11(e)(2) byproduct material does migrate to the groundwater in the DE Horizon the impact would be high and long-term.

4.7.5.3 UIC Class I Wells

Up to five UIC Class I wells would be installed in the Permit Area. The wells would be completed at depths ranging from approximately 6,170 to 8,100 ft bgs. As discussed in **Section 2.1.1**, LCI obtained Permit No. 09-586 from the WDEQ-WQD to dispose process waste water in the Fort Union Formation, which is estimated to be approximately 4,800 thick in the Permit Area. A 300-foot thick low-permeability shale sequence at the base of the Wasatch/Battle Springs Formations overlies the Fort Union Formation and would act as the confinement layer. The confining layer below the injection zone is the Cretaceous-age 1,900-foot thick Upper Lance Formation, which consist of shales, siltstones, and lesser sandstone. Additional information regarding the 300-foot shale confining layer is in the Application for an Underground Injection Control Permit, Class I prepared for LCI by Petrotek, 2010. The document is in the Adjudication File for the WDEQ-LQD Permit to Mine (LCI, 2011b).

Impacts to deeper groundwater could occur from the introduction of drilling mud and fluids during drilling and installation of the deep wells. However, the impacts would be minimal because the drilling muds are designed to seal the permeable zones by depositing the mud filter cake on the wellbore wall.

Drilling fluids would be contained in mud pits to minimize the area of potential soil contamination and to enhance evaporation. Leakage from mud pits or spills or leaks during Construction should not have any detectable impacts on the groundwater, based on the depth of the groundwater below the surface, the clay content in the mud pits, and the low-permeability shale overlying the aquifers.

Drill stem tests would be conducted to ensure the wells have the required injection capacity; however, water consumption during such testing is minimal because of the emphasis on pressure measurement rather than water pumping. As noted in previous sections, the deep well in the southwest corner of the Permit Area was installed in 2008 to confirm the viability of using the deep wells for disposal. The groundwater recovered from well development, sample collection

and drill-stem testing would be evaporated in the mud pit or reused in the drilling process. No impacts to groundwater quality are anticipated due to the relatively small volume of water that would be discharged.

4.7.6 Operation

The Operation phase for the Project is scheduled for seven plus years. Potential environmental impacts to groundwater during the Operation phase include changes to groundwater levels and quality due to the ISR process and consumptive use of groundwater. The ISR process uses a carbonate lixiviant that is pumped through buried pipelines to injection wells in the mine units. The lixiviant is circulated through the ore zone from the injection wells to the production wells, where it is then pumped from the mine units through buried pipelines to the ion exchange circuit in the Plant. Waste water would be temporarily stored in the Storage Ponds and then pumped into the deep disposal wells. Leaks of lixiviant from the wells, pipelines and header houses or waste water leaks from the Storage Ponds could impact groundwater resources in the Permit Area. However near-surface aquifers are not present within the Permit Area; therefore, the risk of impacting the deeper groundwater resources is small. The potential impacts are discussed below on the basis of Consumptive (**Section 4.7.4.1**) and Water Quality (**Section 4.7.4.2**).

Section 4.5.2 in the NRC SEIS summarizes the potential impacts to water resources. Groundwater is expected to be influenced during the operation phase by the potential for leaks and spills of chemicals and pumping for use on for the project. Due to the protective measures and chemical clean-up in place, only minor long-term impacts to the groundwater are expected. Also, groundwater usage is limited to only a few purposes, limiting the amount of water that would be pumped from the ground.

4.7.6.1 Groundwater Consumption during Operation

Permit Area

Groundwater for dust control, drilling, cement mixing and employee use would continue to be pumped from on-site water supply wells, and as described under Construction, a very conservative calculation of the drawdown from pumping of the water supply wells is less than five feet in the FG, KM and N Horizons at distances greater than three miles from the center of the Permit Area. It is not anticipated that withdrawal from the water supply wells would cause significant drawdown in the HJ Horizon based on the intervening shale(s) between the HJ Horizon and the supply well completion intervals and the low projected pumping rates. It is possible that pumping from the UFG could result in drawdown within the LFG, which is the overlying aquifer to the production zone. If drawdown becomes apparent within the LFG monitor wells inside a mine unit, the shallow

water supply well (e.g., LC1W) would be temporarily shut-in and the water level response in the LFG monitor wells would be observed. If the water levels recover within the LFG wells once the pumping in the UFG is stopped, then the water supply well would be identified as the cause of water level decreases. If water level recovery does not occur in the LFG, then LCI would act on the assumption that operation of the mine unit is causing the drawdown and would proceed accordingly with corrective action, if necessary. Similarly, pumping from a UKM completed well (e.g., LC28M) could result in unanticipated drawdown in the KM Horizon, which would be addressed in a comparable manner.

Storage Ponds, Pipelines and Related Equipment

None of these facilities would impact the consumptive use of groundwater. As discussed in **Section 4.7.4.2**, the potential exists for leakage to create an area of perched groundwater, but this would require corrective action.

Mine Units

During Operation the water level changes, including both drawdown and mounding from production and injection, respectively, would be evaluated to minimize interference among the mine units and to determine cumulative impacts. Overall, the bleed rate of 0.5 percent to 1.5 percent, which has been historically applied at numerous ISR facilities, would create a cone of depression around each pattern area. The bleed water would be disposed of in the UIC Class I Injection Wells. The vast majority (e.g., on the order of 99 percent) of groundwater used during Mine Unit Operation would be treated and re-injected. The average rate of groundwater withdrawal (consumptive use) during production is around 70 gpm. The highest rate of groundwater withdrawal during production, groundwater sweep and RO treatment would be on the order of 115 gpm. The water balance for the life of the Project is summarized in **Section 2.1.6.2**, including **Figures 2.1-9** through **2.1-14**, and discussed in more detail in Section OP 3.6.3.1 (Figures OP-5a through 5f) of the WDEQ-LQD Permit to Mine (LCI, 2011b).

Results of the hydrologic investigations to date indicate that the HJ aquifer is laterally extensive and hydraulically connected, except where separated by the Fault (**Section 3.6**). Furthermore, the HJ aquifer is hydraulically separated from the overlying and underlying aquifers by laterally continuous confining units. Groundwater consumption during Mine Unit Operation would generally be limited to the HJ aquifer.

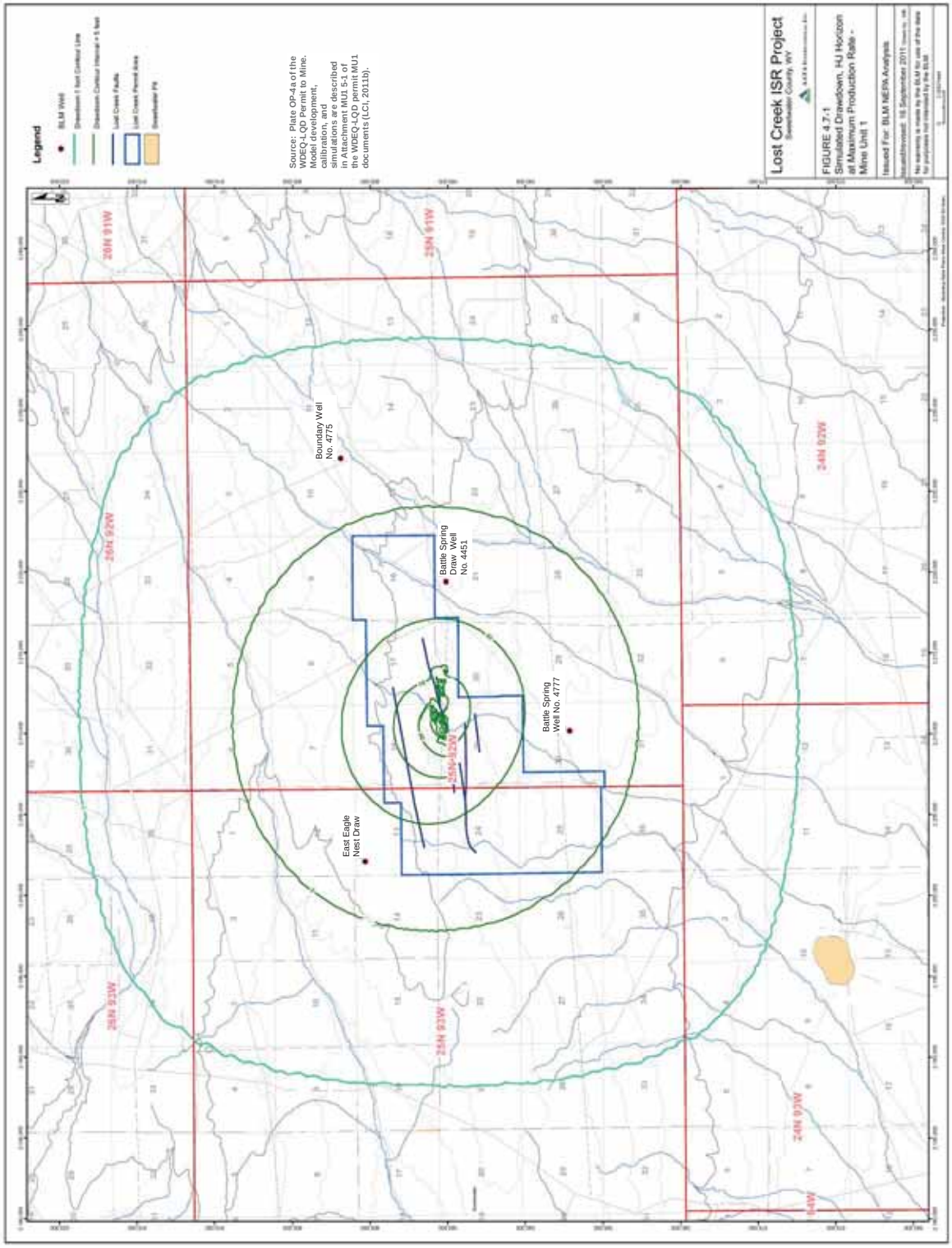
Drawdown during Operation would be greatest in the immediate vicinity of the mine units. A numerical model was used to assess drawdown impacts from Project. The model was developed using site-specific geologic and hydrologic data collected from site characterization activities. The model development, calibration and simulations are described in the report, “Numerical Modeling of Hydrologic Conditions at the Lost Creek In-Situ Recovery Uranium Project,

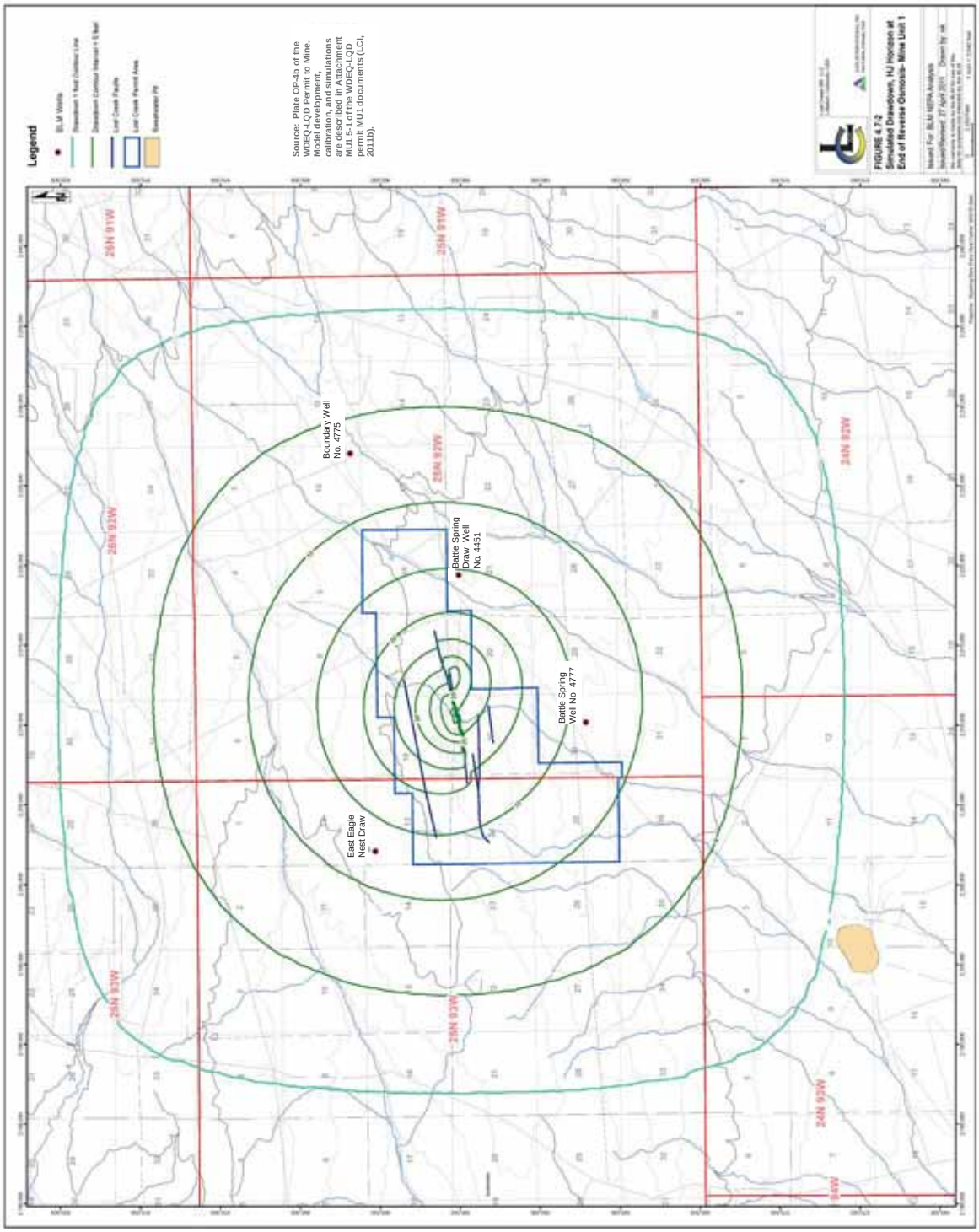
Wyoming," in Addendum 5-1 of the WDEQ-LQD MU1 document (LCI, 2011b). Simulations were run representing the full production-restoration sequence for MU1. The simulation included a maximum production rate of 5,838 gpm (with a net bleed of 38 gpm or 0.65 percent) for a period of 26 months (791 days), groundwater 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 **Figure 4.7-1**. Drawdown during the RO phase is shown on **Figure 4.7-2**. The five-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 MU1 is closest to the Permit Area boundary. Although this simulation only represents MU1 production and restoration, the production and RO rates are maximized. During a portion of the Project, full production and restoration could occur simultaneously; thus, the cumulative effect is represented by combining the predictions represented on the figures and accounting for some shift in mine unit location.

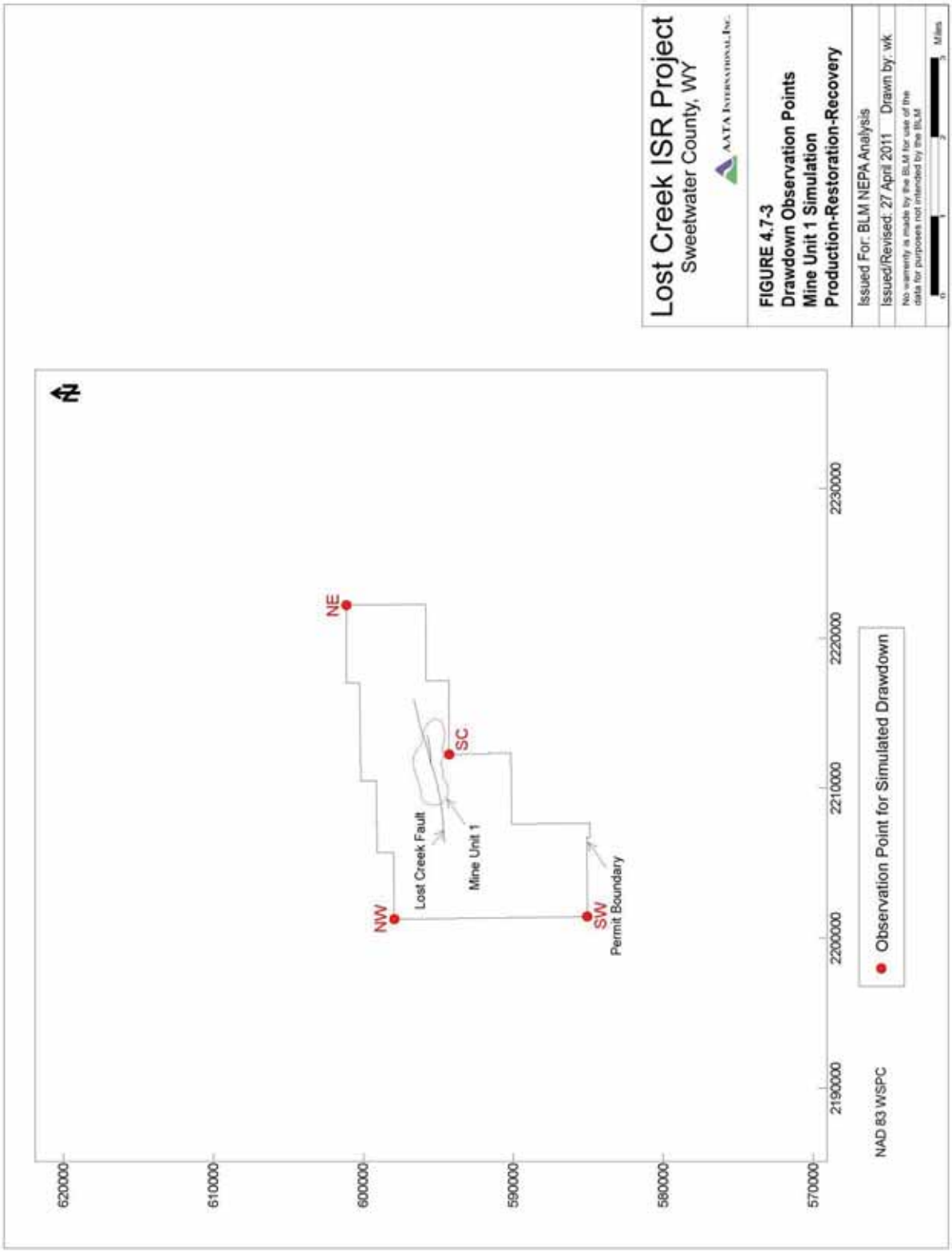
Simulated recovery of water levels in the HJ Horizon aquifer after termination of ISR operations in MU1 is illustrated by placing observation points on the northwest, southwest, northeast and south-central edges of the Permit Area. **Figure 4.7-3** shows the location of the simulation monitoring points. **Figure 4.7-4** illustrates the simulated drawdown that occurs during ISR operations at MU1 and the recovery following termination of operations. The water levels are projected to recharge within ten to 15 years, once groundwater extraction ceases. 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", which is included as Attachment MU1 5-1 in the WDEQ-LQD MU1 documents (LCI, 2011b)).

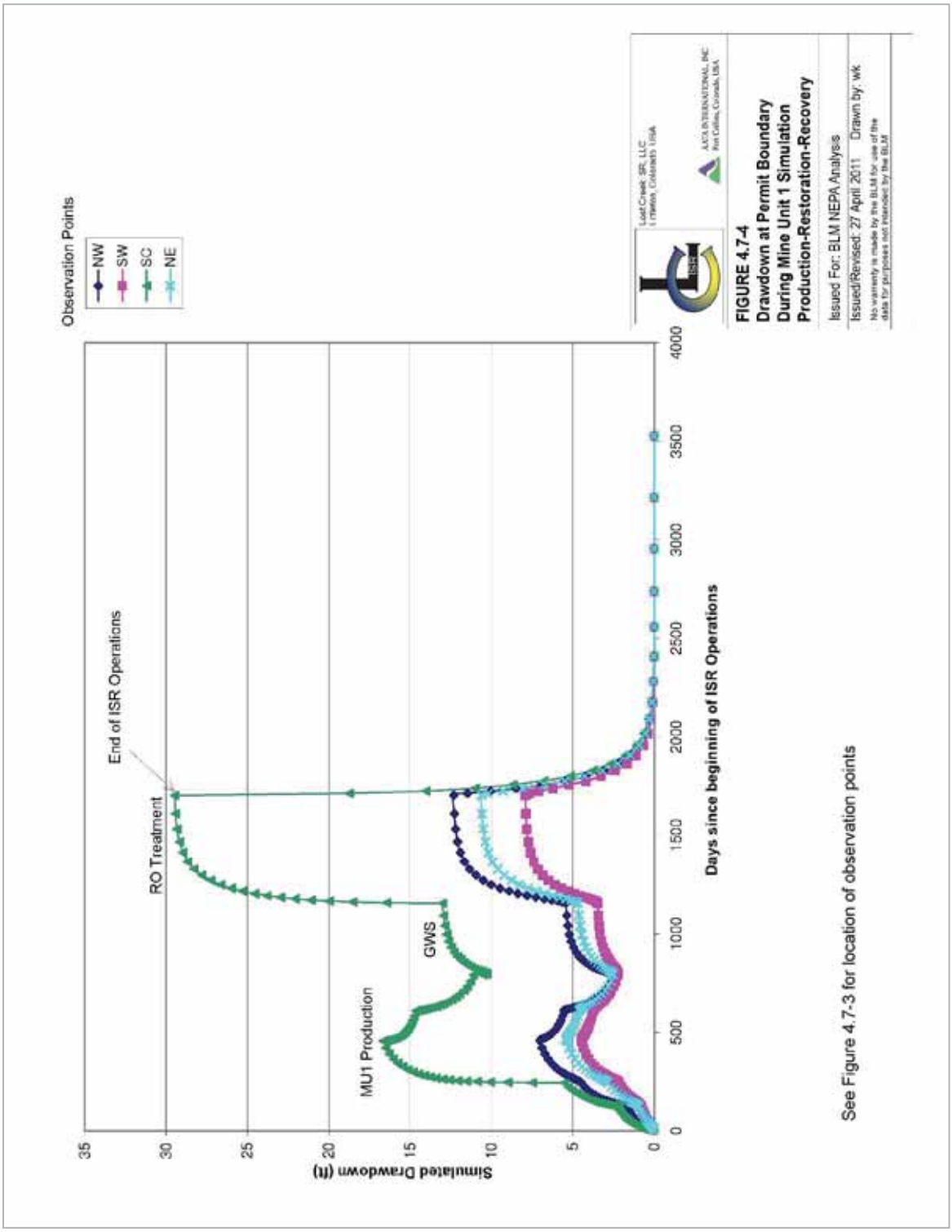
UIC Class I Wells

The UIC Class I injection wells would be competed in the Fort Union Formation. Process waste water would be injected at an average rate of 70 gpm. The proposed locations of the five UIC Class I wells are widely scattered to accommodate regulatory requirements and meet the necessary injection criteria (**Figure 1.2-3**). These wells would be used for injection, not pumping; therefore, no consumptive use would occur. With respect to injection capacity, testing results from the first well installed in the southwest corner of the Permit Area indicate sufficient capacity for the planned disposal quantities. In addition, the TDS concentration in the formation water was in excess of 10,000 mg/L and the concentration of other organic and inorganic constituents exceeded groundwater quality standards (**Section 3.6.4**). Although LCI has permitted five wells, installation of only two to three wells is planned initially, with installation of the fourth and fifth wells based on the need for redundant capacity if another well must be taken out of service.


Legend
BLM Well
Drawdown 1 foot Contour Line
Drawdown Contour Interval = 5 feet
Lost Creek Faults
Lost Creek Permit Area
Groundwater Pit
Source: Plate OP-4a of the WDEQ-LQD Permit to Mine. Model development, calibration, and simulations are described in Attachment MU1 5-1 of the WDEQ-LQD permit MU1 documents (LCI, 2011b).
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.7-1
Simulated Drawdown, HJ Horizon at Maximum Production Rate - Mine Unit 1
Issued For: BLM NEPA Analysis
Boundary Well No. 4775
Battle Spring Draw Well No. 4451
Battle Spring Well No. 4777
East Eagle Nest Draw
25N 92W
25N 91W
24N 92W
24N 91W


Legend
BLM Wells
Drawdown 1 foot Contour Line
Drawdown Contour Interval = 5 feet
Lost Creek Parcels
Lost Creek Permit Area
Breakaway PV
Source: Plate OP-4b of the WDEQ-LQD Permit to Mine. Model development, calibration, and simulations are described in Attachment MU1 5-1 of the WDEQ-LQD permit MU1 documents (LCI, 2011b).
FIGURE 4.7-2
Simulated Drawdown, HJ Horizon at End of Reverse Osmosis- Mine Unit 1
Boundary Well No. 4775
Battle Spring Draw Well No. 4451
Battle Spring Well No. 4777
East Eagle Nest Draw
25N 91W
25N 92W
25N 93W
24N 92W
24N 93W


Lost Creek ISR Project
Sweetwater County, WY
AATA International, Inc.
FIGURE 4.7-3
Drawdown Observation Points
Mine Unit 1 Simulation
Production-Restoration-Recovery
Issued For: BLM NEPA Analysis
Issued/Revised: 27 April 2011 Drawn by: wk
No warranty is made by the BLM for use of the data for purposes not intended by the BLM
0 1 2 3 Miles
N
NE
SC
NW
SW
Lost Creek Fault
Mine Unit 1
Permit Boundary
620000
610000
600000
590000
580000
570000
2190000
2200000
2210000
2220000
2230000
NAD 83 WSPC
Observation Point for Simulated Drawdown


Observation Points
NW
SW
SC
NE
End of ISR Operations
RO Treatment
GWS
MU1 Production
Simulated Drawdown (ft)
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
3000
3500
4000
Days since beginning of ISR Operations
Lost Creek, SR, LLC
Littleton, Colorado USA
A.C.S. INTERNATIONAL, INC
Fort Collins, Colorado, USA
FIGURE 4.7-4
Drawdown at Permit Boundary
During Mine Unit 1 Simulation
Production-Restoration-Recovery
Issued For: BLM NEPA Analyses
Issued/Revised: 27 April 2011 Drawn by: wk
No warranty is made by the BLM for use of the data for purposes not intended by the BLM
See Figure 4.7-3 for location of observation points

Off-Site

BLM has four wells located outside of the Permit Area (**Figure 3.6-15**). The completion depths of two of these wells are shallower than the HJ Horizon; the completion depth of another is substantially greater than the HJ Horizon (although the screened interval is not known). The completion depth of the fourth well may coincide with the LFG Sand; as such, potential drawdown may affect this well.

4.7.6.2 Groundwater Quality during Operation

Permit Area

No groundwater quality impacts are anticipated from pumping of the water supply wells. Any water level declines in these wells are not expected to impact the water quality because of the relative similarity in the water quality at these depths.

Storage Ponds, Pipelines and Related Equipment

Groundwater quality could potentially be impacted during the Operation phase due to an accident such as Storage Pond leakage/failure or an uncontrolled release of liquids due to a mine unit accident. Because of the depth to water in the DE Horizon and the presence of shale layers between DE Sands and the surface, direct leakage to the groundwater is considered unlikely and would be the result of a slow leak or catastrophic failure. However, it could be possible for a leak to create an area of perched groundwater. To minimize the chance of a leak, the Storage Ponds would be designed and built to NRC standards using double liners with a leak detection system between the two liners. The liner material would consist of impermeable polypropylene geomembrane and each liner would be 41 millimeters thick. The ponds would be inspected on a regular basis. If a major release does occur and if the 11(e)(2) byproduct material does migrate to the groundwater in the DE Horizon the impact would be high and long-term.

Mine Units

ISR from a uranium deposit is accomplished by reversing the natural processes that deposited the uranium, i.e., ISR reoxidizes the ore zone to mobilize the uranium from the reduced conditions in the ore zone. A small portion of radium would be mobilized with the uranium, and depending on the conditions within a given sand other metals such as arsenic, molybdenum, selenium, and/or vanadium may also be mobilized during ISR.

The native formation waters in the ore zones of the HJ Horizon are not suitable for human consumption because of naturally high levels of dissolved radioactive materials, including uranium and Ra-226 (**Section 3.6.4**). The ISR process affects

the pattern area within the mine unit, which was exempted per the water use classifications of the WDEQ and the aquifer exemption provisions of the EPA UIC regulations. The area so designated was limited both laterally and vertically.

During Mine Unit Operation, injection of the lixiviant into the pattern area results in a temporary degradation of water quality in that area compared to pre-production conditions. However, proper balancing of pumping and injection rates and pressures, as described in Section OP 3.6 and Attachment OP-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b), restricts these water quality changes to the pattern area and improves mining efficiency. Subsequent restoration activities, described in Section RP 2.3 of the WDEQ-LQD Permit to Mine (LCI, 2011b), are also designed to affect the pattern area.

The target horizon for the Project is the HJ Horizon. Hence, the ISR operations would impact water quality only in the HJ Horizon provided excursions do not occur. Inadvertent movement of the affected water out of the pattern area is termed an excursion. Excursions represent an impact on the groundwater outside of the pattern area, and possibly the mine unit (**Figure 2.1-5**). Excursions can result from an improper balance between injection and recovery rates, undetected high permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuity of the confining units that could allow movement of the lixiviant out of the ore zone, poor well integrity, or hydrofracturing of the ore zone or surrounding units if the injection wells were operated above fracture pressure. Protective measures are required to avert these scenarios (**Section 4.7.1**), and systematic monitoring is designed to detect them as early as possible (**Section 4.7.2**). Mitigation measures and time frames for implementing those measures are required if an excursion occurs (**Section 4.7.1.1**)

A problem due to poor well construction or well damage could result in migration of fluids between aquifers. Because of the depth to water in the DE Horizon and the presence of shale layers between DE Sands and the surface, a shallow leak from a well could create an area of perched groundwater.

UIC Class I Wells

As with any well, a problem due to poor well construction or well damage could result in migration of fluids between aquifers. However, the construction and monitoring requirements described in **Sections 4.7.1** and **4.7.2** are designed to prevent, detect, and correct this problem. Another potential concern would be the loss of injection capacity due to precipitates forming in the injection zone. Comparison of the anticipated composition of the waste stream and the existing water quality in the injection zone does not indicate chemical incompatibility between the fluids, as shown in **Table 4.7-3**. Because of the elevated concentrations of Total Dissolved Solids in the target formation fluids, an aquifer exemption for the target formation was not a requirement.

Table 4.7-3 Comparison of Water Quality in the Injection Stream and the Receiving Formation

Chemical Analyte	Estimated Range of UR ISR, LLC Waste Stream Water Quality		Fort Union Water Composition from Lost Creek Test Well No. 1		
	Minimum (mg/l)	Maximum (mg/l)	Minimum (mg/l)	Maximum (mg/l)	Average (mg/l)
pH	6	9	7.67	11.7	8.69
Ammonia as Nitrogen	50	500	12.3	23	16.8
Sodium	150	3,000	2,760	4,080	3,490
Calcium	200	1,000	28	117	68.5
Potassium	10	1,000	73	9,920	1,473
Bicarbonate as HCO_3	1,500	4,000	1	3,390	1,269
Carbonate as CO_3	0	500	1	689	121
Sulfate	80	2,000	81	1220	285
Chloride	200	4,000	1,440	6,271	3,830
Uranium as U_3O_8	1	15	0.0003	0.0021	0.001
Ra-226 (pCi/l)	300	3,000	0.13	0.35	0.26
TDS	4,000	15,000	10,300	26,500	13,945

Note:
Estimated range of waste stream composition from UR Energy engineering estimate.
Fort Union Formation concentrations from water sampling conducted at TW1.

Off-Site

No water quality impacts to the BLM wells are expected because the completion intervals coincide only partially, if at all, with the HJ Horizon. In addition, because of the distance of these wells from the pattern areas and excursion control, any water level declines in the BLM wells are not expected to impact the water quality because of the relative similarity in the water quality at these depths.

4.7.7 Reclamation

Reclamation includes progressive Mine Unit Restoration and Final Reclamation. Groundwater impacts are related to water quantity, through consumptive use, and to water quality through waste management practices including discharge to the storage ponds and deep wells. The potential impacts are discussed on the basis of Consumption (**Section 4.7.5.1**) and Water Quality (**Section 4.7.5.2**).

Section 4.5.2 in the NRC SEIS (NRC, 2011) also summarizes the potential impacts to water resources during reclamation. Groundwater is expected to be influenced during the reclamation phase by the decommissioning of the wells, potential leaks and spills, and use of the groundwater. Due to the various BMPs in place, no significant impacts from leaks and spills are expected to the groundwater are expected. Well abandonment is conducted to return the hydrological conditions to their previous state and use of the groundwater is limited to certain purposes. As such, while the groundwater may be affected in the short-term, in the long-term it would be returned to its previous state.

4.7.7.1 Groundwater Consumption during Reclamation

Permit Area

Groundwater for dust control, well plugging and abandonment, cement mixing and employee use would continue to be pumped from on-site water supply wells during Mine Unit Reclamation. The drawdown from pumping of the water supply wells would 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. It is not anticipated that withdrawal from the water supply wells would cause significant drawdown in the HJ Horizon based on the intervening shale(s) between the HJ Horizon and the supply well completion intervals and the low projected pumping rates. It is possible that pumping from the UFG could result in drawdown within the LFG, which is the overlying aquifer to the production zone. If drawdown becomes apparent within the LFG monitor wells inside a mine unit, the shallow water supply well (e.g., LC1W) would be temporarily shut-in and the water level response in the LFG monitor wells would be observed. If the water levels recover within the LFG wells once the pumping in the UFG is stopped, then the water supply well would be identified as the cause of water level decreases. If water level recovery does not occur in the LFG, then LCI would act on the assumption

that operation of the mine unit is causing the drawdown and would proceed accordingly with corrective action, if necessary. Similarly, pumping from a UKM completed well (e.g., LC28M) could result in unanticipated drawdown in the KM Horizon, which would be addressed in a comparable manner.

The potential impacts to groundwater during Final Reclamation would be similar to those during Construction. An additional water use during Final Reclamation would be for decommissioning the Plant. LCI estimates that approximately 34,000 gallons of water would be required to decontaminate and decommission the Plant and associated equipment. Using a 100 percent contingency factor, the total volume of water required for decontaminating and decommissioning is around 68,000 gallons of groundwater. The waste water generated during the decontaminating and decommissioning would be disposed in the UIC Class I wells in accordance with NRC requirements.

Storage Ponds, Pipelines and Related Equipment

None of these facilities would impact the consumptive use of groundwater during Mine Unit Reclamation or Final Reclamation.

Mine Units

Drawdown during mine unit reclamation would be greatest in the immediate vicinity of the mine unit in restoration and greatest during groundwater sweep (GWS), when water is pumped from the mine unit without offsetting with water injection. As discussed in **Section 4.7.4.1**, a numerical model was used to assess drawdown impacts from Project. The model was developed using site-specific geologic and hydrologic data collected from site characterization activities. Simulated recovery of water levels in the HJ Horizon aquifer after termination of ISR operations in MU1 is illustrated by placing observation points on the northwest, southwest, northeast and south-central edges of the Permit Area. **Figure 4.7-3** shows the location of the simulation monitoring points. **Figure 4.7-4** illustrates the simulated drawdown that occurs during ISR operations at MU1 and the recovery following termination of operations. The water levels are projected to recharge within ten to 15 years, once groundwater extraction ceases.

During reverse osmosis (RO), the simulated consumptive use (reject brine) was 67.6 gpm. Drawdown during the RO phase is shown on **Figure 4.7-2**. The five-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 MU1 is closest to the Permit Area boundary. Although this simulation only represents MU1 production and restoration, the production and RO rates are maximized. During a portion of the Project, full production and restoration could occur simultaneously; thus, the cumulative effect is represented by combining the predictions represented on the figures and accounting for some shift in mine unit location.

UIC Class I Wells

These wells would be used for injection, not pumping; therefore, no consumptive use would occur during reclamation. During Final Reclamation, the UIC Class I wells would be plugged and abandoned in accordance with the WDEQ-LQD Permit (LCI, 2011b).

Off-Site

The locations of the four BLM wells located outside of the Permit Area are shown on **Figures 4.7-1** and **4.7-2**. As noted previously, the completion depths of two of these wells are shallower than the HJ Horizon; the completion depth of another is substantially greater than the HJ Horizon (although the screened interval is not known). The completion depth of the fourth well may coincide with the LFG Sand; as such, potential drawdown may affect this well. Even if the completion intervals of these wells coincided with the HJ Horizon, the drawdown would not exceed 15 feet, based on the simulation illustrated on **Figure 4.7-2**.

4.7.7.2 Groundwater Quality during Reclamation

Permit Area

No groundwater quality impacts are anticipated from the pumping of the water supply wells. Any water level declines in these wells are not expected to impact the water quality because of the relative similarity in the water quality at these depths.

Storage Ponds, Pipelines and Related Equipment

Groundwater quality could potentially be impacted during Mine Unit Reclamation due to an accident such as Storage Pond leakage or an uncontrolled release of liquids due to a mine unit accident. Because of the depth to water in the DE Horizon and the presence of shale layers between DE Sands and the surface, direct leakage to the groundwater is considered unlikely and would be the result of a slow leak or catastrophic failure. However, it could be possible for a leak to create an area of perched groundwater. The Storage Ponds would be designed and built to NRC standards using impermeable synthetic liners with a leak detection system, and all ponds would be inspected on a regular basis. If a major release were to occur and if the 11(e)(2) byproduct material migrated to the groundwater in the DE Horizon the impact would be high and long-term.

Groundwater quality could potentially be impacted during Final Reclamation due to an accident, such as or an uncontrolled release of liquids when the ponds are being emptied.

Mine Units

Groundwater restoration after ISR returns the ore zone to reducing conditions, reprecipitating any residual uranium mobilized during ISR. TDS and other trace metals such as arsenic, molybdenum, selenium, and/or vanadium which may have also been mobilized during Operation are also reprecipitated.

The native formation waters in the ore zones of the HJ Horizon are not suitable for human consumption because of naturally high levels of dissolved radioactive materials, including uranium and Ra-226 (**Section 3.6.4**). The ISR process affects the pattern area, which was exempted per the water use classifications of the WDEQ and the aquifer exemption provisions of the EPA UIC regulations. The area so designated was limited both laterally and vertically. Ideally, Mine Unit Restoration activities affect only the pattern area. An excursion has been known to occur during restoration in rare circumstances, e.g., due to immediate proximity to an underground uranium mine, but monitoring is required until restoration is deemed complete, and such conditions do not exist at the Lost Creek Permit Area.

A problem due to poor well construction or well damage could result in migration of fluids between aquifers. However, the requirements for monitoring, including MITs, continue during mine unit restoration.

After Mine Unit Restoration is completed and approved by WDEQ-LQD and NRC, the wells would be abandoned in accordance with established protocols (Section RP 3.1 of the WDEQ-LQD Permit [LCI, 2011b]). No impact from the abandonment of the wells is anticipated.

UIC Class I Wells

As with any well, a problem due to poor well construction or well damage could result in migration of restoration or abandonment fluids between aquifers. Another potential concern would be the loss of injection capacity during restoration due to precipitates forming in the injection zone. Comparison of the anticipated composition of the waste stream and the existing water quality in the injection zone does not indicate chemical incompatibility between the fluids, as shown in **Table 4.7-3**, taken from Attachment J of the WDEQ-WQD Permit, which is included in Attachment ADJ-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Similarly, the abandonment fluids, which are primarily cement, must also be suitable for the subsurface conditions.

During Final Reclamation, the UIC Class I wells would be plugged and abandoned in accordance with the WDEQ-LQD Permit. No impact from the abandonment of the wells is anticipated.

Off-Site

No water quality impacts to the BLM wells are expected because the completion intervals coincide only partially, if at all, with the HJ Horizon. In addition, because of the distance of these wells from the pattern areas and excursion control, any water level declines in the BLM wells are not expected to impact the water quality because of the relative similarity in the water quality at these depths.

4.7.8 Groundwater Impacts from Other Alternatives

4.7.8.1 No Action Alternative

Under the No Action Alternative, the Project would not be constructed. Existing wells drilled for the Project would be plugged in accordance with WDEQ regulations. There would be no Project-related impacts to groundwater.

4.7.8.2 Not Fencing the Pattern Areas

Considering operational health and safety, the Proposed Action involves fencing the pattern areas within the operational mine unit(s) to reduce the possibility of damage to the wellheads and other surface facilities by livestock and wild horses. Although any damage by livestock and wild horses would likely be restricted to surface damage, it is possible that a well could be damaged to such an extent that a subsurface leak could occur. However, if a well is damaged to such an extent, repair and integrity testing is required before it could be put back into use. In addition, an assessment of impacts to soil or water due to leakage from the damaged well would be required.

4.7.8.3 Drying Yellowcake On-Site

This alternative would have no impact on groundwater. The dryer would be within the Plant, so the measures taken to prevent impacts to groundwater from the Plant operation, e.g., construction in accordance with appropriate building codes, would be in place, as well as applicable procedures for spill control should unanticipated damage occur.

4.8 Vegetation

4.8.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 2.7 and RP 4.5 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Sections 2.1.1.1.2.1, 2.1.1.1.5.5, and 6.2.3 of the NRC SEIS (NRC, 2011a).

Minimization of vegetation removal, reseeding, and traffic and weed control are part of the Proposed Action. Vegetation removal would be minimized whenever possible to protect topsoil, preserve wildlife habitat, and improve revegetation success. The acreages of the two vegetation communities identified on-site (Upland and Lowland Big Sagebrush Shrublands), and the acreages of disturbance in those communities are listed in **Table 4.5-1**. The disturbance acreages do not differentiate between areas where topsoil and vegetation are removed, i.e., where both the plant and roots are removed, and areas where the vegetation is crushed but the roots remain in place. In most of the pattern areas, the roots would remain in place, which should help reduce erosion and leave organic material in place, and, for shrubs, may provide for more rapid reestablishment than just from seed.

To stabilize soils and support the ecosystem, vegetation would be established at disturbed areas as soon as conditions allow. For short-term disturbances during the life of the Project, such as pipeline installation, the temporary or permanent seed mix may be used, depending on the time of seeding and the erosion risk. For Final Reclamation, the permanent seed mix would be used. The temporary seed mix would be a rigorous certified weed-free annual cover crop such as sterile rye grass or millet. The permanent seed mix, 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), is shown in **Table 4.8-1**.

During the Operation phase, mine units and supporting facilities would be accessed using a defined road network. Employees would be trained to minimize the impact to vegetation by staying on defined roadways and reducing the amount of vehicle traffic to the extent possible. Drilling and construction activities would be limited or halted when field conditions are muddy in order to minimize damage to vegetation. Alternatively, activities may be shifted to areas where they would not impact vegetation. Weed prevention measures following BLM guidelines and recommendations would be implemented (BLM, 1996b and 2004b).

Table 4.8-1 Permanent Seed Mix

Common Name [1]	Scientific Name	Application (pounds per acre)
Thickspike wheatgrass	*Agropyron dasystacum*	4.0
Slender wheatgrass	*Agropyron trachycaulum*	2.5
Western wheatgrass	*Agropyron smithii*	2.0
Indian ricegrass	*Achnatherum hymenoides*	2.0
Great Basin wildrye	*Leymus cinereus*	2.0
Winterfat	*Ceratoides lanata*	1.5
Sandberg bluegrass	*Poa secunda*	1.5
Big Sagebrush [2]	*Artemesia tridentata*	1.0
TOTAL		**16.5**

[1] Alternative selections if one or two of primary selections (other than Big Sagebrush) are not available: Needle-and-thread (*Stipa comata*); and Bottlebrush squirreltail (*Elymus elymoides*)

[2] Sage seed would not be mixed with the other seeds but would be broadcast separately after the other seed has been drilled

4.8.2 Vegetation Monitoring

Monitoring of vegetation impacts would occur throughout the life of the Project to ensure protective measures are working as planned, and vegetation would be monitored during Reclamation to ensure reestablishment to required standards.

4.8.2.1 During Construction, Operation, and Final Reclamation

LCI personnel would inspect active work areas to ensure employees are minimizing impacts to vegetation. Any problems noted during inspections would be brought to the supervisor's attention for correction. Activities throughout the Permit Area would also be periodically checked to ensure no unanticipated impacts are found. It should be noted that a detailed estimate of the topsoil and vegetation disturbance acreage, such as **Table 4.5-1** has not been previously required for an ISR operation in Wyoming. Therefore, part of the periodic checks would be to ensure the approach used to develop this estimate is effective and efficient.

4.8.2.2 Monitoring Revegetation Success

Both interim and final revegetation efforts would be evaluated. Interim revegetation efforts, such as reseeding of a mine unit pattern area after construction, would be checked regularly for effectiveness e.g., reducing the potential for erosion and controlling weeds. (Interim revegetation is discussed

under Drilling and under Surface Facilities in Mine Unit Development in **Section 2.1.3**.)

Revegetation after Final Reclamation would be monitored annually for plant germination and growth, weeds, and overall progress toward meeting the reclamation success criteria. The monitoring results would be submitted to BLM and WDEQ-LQD as part of the Annual Report. If reclamation progress was deemed insufficient, then a program to address the concerns (e.g., additional weed control or reseeding of poorly germinated area) would be developed in conjunction with BLM and WDEQ-LQD. Revegetation after Final Reclamation would be deemed complete no earlier than the fifth full growing season after seeding and when:

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

Because many of the reclaimed areas are 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 for bond release (The reclamation bond is discussed under Financial Assurance in **Section 2.1.5**). 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 BLM and WDEQ-LQD for review and approval at least six months prior to the fifth full growing season. The sampling results from the evaluation of the reclamation success would be reviewed and approved by BLM and WDEQ-LQD prior to approval of bond release for surface reclamation.

4.8.3 Impact Significance Criteria

Revegetation success after short-term disturbances, e.g., pipeline installation, would be evaluated to determine effectiveness in stabilizing topsoil and minimizing erosion. Revegetation success after Final Reclamation would be evaluated in accordance with BLM and WDEQ-LQD criteria discussed in **Section 2.1.5.2 and 4.8.2**. These criteria are in accordance with the Rawlins RMP

Management Goals for Vegetation, which are to manage vegetation such that the region maintains a diverse and healthy community of plants that continue to support and promote ecosystem functions. Additionally, the control of weeds or invasive plants would support these management goals.

4.8.4 Vegetation Impacts from the Proposed Action

During the life of the Project, a total of approximately 345 acres of the land surface and associated vegetation could potentially be disturbed, which is about eight percent of the 4,254-acre Permit Area. The disturbance is progressive, i.e., it does not all occur during Initial Construction. The disturbance associated with each of the Project facilities is listed in **Table 4.5-1**, and is differentiated by vegetation type. Most of the disturbance follows the ore trend, which extends east-west through the Permit Area (**Figure 2.1-1**), and is in the West Battle Springs Draw drainage (**Figure 3.5-1**), which drains most of the Permit Area. The disturbance is not concentrated in any one of the three grazing allotments (**Figure 3.1-2**). The acreage that would be disturbed in each vegetation community has been estimated, and the actual disturbance would be evaluated against that estimate to ensure it is not substantially exceeded.

Some of the surface disturbance would be long-term, where topsoil and vegetation would be removed for the life of the Project, e.g., under the Plant. These areas would only be reseeded during Final Reclamation, after the facilities are removed and topsoil replaced. Other surface disturbance is considered short-term, e.g., pipeline installation, where vegetation and topsoil would be removed, but topsoil would be replaced shortly after the disturbance. These areas would be reseeded after topsoil replacement to reestablish vegetation for erosion and weed control (**Section 4.8.1**). However, in the following estimates of the affected acres of vegetation, all of the disturbance is assumed to be long-term, i.e., no 'credit' is taken in the acreage estimates for interim reseeding with either the temporary or permanent seed mix. This was done because the success of vegetation reestablishment, after reclamation is completed in any area, cannot be evaluated in accordance with WDEQ-LQD criteria before the fifth full growing season after seeding.

Other vegetation disturbance is due to crushing of the plants by equipment, e.g., as drill rigs drive through the pattern areas. Although the roots may remain intact in these areas, making vegetation regrowth easier, these areas are included in the disturbance estimates.

Vegetation in the Permit Area could also be impacted by changes in the proportions of the species present. Of particular concern is the introduction of weeds. Based on the use of effective protection measures (**Section 4.8.1**), no specific acreage estimate was assigned to this impact. The effectiveness of reseeding, with either the temporary or permanent seed mix (**Section 4.8.1**), could be impacted by grazing or drought.

Spills of fuels, lubricants and other chemicals used during Construction could also have an impact on vegetation, if not remediated quickly. Because these impacts would be tied to the impacts on soil and because soil conditions would affect the ability for vegetation to reestablish itself after such an impact, the discussion of these impacts and associated monitoring and mitigation are discussed under Soil Impacts (**Section 4.5**).

4.8.4.1 Construction

The Construction phase includes Initial Construction and the progressive Mine Unit Development. Initial Construction would require about seven months. Most of the disturbance during Initial Construction would be long-term, i.e., lasting for the duration of the Project, because it would include vegetation removal from the areas on which Project facilities would be built. For the purpose of determining the acres of vegetation disturbance during Initial Construction, the 'life-of-Project' facilities are listed below and in **Table 4.5-1**:

- the Plant and related facilities (e.g., the Storage Ponds);
- staging areas (even though two of them may not be needed);
- deep wells and associated pipelines (The deep well in the southwest corner of the Permit Area was installed in 2008 to obtain the necessary subsurface information on the feasibility of this disposal option. The disturbance associated with that well is still included in this estimate. Not all of the deep wells may be needed and not all of them would be installed initially.);
- the trunkline (which would actually be constructed in stages as the mine units are brought on-line); and
- access road improvements.

The area of vegetation disturbance (primarily vegetation removal) during Initial Construction is about 95 acres (rounded to closest 5 acres). Approximately 80 percent of this disturbance is in the Upland Big Sagebrush Shrubland, with the rest, about 20 percent, in the Lowland Big Sagebrush Shrubland.

During Mine Unit Development, most of the surface disturbance would result from activities related to drilling of injection, production and monitor wells and construction of pipelines, header houses and necessary access roads. During Mine Unit Development, the impacts would be similar to those during Initial Construction, but the facilities being constructed would be smaller, e.g., header houses, and the facilities would be in place for the life of the mine unit, but not the life of the Project. For the purpose of determining the acres of vegetation disturbance during Mine Unit Development, the mine unit facilities are listed below and in **Table 4.5-1**:

- pipelines outside the pattern areas;
- drill pads outside the pattern areas (This includes exploration holes and the monitor well rings. The MU1 monitor wells were installed in 2006 to 2008 to obtain the necessary subsurface information for permitting the Project. The surface disturbance associated with those wells is still included in this estimate.);
- secondary and two-track roads to and within the mine units; and
- pattern areas.

The area of vegetation disturbance (primarily vegetation crushing in the pattern areas) during Mine Unit Development is on the order of 240 acres. All but about 85 percent of this disturbance is in the Upland Big Sagebrush Shrubland, with the rest, about 15 percent, in the Lowland Big Sagebrush Shrubland. Based on the Project schedule presented in **Figure 2.1-8**, about 50 acres of disturbance would occur during the development of MU1, which would be at about the same time as the Initial Construction of the life-of-Project facilities. Approximately another 95 acres of disturbance would occur about two years later, during development of Mine Unit 2; and another 95 acres two years after that for Mine Unit 3.

Based on available information, an additional 15 acres would be disturbed for Mine Unit Development in the KM Horizon because the underlying KM Horizon ore body footprint is similar to the HJ Horizon. Therefore, the total disturbance area is 345 acres (330 acres for the Initial Construction and Mine Unit Development in the HJ Horizon and 15 acres for Mine Unit Development in the KM Horizon). A more detailed assessment of the surface disturbance related to development of the KM Horizon would be available when LCI submits a permit revision to WDEQ-LQD.

Section 4.6 of the NRC SEIS discusses the impacts to ecological resources in the Permit area, including impacts on the vegetation in the area. While vegetation would be removed as a result of the Construction activities, the small percentage of affected area makes the overall impact small (NRC, 2011a).

4.8.4.2 Operation

During the Operation phase, there would be little, if any, new disturbance.

The NRC SEIS states in Section 4.6.1.2.1 that the impacts to vegetation during the Operation phase would be minimal since most of the land used was cleared during the Construction phase (NRC, 2011a).

4.8.4.3 Reclamation

The Reclamation phase includes the progressive Mine Unit Reclamation and the Final Reclamation. During Mine Unit Reclamation, disturbance would again

occur during some activities, e.g., when wells are abandoned and pipelines are removed from reseeded areas. However, this 're-disturbance' of the same areas, e.g., a pipeline corridor, is not counted twice in the assessment of the acres disturbed.

There should be no additional vegetation removal or crushing during Final Reclamation. Disturbance of reseeded areas, e.g., pipeline corridors, would occur during some activities. However, this 're-disturbance' of the same areas is not counted twice in the assessment of the acres disturbed. As the areas are reseeded with the permanent seed mix, there could be changes in the proportion of various species, including an increase in weeds.

Section 4.6 of the NRC SEIS discusses the impacts to ecological resources, including vegetation in the area. New damage from reclamation may result from spills or leaks during the decommissioning process, but with the mitigation measures this is not expected to be significant. However, the NRC discusses some concern that the slow reestablishment of sagebrush shrubland and the woody plant species could lead to slightly more significant impacts (NRC, 2011a).

4.8.5 Vegetation Impacts from Other Alternatives

4.8.5.1 No Action Alternative

Under the No Action Alternative, surface disturbance would be avoided and there would be no impacts to surface vegetation related to the Project. Impacts from other existing activities, such as cattle grazing, mineral exploration, recreation and hunting would continue.

4.8.5.2 Not Fencing the Pattern Areas

There would be a slight reduction in the acres of vegetation disturbance if the fences around the patterns areas were not constructed. However, the mitigation measures in the pattern areas, specifically reseeding, would be adversely impacted, as the new vegetation growth in the reseeded areas would be preferred by livestock and wild horses.

4.8.5.3 Drying Yellowcake On-Site Alternative

This alternative would have no impact on vegetation resources at the Permit Area, as the dryer would be within the Plant footprint.

4.9 Wildlife

4.9.1 Agency-Required Measures

This section describes the agency-required measures which would be included in the Proposed Action for the protection of wildlife in and near the Permit Area. All wildlife management practices were established in conjunction with the BLM, WGFD and USFWS guidelines and are designed to be consistent with regional recommendations by land and wildlife management agencies (BLM, 2008c; WGFD 2008b; and WGFD 2009). The Wildlife Protection Plan for the Project is included in Attachment OP-6 of the WDEQ-LQD Permit to Mine, and correspondence with USFWS and WGFD about these Plans is provided in Addendum OP-A6-A of that attachment (LCI, 2011b). Standard construction, erosion control, and other BMPs described in other sections of this EIS would also help to minimize wildlife impacts.

Particular attention was given to protection measures for Greater sage-grouse. The Project is located on the edge of the South Pass Greater sage-grouse Core Breeding Area (WGFD, 2008b), as shown on **Figure 3.8-5**. The measures for Greater sage-grouse were adapted from the Core Population Area Stipulations (WGFD, 2008b) and the stipulations developed by the Sage Grouse Implementation Team (Mead, 2011) to be practical in an ISR environment. The stipulations and their application are included in Table OP-A6-1 of the WDEQ-LQD Permit to Mine (LCI, 2011b). A detailed assessment of the impacts on Greater Sage-Grouse using the SGIT Stipulations is included in **Section 4.9.5.3** of this EIS.

Based on the BLM review of the agency-required measures, three BLM management actions were added (**Section 4.9.1.10**). The first measure addresses the specific dates for prohibition of disruptive activities near Greater sage-grouse leks. Based on bird behavior in the Rawlins Field Office area, the dates are slightly different than the dates in other areas in Wyoming. The second measure addresses continued consultation with agencies and incorporation of annual monitoring data through an Adaptive Management Plan. The third measure relates to new fence construction (**Section 4.9.1.2**) and addresses potential discrepancies between BLM and WDEQ-LQD fencing criteria. Fences would be constructed according to BLM standards unless modified following consultation with affected parties. All fencing would be ‘wildlife’ friendly fencing, with appropriate perching and collision deterrents, with the exception of the fencing around the Storage Ponds, which would be exclusion fencing.

4.9.1.1 Road and Right-of-Way Measures

The East and West Access Roads would be upgraded and access roads within the Permit Area would use existing two-track roads to the extent possible to help minimize new disturbance of sagebrush habitat. The roads would be upgraded or constructed following the BLM and WGFD recommendations to minimize the road width, revegetate road shoulders, and limit vehicular speeds.

All employees and contractors would be trained to recognize types of wildlife in the area, their susceptibility to disturbance or to collisions with motor vehicles, and measures that should be taken to avoid disturbance and wildlife/vehicle collisions. Speed limits within the Permit Area would be set based on the following considerations: the condition of the road, design of the road, safety factors, protection of equipment, wildlife and livestock protection, and dust protection measures. Generally, the speed limit on main roads would be 30 miles per hour and on secondary roads the speed limit would be 20 miles per hour. However, in no case would the speed limit be greater than 30 miles per hour. All employees would receive training regarding speed limits during indoctrination training. Site visitors would be advised of the Permit Area speed limits during site-specific training. Speed limit signs would be posted on the main roads with the permission of the BLM.

An additional protective measure that may be implemented in concert with the BLM would be to gate or sign existing two-track roads that are adjacent to the main access road and Plant in order to help prevent additional traffic disturbance in the area. Project personnel travel outside of primary construction and drilling areas would be minimized through education and required use of main and secondary access roads.

4.9.1.2 Fencing and Screening Measures

Mine unit pattern areas would be fenced with standard wildlife friendly fencing based on the 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 by the BLM. Access to the fenced areas would be through gates (e.g., at the Storage Ponds). Because there is the potential for gates to be inadvertently left open on occasion, pitless cattle guards or automatic gates may be installed to prevent cattle and wild horses from entering an open gate and becoming trapped in the fenced area.

All mud pits outside of fenced areas would be fenced during the drilling phase, while the pits are open.

The Plant and Storage Ponds would be fenced for the duration of the Project. The fence around the Plant would be standard wildlife friendly fencing based on the BLM Manual Handbook 1741-1, Fencing (1989). The fence around the Storage Ponds would be constructed to prevent access by terrestrial mammals and to improve safety (Type I fencing per WDEQ-LQD Guideline No. 10 [1994c]). The Storage Ponds would be monitored daily for wildlife mortality. If evidence of mortality is present, additional measures may be taken to prevent access. Additional deterrents would be consistent with agency recommendations.

Anti-perch measures on fence lines would be taken to reduce excessive predation of Greater sage-grouse.

4.9.1.3 Transmission Lines

The proposed pipelines, transmission line, and any other utilities would be placed in or adjacent to the access road right-of-way to help minimize habitat impacts where possible. To prevent the electrocution of raptors, the primary and secondary transmission lines and power poles would be built to the latest approved methods (APLIC, 2006). This would include cross-arm and transformer design. Tertiary transmission lines would be buried in order to minimize risks to raptors and large birds. In addition, to discourage roosting by raptors and corvids (and, in turn, increased predation of Greater sage-grouse), appropriate anti-perching and anti-roosting devices would be placed on power poles and cross-arms. The design would follow the BLM guidelines (Oles, 2007) or other appropriate guidelines.

4.9.1.4 Disease

To reduce the threat of mosquito-borne illnesses in wildlife, LCI would treat the two Storage Ponds with an approved insecticide to prevent mosquito hatches. Drilling mud pits would be backfilled as soon as possible after use in order to eliminate their use by mosquitoes. Equipment and materials would be stored in a manner that minimizes the accumulation of stagnant water. Used tires would be disposed of as they are generated or would be stored in a manner that prevents accumulation of water until taken off-site for disposal.

4.9.1.5 Wildfire

LCI would implement procedures to minimize the likelihood of starting a wildfire (including Hot Work Permits, Site Inspections, and Proper Storage of Waste). All field personnel would be trained in Emergency Response Procedures, including reporting of fires. ISR uranium facilities generally use plastic piping, therefore, minimal welding and cutting takes place in the field. In addition to the preventative measures described in the NRC Technical Report (e.g., Sections 5.7.1.4 and 7.6) (LCI, 2010), LCI would have a supply of fresh water from the

water supply wells (**Section 4.7.5.1**) that could be used to help with wildfire suppression, if necessary.

LCI would not use prescribed fires or weed burners to remove vegetation or to control invasive species unless prior approval is granted by the BLM and WGFD.

4.9.1.6 Potentially Harmful Materials

Several measures would be used to prevent exposure to potentially harmful materials, and should an accident occur, procedures would be in place to promptly remove/remediate any releases. All liquid chemicals and petroleum products in and around the Plant would be maintained within bermed areas sufficient to contain any potential spill. No bulk hazardous chemicals would be used in the mine units. The mining solutions would have a pH of around 8.0 and would not contain any petroleum-based chemicals or elevated levels of heavy metals that present an acute hazard to wildlife or employees.

Any wildlife mortality that could be attributed to exposure to toxic substances would be reported immediately to WDEQ-LQD (and other WDEQ divisions as necessary), the BLM, USFWS, and WGFD. The goal of such reporting would be to identify and resolve the problem as quickly as possible.

As previously discussed, the water quality in the Storage Ponds would be monitored quarterly and whenever a process change may result in a significant change in water quality. The Storage Ponds would contain produced groundwater and process waters with a near neutral pH. No petroleum-based products would be sent to the Storage Ponds. Due to implementation of fencing, deterrents, and the control of algae and plankton, the water quality in the Storage Ponds is not expected to pose a risk to birds. However, if mortalities or frequent habitation of the Storage Ponds are noted, LCI will work with WGFD to develop additional protective measures to ensure the protection of birds.

4.9.1.7 Reclamation

Reclamation would be practiced throughout the Construction and Operation phases. Disturbed surfaces would be revegetated at the next appropriate season using a temporary or permanent mix seed, depending on whether the area would be redisturbed (**Section 4.8**). LCI would continue to reclaim disturbed areas as soon as possible after exploration and ISR activities to help ensure reestablishment of habitat, as described in Section RP 4.5 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

Weed control is an important issue for Reclamation and protection of existing habitats for Greater sage-grouse and other species, and plant communities. Weed prevention measures, following the BLM guidelines and recommendations, would be implemented (BLM, 1996b and 2008c).

4.9.1.8 Reduction of Human Disturbance and Incidental Loss of Wildlife

All employees would be informed of applicable wildlife laws and penalties associated with unlawful taking and harassment of wildlife. Employees would also be trained to recognize types of wildlife in the area, understand exclusion areas and dates, and report unusual activity or sightings, accidents, and other field conditions related to wildlife. Adherence to rules and procedures established for wildlife and habitat protection, such as speed limits, traffic routes, would also be monitored to reduce disturbance and mortality.

4.9.1.9 Wildlife Closures and Timing Windows

Both Greater sage-grouse and raptors have been identified by the BLM and WGFD to have seasonal time periods where restriction of activities can be particularly effective for their protection. The wildlife exclusion periods recommended by the BLM and WGFD are presented in **Table 4.9-3**. LCI would follow exclusion periods, as applicable, by species to protect key wildlife resources in the Permit Area. During exploration drilling, the standard timing restrictions identified by the BLM would continue to be followed, unless otherwise approved by the BLM.

Table 4.9-1 Surface Activity Restrictions for the Protection of Wildlife

Species [1]	Exclusion Period		Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Sage Grouse	Occupied Leks	No surface disturbing or disruptive activities within 0.6 miles of an occupied lek. [2]												
	Core Area	Activity (production and maintenance activities exempted) will be prohibited from March 1 through July 15th outside of the 0.6 mile perimeter of an occupied lek within suitable habitat.[3]												
Raptors	Avoid disturbance within 1-mile nest buffer from March 15 to July 31. [4]													
	Avoid disturbance within 1-mile nest buffer from March 1 to July 31. [3]													
Ferruginous Hawks	No surface occupancy should occur within 1200 feet of active ferruginous hawks nests.[3]													

Notes:
(1) Includes species, observed at the site, for which timing restrictions are in place per the Rawlins BLM 2007 Draft Resource Management Plan (RMP). If additional species, listed in the RMP, are observed then BLM will be consulted to determine applicable timing and distance restrictions for those species.
(2) As taken from stipulations set forth in SGIT (2010) and Wyoming Interagency (2011) for the protection of sage grouse.
(3) As taken from stipulations set forth in the Rawlins Field Office RMP (BLM, 2008c).
(4) Spatial and seasonal buffers recommended by the USFWS for the protection of raptors (USFWS, 2010)

4.9.1.10 Greater Sage-Grouse Protection

A variety of protection measures would be implemented for Greater sage-grouse protection as required by the Governor's Executive Order for Greater sage-grouse (2011-05) (Mead, 2011). These measures include road design, traffic controls; fencing, habitat enhancement, personnel scheduling, and facility maintenance, as described in more detail below. Furthermore, a detailed discussion of how the project meets the SGIT (Mead, 2011) stipulations is included in **Section 4.9.5.3**. An Adaptive Management Plan would also be adopted, as outlined below.

As previously discussed, access roads would follow existing two-track roads to the extent possible to help minimize disturbance of habitat. Road widths would be minimized, while still conforming to the International Fire Code, as requested by county zoning. Increased traffic due to Construction and the addition of new roads could increase accidental fatal collisions with Greater sage-grouse. In an effort to mitigate strikes and comply with the Executive Order, main hauling roads would be located farther than 1.9 miles away from occupied leks. This stipulation applies to new roads; however, existing roads are exempt through the "grandfather clause". The BLM states that, "any areas already disturbed or approved in mine plans prior to the Governor's Executive Order, dated August 1, 2008, are not subject to new Greater sage-grouse stipulations, except that these mine operations may not initiate activities resulting in new surface occupancy within 0.6 miles of the perimeter of a Greater sage-grouse lek" (Mead, 2011).

Protection measures, such as reduced speed limits and watering the road, would be implemented to reduce the amount of dust generated, which would potentially affect palatability of sagebrush.

Protection measures involving fencing in order to reduce impacts to Greater sage-grouse were discussed previously in the fencing section (**Section 4.9.1.2**).

Adaptive Management

In addition to the above mentioned protection measures, per Mead (2011), the following adaptive management plan would be implemented to manage Greater sage-grouse populations within the area of impact of the Project.

Baseline data has been collected from 2007 through 2011 providing a reference to compare future population trends and habitat use. This baseline data collection protocol established both an impact zone and a control area for Greater sage-grouse for this project. The impact zone is simply defined as the area within a 4.0-mile buffer surrounding the mine project area. The area outside of a 4.0-mile buffer would not be disturbed by project activities and would be the control area. The control area contains 15 Greater sage-grouse leks which would be continued to be monitored through development and on into, and through production. Concurrently, a suite of control leks (39 total) would also be monitored during the

same time frame. Monitoring of leks would follow protocol established by the WGFD. As new leks are discovered within the impact or control areas they would be included in the analyses.

A technical advisory committee (TAC) consisting of the BLM, WGFD, the proponent, and appropriate consultant(s) would be created. The TAC would meet on an annual basis, and as called upon by the proponent, to review and discuss the annual wildlife report findings related to Greater sage-grouse. The report would include, at a minimum, the past year's lek monitoring data. Lek attendance would be summarized at impact leks and control leks on an annual basis. Trends would be determined across three-year running averages, comparing impact area leks to control area leks. If a decline is observed at impact area leks as compared to control leks (using a 3-year running average during any five-year period), the trends would be analyzed to determine statistical significance and to determine if the downward trend is likely attributable to Project activity. If so, this would indicate that an impact threshold has been reached. The TAC would discuss an appropriate protection measures to apply in an attempt to reverse or minimize the impact(s). In the event that an impact has been determined but the cause of the impact cannot be determined the TAC would discuss and implement protection measures with the assumption that the ISR project has some relation to the determined impact. It would be incumbent on the proponent to pay for a study to determine actual cause of the determined impact if the proponent wishes to avoid applying additional protection measures to the company's operations. All additional protection measures would be monitored and their effectiveness analyzed during the annual meeting. If, after a two-year period, the additional protective measures show no positive effect on the impacted leks, additional measures would be applied. This cycle would repeat until all possible protection measures have been applied or the impacted leks show a positive effect from the applied measures.

Based upon Greater sage-grouse research related to energy development, the most likely impacts would occur from human activity and disturbance. Primarily actions that are perceived by Greater sage-grouse either visually or auditorily would elicit a behavioral response from Greater sage-grouse. Thus, most disturbance issues would likely involve movement and noise. Traffic levels and speeds, traffic noise, machinery movement or noise, are examples of impact-inducing factors. Thus, protective practices would include options that can help reduce or eliminate disturbance issues. Practices to consider include; setting vehicle speed limits, traffic timing, reducing traffic, or sound reduction techniques, as well as other protective measures discussed above.

Additional Protective Measures to be Considered Based on Results from Monitoring

Based on available information, it can be conservatively anticipated that at least some Project activities within the Permit Area would negatively influence populations. Enhancement of selective habitats could be considered as an optional protective measure. Habitats to be prioritized for enhancement would be selected according to the analyses described in **Section 4.9.2.4**. Enhancement considerations would be based on patch-size and large spatial scales, in order to increase the probability of a population-level effect and would also focus on the seasonal habitat(s) most influenced by Project activities. For example, if suitable nesting habitat is most influenced, then habitat enhancements would focus on increasing grass height and cover within relatively dense sagebrush stands and maintaining that height and cover to the following nesting season as residual grass. This enhancement plan would be developed and implemented with the assistance of the BLM and WGFD rangeland specialists.

Greater sage-grouse show remarkable fidelity, especially to nesting locations, and it has been shown in a developing natural gas field that adult females would not vacate their nesting areas regardless of the level of development that occurs within those areas (Holloran, 2005). Because of this fidelity, maintaining individuals that are using habitats within the Small Greater sage-grouse Monitoring Area (**Section 4.9.2.4**) may expedite recolonization of the Permit Area following completion of Production. Therefore, personnel activities that may disturb females using habitats would be curtailed (e.g., dogs must be leashed at all times, walking into undisturbed habitats would be discouraged, and speed limits would be strictly enforced). Trash and road kill would be collected on a regular basis to minimize corvid occurrence within the Small Greater sage-grouse Monitoring Area. Whenever a nesting female is discovered, additional protective measures may be instituted, including but not limited to delaying or limiting Project activities close to the nest until the female has left the area. Protective measures would be determined on a case-by-case basis, depending on factors such as proximity and timing relative to critical Project activities. More details on the protective measures described in this section can be found in section 2.2 of Attachment OP-6 in the WDEQ-LQD Permit to Mine (LCI, 2011b).

4.9.1.11 Raptor Protection

Spatial and seasonal buffers recommended for the protection of raptors by the Rawlins Field Office RMP (BLM, 2008c) and the USFWS (2010d) would be adhered to, as previously discussed.

4.9.1.12 Wildlife Enhancements

In coordination with the BLM and WGFD, wildlife enhancements could be orchestrated in the Permit Area or nearby areas that are not proposed for Operation or disturbance. These enhancements could include placement of new raptor nest platforms, creation of new water sources, or habitat modifications/improvements to improve specific habitat conditions for Greater sage-grouse (**Section 4.9.1.10**) or other high interest species. All seeding would be completed with native species; sagebrush would be included in all seed mixes.

4.9.2 Wildlife Monitoring

Monitoring of wildlife resources in and near the Permit Area would be completed on an annual basis throughout the life of the Project. The purpose of the annual monitoring would be to document wildlife resources, population trends, and habitat conditions to help minimize adverse impacts to wildlife.

4.9.2.1 Annual Monitoring and Report

Annual wildlife monitoring would be coordinated with the Rawlins BLM Field Office and WGFD. Consultation with the BLM and WGFD would be conducted prior to completing any annual survey work. Wildlife inventory and monitoring would be completed by BLM or WGFD biologists, or a third-party contractor paid for by LCI.

An annual monitoring report would be prepared and submitted to the BLM, WGFD, and other interested parties by November 15 of each year. The report would include: survey methods, results, any trends, an assessment of protection measures implemented during the past year; recommendations for protection measures for the coming year; recommended modifications to monitoring or surveying; and any recommendations for additional species to be monitored (e.g., a newly listed species). The Annual Wildlife Monitoring Report, data and mapping would be formatted to meet WDEQ-LQD requirements. Only qualified wildlife biologists or ecologists would be employed for wildlife monitoring.

In addition to the specific annual monitoring for wildlife, LCI would document all known instances where Project activities may have impacted wildlife (such as wildlife/vehicle collisions on roads, or other mortality within the Permit Area). Any large die-offs or other evidence of possible wildlife exposure to toxic chemicals would be reported immediately to WDEQ-LQD (and other WDEQ divisions as necessary), the BLM, USFWS, and WGFD. A record of wildlife mortality would be kept at the Permit Area and included in the Annual Wildlife Monitoring Report.

Monitoring and survey methods are designed to be consistent with standard protocol used by WGFD (2007), and to also follow monitoring requirements and

recommendations from WDEQ-LQD (Wildlife Monitoring Requirements for Surface Coal Mining Operations).

Table OP-A6-6 in the WDEQ-LQD Permit to Mine (LCI, 2011b) includes the wildlife monitoring schedule, which is described in the following sections.

4.9.2.2 General Wildlife

No specific monitoring measures are proposed for most wildlife species. Any known mortality of sensitive wildlife species due to Project activities would be recorded and reported. Any large die-offs or other evidence of possible wildlife exposure to toxic chemicals would be reported immediately to the BLM, WGFD, and USFWS.

4.9.2.3 Big Game

An annual record of all big game mortality due to fence entanglements, vehicle collisions, and other factors would be completed. Winter mortalities would be estimated each spring from observations taken during wildlife surveys and other mine activities. The data to be recorded include: species, date, probable cause of mortality, and location. A table summarizing big game mortality would be submitted in the Annual Wildlife Monitoring Report.

If concentrations of pronghorn appear suddenly or if apparent migration blocks (fences, snow drifts along roads or other blocks) are observed, local WGFD personnel would be notified immediately. Any big game concentrations or migration blocks would be reported in the Annual Wildlife Monitoring Report.

4.9.2.4 Greater sage-grouse

The Greater sage-grouse monitoring protocols presented here are designed to assess the effects of Project activities on: Greater sage-grouse populations; seasonal habitat selection; and productivity within the Greater sage-grouse Monitoring Areas (**Figure 4.9-1**). **Section 4.9.1.10** discusses how the Greater sage-grouse monitoring data would be used for adaptive management. As previously noted in **Section 3.8**, the Greater sage-grouse Monitoring Areas are:

- The Small Greater sage-grouse Monitoring Area, which is delineated to conservatively establish the area where nesting and early brood-rearing females may be influenced by Project activities; and
- The Large Greater sage-grouse Monitoring Area, which is delineated to maximize the probability that control leks would be included. Control leks are considered to be leks within and/or near Core Area boundaries that are not influenced by the Project, major highways, or other anthropogenic activities, except livestock grazing and public recreation.

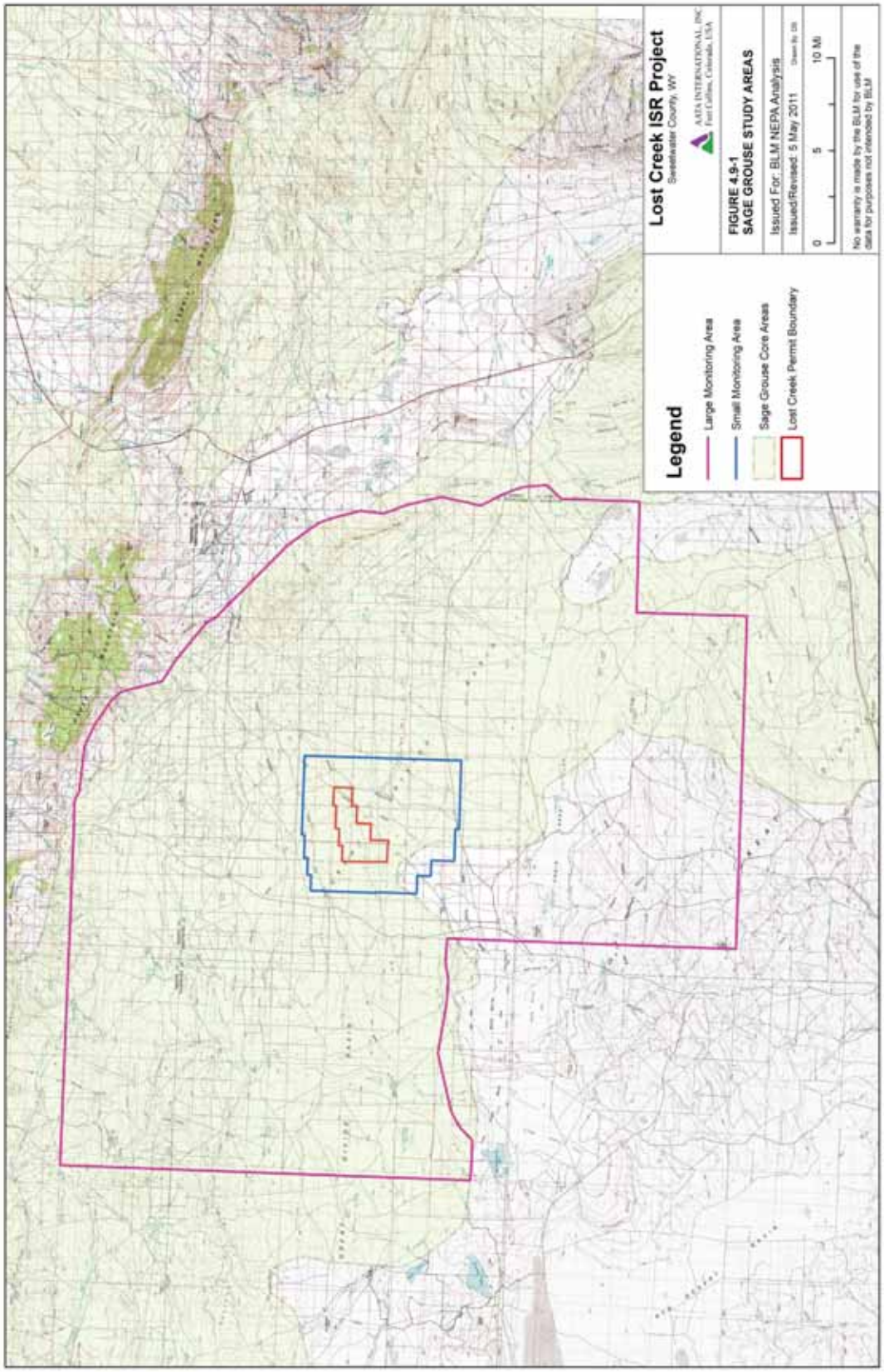
LCI would use lek search and lek count protocols to assess potential impacts of Project activities on Greater sage-grouse populations. The objective of lek counts is to track male breeding population size within the Greater sage-grouse Monitoring Areas throughout the life of the Project. The objective of lek searches is to determine if new leks become active within the Greater sage-grouse Monitoring Areas during the life of the Project.

To determine the potential effects of the Project on habitat selection, LCI would model the seasonal habitats existing within the Small Greater sage-grouse Monitoring Area. The objectives of these models are to quantify the amount of habitat functionally influenced by the Project on a seasonal basis (e.g., nesting, early brood-rearing, summering and wintering habitats).

LCI would use brood survey routes and wing surveys to assess potential Project impacts on Greater sage-grouse productivity. The objective of both surveys is to track chick productivity of females potentially influenced by Project activities throughout the life of the Project.

Greater sage-grouse surveys discussed below would follow standard protocol as recommended by the WGFD Greater sage-grouse Technical Committee and by Connelly et al. (2003).

This comprehensive Greater sage-grouse monitoring plan is designed to accomplish definitive monitoring of the effects of Project activities on Greater sage-grouse. The monitoring would lead to and guide effective protection actions. However, it is a cost intensive, long-term commitment and is timed to establish baseline conditions. Should a situation arise that prohibits or significantly delays LCI's activities (before or after regulatory approvals for the Project are issued), the commitment may be curtailed and may be limited to only the required annual lek counts within the Small Greater sage-grouse Monitoring Area. LCI would inform WGFD, the BLM, WDEQ-LQD, and NRC should this monitoring change be necessary.


Legend
Large Monitoring Area
Small Monitoring Area
Sage Grouse Core Areas
Lost Creek Permit Boundary
Lost Creek ISR Project
Sweetwater County, WY
AMTA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
FIGURE 4.9-1
SAGE GROUSE STUDY AREAS
Issued For: BLM NEPA Analysis
Issued/Revised: 5 May 2011
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No warranty is made by the BLM for use of the data for purposes not intended by BLM

Populations

Lek Counts

Lek count data would be the primary data used to assess the population-level effects of developing the Lost Creek uranium deposits. The lek monitoring methods are therefore as comprehensive as possible. The objective of lek count monitoring is to track, as inclusively as possible, male breeding populations on leks potentially influenced by Project activities concurrent with leks not influenced by such activities but similar in other aspects throughout the life of the Project.

Counts would be conducted at all known leks within the Greater sage-grouse Monitoring Areas starting with the 2010 baseline list of known leks, established from existing data (e.g., the WGFD Greater sage-grouse database) and a comprehensive lek search of the Greater sage-grouse Monitoring Areas conducted in April 2010. The list of known leks would be updated on a three-year cycle based on lek search flight results.

All known leks within the Greater sage-grouse Monitoring Areas would be counted annually. This number of leks may increase, depending on results of lek searches conducted throughout the life of the Project; however, the number would not be decreased from the 2010 baseline unless leks are established as 'unoccupied' following protocols outlined by the WGFD Greater sage-grouse Technical Committee. LCI would coordinate monitoring efforts with the BLM and WGFD to avoid duplicative efforts and, as a result, undue disturbance of the leks. The count methodology that LCI would use is outlined below.

The general lek count methodology is as follows:

- Counts would be conducted during the month following the peak of mating activity (April 1 to May 7). Research has shown that the highest number of male Greater sage-grouse is observed during this period. The increased number of males is due to young males showing up later in the strutting season even though most of the breeding has already occurred.
- Counts would be conducted from the ground as close to sunrise as possible and extended for one-half hour after sunrise. The phase of the moon may affect lek use patterns. During a full moon, Greater sage-grouse may display at night and consequently terminate activities earlier in the morning. This variation in activity may influence the choice of counting dates.
- Counts would be conducted a minimum of three times each year for each lek (at least one count every seven to ten days).
- All leks within a lek complex would be counted on the same day, with lek complexes estimated from spatial orientation of leks within the Greater sage-grouse Monitoring Areas.

- Counts would be completed on days with good weather conditions. Optimum weather conditions for counts are clear, calm days. Wind speeds should be less than 20 mph because high winds reduce lek activity. Temperature seems to have little effect on activity. Weather conditions would be recorded during each count.
- Known lek locations are sited in mid-day periods prior to completing any counts. Access routes and counting points are predetermined to allow the observer to count the lek without disturbing birds by driving or hiking. Counts are made by using binoculars and spotting scopes from observation points. Observation points for each lek would be established and noted in 2010 and each lek would be counted from these points in subsequent years.
- The location of each lek would be accurately determined and recorded using the Universal Transverse Mercator geographic coordinate system and the North American Datum 83. Observers should not disturb Greater sage-grouse to obtain lek locations. If a lek is active, the observers should make the best estimate of the lek location and return later to confirm.
- Data would be recorded on the standardized statewide reporting form.

Lek Searches

Breeding Greater sage-grouse may be displaced by some Project activities and thereby occupy other existing active leks or form new leks farther from those activities. Thus, lek searches would be required to accurately assess the population-level response of Greater sage-grouse to Project activities.

During the peak breeding period in April 2010, a systematic search for leks within the Greater sage-grouse Monitoring Areas would be conducted from the ground to ensure the baseline survey is as thorough as possible. Ground searches would be conducted from 0.5 hours prior to sunrise to 1.5 hours after sunrise. If the April full moon coincides with the peak breeding period, additional searches throughout the nights with good moonlight would be conducted. The ground at all potential leks would be searched once the birds have left the site for evidence of consistent use (e.g., fecal droppings and feathers). Ground searches for leks can be more effective than aerial searches due to the birds' reaction to aircraft (crouching), which makes the birds difficult to see and thus the leks difficult to identify, especially smaller leks. Ground searches can also be more effective as a result of focusing all locating techniques, such as listening and habitat inspection. Additionally, as Greater sage-grouse display all night during the full moon at the peak of the breeding period, night surveys can be effective at finding leks by sound.

Lek searches of the Greater sage-grouse Monitoring Areas would be conducted from fixed-wing aircraft every third year following establishment of baseline (i.e., 2013, 2016, and continuing through the Project). Searches would be conducted

during the peak of the breeding period between 0.5 hours before and 1.5 hours after sunrise. Transects (approximately 1.0 kilometer [0.6 miles] apart) would be flown along north-south lines. Flights would be limited to days with good visibility and weather. Transects would be flown from approximately 100 to 150 meters (328 to 492 feet) above ground level. Return visits from the ground to all potential new sites would be conducted to confirm a location as a lek as soon as feasible following aerial searches. If a new lek is found, it would be added to the known lek list and counted annually. Although, counting of new leks during the year of discovery would be initiated later in the breeding period (i.e., after the lek search), since maximum male attendance generally occurs after the peak of breeding due to the behavior of yearling males (thus counts should not be biased).

As noted above, aerial searches may not be as effective as ground searches; however, ensuring the data are collected in a standardized manner throughout the life of the Project is critical. Aerial searches do not require the same level of experience as a ground-based search and logistical considerations are less daunting. Therefore, aerial searches increase the likelihood that comparable data can be collected throughout the life of the Project.

In addition to determining Project-related impacts on Greater sage-grouse, lek data will also be used to assess the extent of impacts attributable to non-Project related activities such as other energy development project activities, grazing, and non-Project related traffic. Lek data will also be used to focus any potential Great sage-grouse habitat enhancements on areas used by birds, which are most impacted by the Project. Section 2.2.1.3 of attachment OP-6 in the WDEQ-LQD Permit to Mine (LCI, 2011b) describes these analyses in detail.

Habitat Selection

Non-invasive techniques for monitoring Greater sage-grouse nesting and early brood-rearing habitat selection and success are limited to radio telemetry [Spotlight capture and collaring of females during the peak of breeding appears to have negligible effect on subsequent behavior (Holloran, verbal communication, January 2010)]. However, given the potential reaction of females to Project activities, the probability of maintaining a sample of radio-equipped birds in areas affected by Project activities throughout the life of the Project may be low (deduced from Walker et al., 2007). Therefore, for the purposes of designing the monitoring program, it has been assumed that uranium extraction in the Permit Area would have an influence on nesting and early brood-rearing females similar to the influence of natural gas development.

Information from nesting female long-term reactions to natural gas development suggests that the area within one kilometer (0.6 miles) of infrastructure associated with energy development is functionally lost as nesting habitat (Holloran et al., 2010). Holloran et al. (2010) also report that Greater sage-grouse females in Wyoming rear their broods during the early brood-rearing period within 1.65

kilometers (1.0 mile) of their nest. Thus, the amount of nesting and early brood-rearing habitat that would be influenced by developing the Project would be conservatively estimated as all suitable habitats within the Permit Area and within 2.65 kilometers (1.65 miles) of the Permit Area. Additionally, Ur-E's (LCI's parent company) two-year proposed exploratory drilling plan suggests activity south and southeast of the Permit Area. In anticipation of future actions (**Section 5.1.1**) LCI would buffer this area of proposed activity by 2.65 kilometers and include this as potentially impacted habitat (i.e., as part of the Small Greater sage-grouse Monitoring Area). Given the nature of exploratory drilling, this portion of the Small Greater sage-grouse Monitoring Area may be modified to reflect on-the-ground activities that occur and differ from proposed future plans.

To establish suitable habitats within the Small Greater sage-grouse Monitoring Area, LCI began seasonal habitat selection monitoring in 2010, and continued the monitoring in 2011, using radio-equipped female Greater sage-grouse. Data from 2010 was summarized in the annual monitoring report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011), and the 2011 monitoring report is being completed. Thirty-six female Greater sage-grouse were captured in April 2010 from nine leks closely associated with the Permit Area using spotlighting and hoop-netting techniques. Each captured female was: fitted with a 19.5-gram Advanced Telemetry Systems necklace-style radio-transmitter; identified as yearling or adult (at least two years old) by shape of outermost wing primaries; and released at point of capture. An additional 11 females had been collared in 2008-09 on leks situated in the southeastern portions of the Large SG Monitoring Area for a research project being conducted through the University of Wyoming. These females were also included in the monitoring. Starting in late April, pre-nesting females were located at least twice weekly to determine nest initiation. Nesting locations of radio-equipped females were found by circling the signal source until females can be observed; nest sites were marked with a GPS to facilitate location identification following the completion of incubation. Incubating females were be monitored at least twice weekly.

Nest success (hatched or not) was assessed by visual examination of eggshell fragments after a female has left her nesting area. Conditions at unsuccessful nests were examined to determine cause of failure. Females with broods were found twice between 5 and 14 days post-hatch to determine early brood-rearing habitat selection. At 14 days post-hatch, early brood-rearing success was determined (at least one chick alive 14 days post-hatch is a successful female); the existence of chicks was assessed either through direct visual confirmation of a chick, or through the reaction of the female to the researcher. Brooding females were located at least once per week from 14 days post-hatch through August. (It was expected that late brood-rearing habitat selection would be associated with mesic sites.) Barren females (e.g., females that were unsuccessful nesters or brooders) were located at least monthly from nest or brood loss through August to determine seasonal habitats selection.

From September through March, all radio-equipped Greater sage-grouse were located from fixed wing aircraft at least bimonthly. Reference transmitters (i.e., transmitters of known location deployed pre-flight by observers) were used to determine flight location accuracy.

Seasonal habitat selection data (nest, early brood, late brood, summer, and winter) from the 2010 and 2011 monitoring will be used to generate Resource Selection Functions (RSFs) in a 'used' versus 'available' analysis. RSFs would be applied to map the suitable seasonal habitats existing within the Small Greater sage-grouse Monitoring Area. For this analysis, it would be assumed that Project activities within the Permit Area would influence the total acreage of suitable area by season that occurs within the boundaries of the Small Greater sage-grouse Monitoring Area.

Productivity

Three approaches would be used in evaluating Greater sage-grouse productivity: transects; wing barrels; and climate.

Transects

Late brood-rearing and barren female summer locations from radio-equipped birds would be used to identify areas where birds using nesting or early brood-rearing habitats closely associated with the Permit Area concentrate during the summer. Eight permanent walking transects 1000-m in length were established in each of these areas. Attachment A, Figure 2.2G shows the locations, start and stop points, dominant vegetation, and maps of these transects. Transects were surveyed twice during a one-week period in late July from sunrise to two hours after sunrise to ensure feeding times were captured in monitoring efforts. All Greater sage-grouse observed were counted and classified (adult male, adult female, young of the year). These 2010 established transects will be surveyed annually through the life of the Project. Data collected from these efforts will be compared by total grouse use by sex and numbers of chicks per female.

Wing Barrels

LCI would work with biologists from WGFD to establish wing-barrel locations to further investigate annual differences in productivity relative to Project activities. Wing barrels with signs designed to explain the reasoning for monitoring have been placed at access routes to areas where females closely associated with the Permit Area are located during nesting or early brood-rearing summer (treatment area). A comparable area in terms of available summering habitats and spatial scale would also be monitored in this fashion to act as a control. Barrels would be placed and monitored each hunting season throughout the life of the Project. Wings collected from these barrels would be compared (treatment versus control area) by the number of chicks per female in the harvest.

Climate

Seasonal weather patterns may dictate Greater sage-grouse use of traditional summering areas. In particular, brood-rearing females would remain in sagebrush upland habitats until range desiccation forces them onto more mesic sites. Seasonal weather data would be used to assist in assessing the potential effects of this behavior on productivity results.

4.9.2.5 Raptors

Annual monitoring of known raptor nests would be completed each spring between April and July to determine nest status. Nest surveys would be completed from the ground.

A ground survey of the Permit Area and surrounding one-mile radius would be completed during the first two weeks of February each year for signs of golden eagle and great-horned owl nesting and or courtship. Early courtship behavior would be documented in new nesting areas; and the BLM, USFWS, and WGFD would be consulted to determine appropriate protection measures.

Three thorough surveys for nesting raptors would be completed for the Permit Area and surrounding one-mile perimeter through the spring. One survey would be completed during March to locate great-horned owl and golden eagle nests. A second survey would be completed early in the raptor nesting season. Field surveys for potential nesting raptors within 0.5 miles of existing Project activities and those activities proposed for the coming year shall be conducted. The objective is to document early courtship behavior in potential conflict situations, because, once eggs are laid, protective options become restricted. Reporting would indicate whether nesting territory is: not occupied (inactive); occupied by one raptor (active); or occupied by a pair (active).

One survey would be completed from mid-May to mid-June to locate new raptor nests (nests that have become established since the April survey) and to check the status (activity, number of young birds) of all nests. Follow-up visits to previously identified nests would be timed to facilitate documentation of nesting activity, according to the biology of the species present and variations in breeding chronology, including: nest building; reproductive attempts and success; and fledging success. The status and productivity of the nests would be reported annually by location, nest type and characteristics, species, and number of fledged birds.

Nest surveys would be completed from the ground. Nest checks would be brief and conducted to avoid flushing incubating raptors.

The linear distance of each nest site (active and inactive) from the nearest known regular human or equipment activity would be determined each breeding season.

The presence of visual barriers (i.e., direct line of site blocked between the disturbance and the nest) would be noted. It would be determined if the activity/disturbance is unrelated or related to Project activities. This information would be shown on a raptor monitoring map in the Annual Wildlife Monitoring Report.

4.9.2.6 Migratory Birds of High Federal Interest

Nesting non-game bird surveys would be conducted in representative vegetation/habitat types within the Permit Area. These surveys would be used to document breeding MBHFI that are present in the area.

Surveys would follow techniques recommended by WDEQ-LQD (1994b). Two transects would be established in each vegetation type of the Permit Area. Transects would be 1,000 meters (0.62 miles) in length (2,000 meters [1.24 miles] per habitat type – Upland Big Sagebrush Shrubland and Lowland Big Sagebrush Shrubland).

In both vegetation types, 100-meter (328-foot) -wide belt transects would be walked. Birds (including non-game and non-MBHFI birds) observed or heard would be recorded. Transect start and stop points would be located by GPS. Transect locations would be shown on a 1:24,000-scale quadrangle map.
Surveys would be completed during the peak of the nesting season, during the first week of June. Surveys would be completed from 0.5 hours before sunrise to 9:30 AM.

4.9.2.7 Threatened and Endangered Species

Federally Listed or Candidate Species

Any observation of a federally listed (T&E) species would be recorded and promptly reported. Any mortality of a listed species would be reported to the USFWS within one day of discovery.

If new species (that are present in the Permit Area) are listed as threatened or endangered during the Operation phase, the USFWS would be consulted to develop specific protection and monitoring measures.

BLM Special Status Species

Pygmy Rabbits

Based on current wildlife inventories, Pygmy rabbits are restricted to Lowland Big Sagebrush Shrubland habitat areas within the Permit Area. Pygmy rabbits would be surveyed using techniques described by Ulmschneider (2004). Four transects would be established in Pygmy rabbit occupied lowland sagebrush

swales within the Permit Area. Lowland sagebrush occurs in narrow swales and drainages of the Permit Area. Transect length (from start and stop point) would be 0.5 miles. Transects would not be linear but would meander through the habitat area. Meandering transects would start and end at the same points each year. Data would be recorded on standard data forms using the recommended data recording methods (Ulmschneider, 2004). Annual transect tracts would be recorded and presented on a map in the Annual Wildlife Monitoring Report.

4.9.2.8 Lagomorphs

Prey abundance would also be monitored. Desert cottontail and white-tailed jackrabbit populations would be evaluated using spotlight surveys through native habitat in the Permit Area. Surveys would be completed at night as close to the full moon as possible. One survey would be completed in June and another survey would be completed in August of each year. Transects would be established along approximately 1.5 miles of road within the Permit Area. Once reclaimed/restored areas are established, transects would be established in these areas. All transect locations would be presented on a map in the Annual Wildlife Monitoring Report.

4.9.3 Impact Significance Criteria

Habitat loss or alteration, incremental habitat fragmentation, displacement of, and stresses on, wildlife, and direct and/or indirect mortalities were considered in order to assess the significance of impacts on wildlife. The availability of, and proximity to, the same or similar habitat, as well as the size of the population were also used to evaluate the significance of impacts on wildlife.

The Rawlins RMP Management Goals for wildlife focus on maintaining a functioning habitat to support and sustain native populations. The significance criteria used to address wildlife examine both the habitat availability and a healthy population size, which address the management goals of the Rawlins RMP.

4.9.4 Wildlife Impacts from the Proposed Action

A detailed discussion of the potential impacts to wildlife is provided in the following sections for each phase of the Project (**Section 4.9.5** – Construction, **Section 4.9.6** – Operation, and **Section 4.9.7** – Reclamation). Because the majority of the wildlife species in the northeast portion of the Basin rely on sagebrush habitats for survival, they would generally be impacted in similar ways. Therefore, unless a unique impact to a particular species is anticipated, the effects of the Project on all wildlife are assessed as a whole. Wildlife species which could be uniquely impacted are discussed in detail in separate subsections, including: big game; Greater sage-grouse; raptors; waterfowl and shorebirds; migratory birds of high federal interest; threatened and endangered species; and

reptiles and amphibians. The impacts from the No Action Alternative and the Other Action Alternatives are evaluated in **Section 4.9.8**. Agency-required protective measures and monitoring associated with the Proposed Action are discussed in **Sections 4.9.1** and **4.9.2**, respectively.

During the life of the Project, a total of approximately 345 acres of wildlife habitat would be disturbed, which is approximately eight percent of the 4,254-acre Permit Area. As outlined in **Section 4.8.4**, the disturbance is progressive. The two major vegetation/habitat types disturbed are the Lowland and Upland Big Sagebrush Shrublands. Of the 330 acres disturbed, approximately 85 percent would be in the Upland Big Sagebrush Shrubland and approximately 15 percent would be in the Lowland Big Sagebrush Shrubland (**Table 4.5-1**).

4.9.5 Construction

The Construction phase includes both the construction of the Plant and other life-of-mine facilities (Initial Construction) and the progressive construction of mine units during the Project (Mine Unit Development). The seven-month Initial Construction includes construction/upgrading of access roads/utility corridors, the Plant, the Storage Ponds, and the UIC Class I wells. Mine Unit Development includes exploration drilling, installation of monitoring wells, installation of the production and injection wells, and construction of the associated surface facilities. As construction of facilities is completed, surrounding areas would be reclaimed, in order to minimize long-term disturbances. During Construction, potential impacts to wildlife include habitat disturbance/loss, stress due to increased noise from traffic and construction activities, and direct mortality from increased traffic and construction activities.

4.9.5.1 General Impacts on Wildlife

During Initial Construction, approximately 95 acres (rounded to the nearest 5 acres) would be disturbed (two percent of the total Permit Area). Of the acres disturbed, approximately 80 percent corresponds to disturbance of the Upland Big Sagebrush Shrubland and approximately 20 percent correspond to disturbance of the Lowland Big Sagebrush Shrubland (**Table 4.5-1**). These 95 acres of disturbed land represent a long-term direct impact to a small percentage of the available wildlife habitat. During Initial Construction and throughout the life of the Project, approximately ten acres around the Plant would be restricted from cattle and wild horses, but not wildlife, and approximately 2 acres around the Storage Ponds would be fenced to restrict all wildlife (**Section 2.1.2.6**). Since only a small percent of the total Permit Area would be disturbed, wildlife is expected to disperse from the Permit Area ahead of sequential Construction and mining.

During Mine Unit Development, the habitat disturbance would be similar to that during Initial Construction, but the facilities being constructed would be smaller,

e.g., header houses, and the facilities would be in place for the life of the mine unit but not the life of the Project. The total area of habitat disturbance during Mine Unit Development, which would consist primarily of vegetation crushing in the pattern areas, is on the order of 240 acres. Approximately 85 percent of this disturbance is in the Upland Big Sagebrush Shrubland, with the remainder, about 15 percent, in the Lowland Big Sagebrush Shrubland. Approximately 50 acres of disturbance would occur for the first mine unit, and 95 acres for the next two mine units (**Section 4.8**). The pattern areas within these mine units would be fenced to restrict cattle and wild horses, but not wildlife, from entering (**Figure 2.1-5** and **Section 2.1.2.6**). During drilling, mud pits would be fenced if they are located outside of the fenced portion of the mine units. Inside the fenced portion of the mine units, mud pits would not be fenced, in part due to the limited time the pits are open and the level of activity around the pits while they are open. Temporary mud pits have not been the cause of significant wildlife mortality at other ISR operations. If conditions are found to differ from those at other ISR operations, more protective measures, such as temporary fencing, would be evaluated. The ISR process is iterative; new mine units are brought into production as older mine units are reclaimed. Therefore, not all disturbance would occur at once and the disturbance would be clustered.. In addition, as discussed in **Section 2.1.5.1**, disturbed areas would be reseeded as soon as possible after Construction and maintained through Operation to help minimize the duration of the disturbance.

Species displaced during Construction would relocate to adjacent, undisturbed areas and likely return to their previously occupied habitats after Construction ends and suitable habitats are reestablished. Small mammals and songbirds dependent on shrubs for food, nesting, and cover would be impacted most in areas where vegetation clearing is needed for Construction. Birds are mobile and would likely disperse into adjacent areas with an abundance of similar habitat. The Lowland Big Sagebrush Shrubland habitat has the highest diversity and density of nesting birds and small mammals in the Permit Area (LCI, 2010); less than one percent of this habitat type in the Permit Area is to be disturbed during Construction. In general, because only a small percentage of the total Permit Area would be disturbed, wildlife species are expected to disperse as Construction activities approach, minimizing the occurrence of direct mortality. However, direct mortality of smaller, less mobile species, such as passerine birds, amphibians, reptiles, and small mammals, could occur due to vehicle traffic or equipment use. Direct mortality is not expected to have a population-level effect.

Increased noise from Construction equipment could cause wildlife to relocate; however, equipment noise is expected to be indistinguishable from wind noise at the Permit Area boundary (**Section 3.11**). Therefore, noise from Construction activities would not affect wildlife receptors outside of the Permit Area and is not expected to impact receptors in many parts of the Permit Area that are further from the Construction activities.

During the Construction phase, increased heavy equipment would be transported to the Permit Area. Increased on-site traffic in the Permit Area could impact wildlife due to an increase in noise and an increased chance of direct mortality due to vehicle collisions. However, the volume of traffic associated with the Project is expected to be relatively small compared to the current traffic on nearby off-site roads. Due to the comparatively small workforce associated with the Project; and the restricted time of work hours, impacts to wildlife from increased traffic on-site and off-site would be negligible.

4.9.5.2 Big Game

The Permit Area provides Winter/Yearlong Pronghorn Range and seasonal range for elk and mule deer. Elk and mule deer have been spotted only rarely in the Permit Area; thus, impacts to these species are expected to be minimal.

Impacts to pronghorn may include loss and modification of habitat, increased mortality from increased traffic on local and regional roads, increased disturbances due to human presence, and increased poaching and/or harvest from improved access on newly constructed roads. At most, about eight percent of pronghorn habitat (Lowland and Upland Big Sagebrush Shrublands) in the Permit area would be disturbed during the Construction phase. However much of this disturbance would be short-term as the individual mine unit areas are reclaimed. Pronghorn have been shown to become habituated to increased traffic volumes and heavy equipment if the traffic and equipment move in a predictable way (Reeve, 1984). Construction activities and unpredictable traffic flows; however, may cause pronghorn to disperse from the area. Pronghorn displacement of up to 0.6 miles has been observed from construction activities (Easterly et al., 1991). There is, however, adequate Winter/Yearlong Pronghorn Range habitat surrounding the Permit Area to accommodate this displacement and pronghorn may possibly return to the Permit Area once Construction activities have concluded. Impacts to pronghorn are expected to be minimal because the species is highly mobile and impacts are not expected to threaten the continued existence of the species' population in the Permit Area and surrounding habitat.

Section 4.6.1.1.1.2 of the NRC SEIS discusses the Project impacts to wildlife. Since no crucial habitats for big game animals are affected by the construction and big game animals are mobile and can move to areas away from the Project, impacts on big game animals are expected to be minimal (NRC, 2011a).

4.9.5.3 Greater Sage-Grouse

Impacts to Greater sage-grouse during Construction would include loss and/or modification of habitat from facility construction, fencing and increased disturbances due to human presence. The Greater sage-grouse leks found in the study area (**Section 3.8.3.2**) are located in the Upland Big Sagebrush Shrubland community in areas with cushion plants, blowouts and bare ground. Less than 10

percent of this habitat in the Permit Area would be disturbed during Construction. Potential impacts from the Project are discussed below.

The NRC SEIS, Section 4.6.1.1.1.2 discusses wildlife impacts from the project, including impacts to Greater sage-grouse. Habitat could be destroyed and human activity could disrupt normal behavior of the bird. The NRC suggests that due to the protected nature of this bird, the effects from construction could have a larger impact, but with protective measures, could be mitigated (NRC, 2011a).

The orientation of the Project facilities and existing Greater sage-grouse leks are shown on **Figure 4.9-2**. The Plant and the majority of the mine units are outside the two-mile buffers for the closest active and occupied leks, which are the Green Ridge Lek to the east and the Discover and Discover South Lek to the west. (Although the two-mile buffers are no longer applicable in Greater sage-grouse Core Areas, the buffers were recognized when baseline monitoring began in 2006 (**Section 3.8.3.2**).) The necessary support facilities were sited, in part, based on distance from existing occupied Greater sage-grouse leks. In particular, the Plant was sited between the two-mile buffers for the closest active and occupied leks. The closest lek to the permit area (Crooked Well Lek) is considered Occupied - Inactive based on data from the last several years (**Section 3.8.3.2** and Attachment D9-4 of the WDEQ-LQD Permit to Mine [LCI, 2011b]). As discussed in **section 4.9.1.10**, the Proposed Action would include adherence to the Wyoming Greater sage-grouse Implementation Team (SGIT) stipulations (Mead, 2011 and Wyoming Interagency, 2011). Potential impacts to Greater sage-grouse were assessed in accordance with these stipulations and are discussed in detail below in order of Surface Disturbance, Surface Occupancy, Seasonal Use, Transportation, Noise, Overhead Lines, Vegetation Removal and Sagebrush Treatment, and Specific Stipulations.

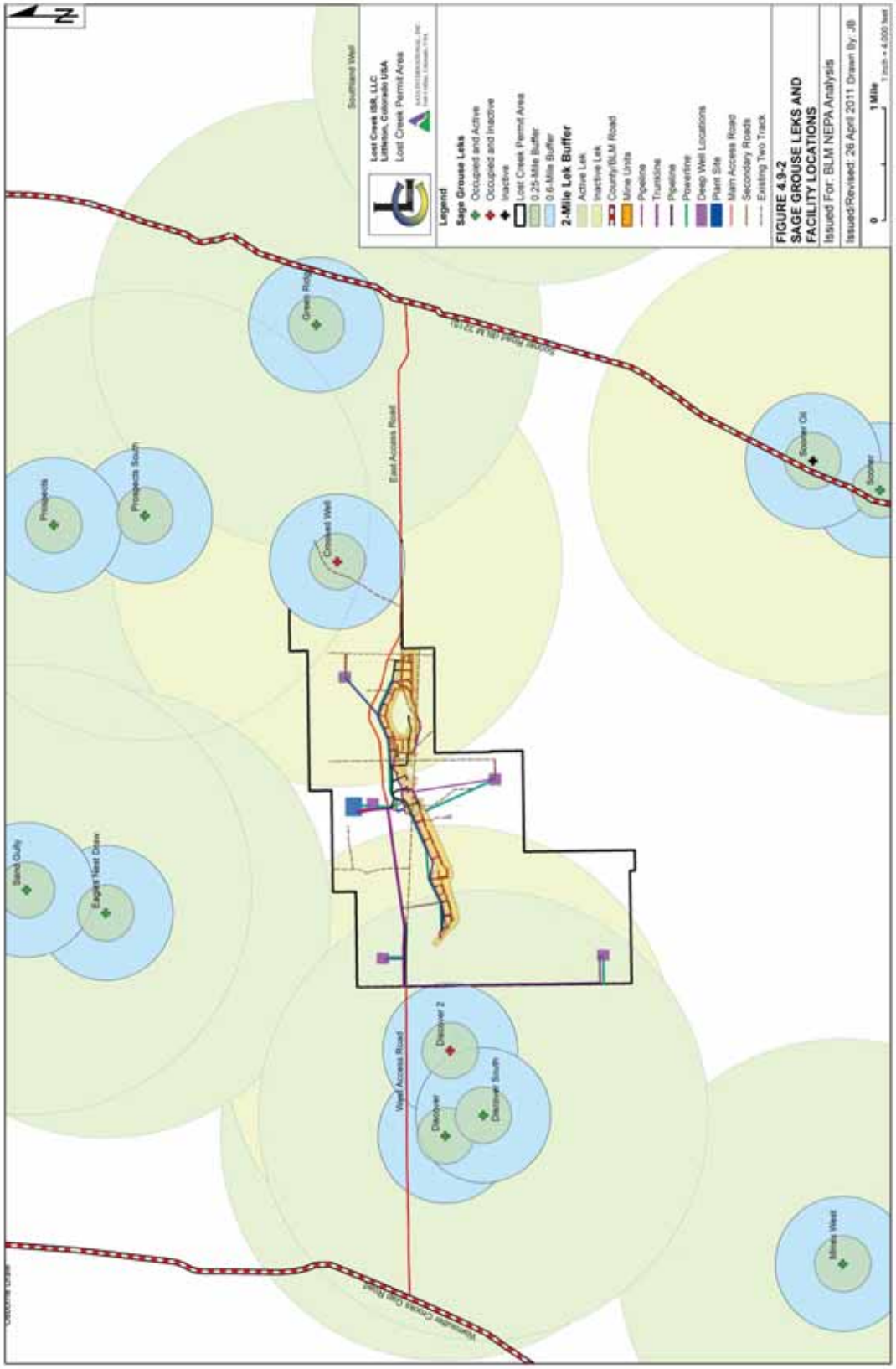
Assessment of Impacts on Greater Sage-Grouse using SGIT Stipulations

Surface Disturbance

As advised by WGFD, LCI completed the Project Impact Analysis Area (PIAA) process (now known as the Density and Disturbance Calculation Tool [DDCT]) outlined by the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011) in order to evaluate potential effects of the Project on Greater sage-grouse. Results of the PIAA/DDCT process and WGFD review are documented in **Appendix B**. The analysis was sent to WGFD for review and they commented that they approved of the way the analysis was carried out and the results indicated that the surface disturbance resulting from the Project was in line with the SGIT stipulations. In accordance with the PIAA defined methodology, a PIAA boundary was determined (total size 147,060 acres). A total of 1,341 acres (including both proposed and existing disturbance) was determined to be the Maximum Disturbance based on the Project's PIAA disturbance calculations, which includes the 330 acres of surface disturbance anticipated for the Initial

Construction and development of the HJ Horizon. Therefore, the Maximum Disturbance would equate to 0.90 percent of the defined PIAA, which is less than the SGIT maximum disturbance stipulation of five percent.

Habitat Assessment is critical to determining Maximum Disturbance. Habitat Assessment involves the collection of baseline Greater sage-grouse population data. To complete the Habitat Assessment, LCI initiated a detailed Greater sage-grouse monitoring program for the Project. During 2010, Greater sage-grouse telemetry was started along with other components of the Habitat Assessment. **Sections 3.8.3.2** and **4.9.1.1** describe the Greater sage-grouse monitoring program that commenced in 2010 and would continue during the Project. The initial monitoring results are summarized in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011). This monitoring is also being completed as part of the Monitoring/Adaptive Response component of the SGIT General Stipulations (Stipulation No. 9).


Lost Creek ISR, LLC
Littleton, Colorado USA
Lost Creek Permit Area
Legend
Sage Grouse Leks
Occupied and Active
Occupied and Inactive
Inactive
Lost Creek Permit Area
0.25-Mile Buffer
0.6-Mile Buffer
2-Mile Lek Buffer
Active Lek
Inactive Lek
County/BLM Road
Mine Units
Pipeline
Transline
Pipeline
Powerline
Deep Well Locations
Plant Site
Main Access Road
Secondary Roads
Existing Two Track
FIGURE 4.9-2
SAGE GROUSE LEKS AND
FACILITY LOCATIONS
Issued For: BLM NEPA Analysis
Issued/Revised: 26 April 2011 Drawn By: JB
0
1 Mile
Southland Well
Green Ridge
Prospects
Prospects South
Crooked Well
East Access Road
Scooter Oil
Scooter
Blind Gully
Eagles Nest Draw
West Access Road
Discover 2
Discover
Discover South
Mines West

Surface Occupancy

According to the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), there should be no surface occupancy within 0.6 miles of the perimeter of occupied Greater sage-grouse leks. One active lek (Discover) and one Occupied-Inactive lek (Discover 2) to the west of the Permit Area are within 0.6 miles of the West Access Road. The Discover South Lek is occupied, active, and just outside of the 0.6 mile buffer of the West Access Road. This road is currently a two-track road, and would be upgraded for Project use. Two active leks (Green Ridge and Sooner) to the east of the Permit Area boundary are within 0.6 miles of Sooner Road. Sooner Road is already an established road and no new surface occupancy would be associated with this road. The Green Ridge Lek is just outside the 0.6-mile buffer of the East Access Road. The Crooked Well Lek, which intersects the Permit Area boundary, is currently classified as Occupied-Inactive (**Section 3.8.3.2**). Greater sage-grouse have not been observed at this lek for many years. As seen in **Figure 4.9-2**, this lek is within 0.6 miles of the East Access Road (existing currently as a two-track road). Seasonal restrictions (described in the section below) would be adhered to if this road is upgraded.

As discussed above, three occupied leks, two Occupied-Inactive (Discover 2 Lek and Crooked Well Lek) and one occupied, active lek (Discover) are within 0.6 miles of the access roads, which would be upgraded. This surface occupancy could impact the status of Greater sage-grouse occupation of these leks. This is contrary to the stipulations set forth in the SGIT; however, the executive order does allow for exceptions to be considered on a case-by-case basis. Both BLM and WGFD staff attended a field site visit to the Permit Area. The three lek sites were visited and it was confirmed from being on site that the natural topography blocked the pre-existing two-track road from view of the leks. This visit confirmed the finding of the view shed analysis conducted by the proponents (**Appendix C**). WGFD reviewed the potential impacts to Greater sage-grouse associated with upgrading the existing two-track road and determined that upgrading the existing two-track road to provide access to the Permit Area would have less impact to the Greater sage-grouse than creating a new road outside the 0.6-mile lek buffer (WDEQ, 2011a). (Alternate routes considered for the East and West Access Roads are discussed in **Section 2.2.3.8**.)

Seasonal Use

In accordance with the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), Project activity, including initial exploration and construction, would take place only between July 1 and March 14 in areas outside of the 0.6-mile perimeter of a lek in Core Areas where breeding, nesting, and early brood-rearing habitat is present. Production and maintenance activity (Project operation) would be exempted from this timing restriction. In accordance with the Rawlins Field Office RMP (BLM, 2008c), surface disturbing and disruptive activities would

occur only between July 16 and February 28 in Core Area where breeding, nesting, and early brood rearing habitat is present.

Transportation

According to the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), main roads used to transport production and/or waste products should be located greater than 1.9 miles from the perimeter of an occupied Greater sage-grouse lek. Other roads used for access and maintenance should be greater than 0.6 miles from the perimeter of an occupied Greater sage-grouse lek. As discussed in the surface occupancy section above, Sooner Road is a preexisting, established road, as is Wamsutter-Crooks Gap Road. The East and West Access roads are existing two-track roads, which would be upgraded. Any scheduled improvements to these roads would comply with seasonal restriction guidance provided by the SGIT. Wamsutter-Crooks Gap Road and the West Access Road would be used to transport production and waste. Three occupied leks, one Occupied-Inactive (Discover 2 Lek) and two occupied, active leks (Discover Lek and Discover South Lek) are within 1.9 miles of these roads.

To assess the potential impact of the road use, topographical visual assessments and analysis of opportunity costs of habitat fragmentation due to implementation of new access roads were performed. WGFD reviewed the potential impacts to Greater sage-grouse and determined that this option would have less impact to the Greater sage-grouse than creating new roads outside the 1.9-mile lek buffer (WDEQ, 2011a). (Alternate routes considered for the East and West Access Roads are discussed in **Section 2.2.3.8**.) Furthermore, the estimate increased production transport of one 18-wheeler truck per day was not expected to have significant impacts. Impacts from roads within 0.6 miles of leks are discussed in the surface occupancy section above. Increases in traffic would occur primarily during scheduled working hours, 7 AM to 5 PM, which overlap by one hour with the primary hours of concern for breeding Greater sage-grouse (6 PM to 8 AM) (Attachment OP-6 of the WDEQ-LQD Permit to Mine [LCI, 2011b]).

Noise

Noise caused by traffic and construction-related activity also may pose an adverse impact to Greater sage-grouse. Anthropogenic noise can reduce lek attendance and cause animal displacement. According to the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), noise should be limited to 10 dBA above ambient noise measured at the perimeter of a lek from 6 PM to 8 AM during initiation of breeding (March 1 to May 15). The distance from occupied leks to areas of construction or traffic is at least 0.25 miles (1,320 feet), with the exception of Sooner Lek, which is approximately 300 feet from the existing Sooner Road. As discussed in **Section 4.12**, noise from heavy construction equipment would be indistinguishable from the ambient wind noise at a distance

of 1,000 feet. Therefore, the adverse impacts of noise on Greater sage-grouse at most leks are expected to be negligible.

Sooner Road would not be expected to undergo any additional construction or improvements; therefore any increase in noise in the vicinity of Sooner Lek would be a result of increased traffic use. It is expected that increases in traffic on Sooner Road would be primarily due to commuter traffic rather than transportation of heavy construction equipment, which would primarily use the Wamsutter-Crooks Gap Road. Therefore, the impacts to Greater sage-grouse from traffic noise were assessed using an approximate commuter traffic noise level. A summary of noise effects on wildlife populations (Federal Highway Administration, 2004) includes reference to measured average traffic noise levels at 50 feet (15 meters) of 54 to 62 dBA for passenger cars and 58 to 70 dBA for heavy trucks. Using the highest value of 70 dBA for the starting source, a calculation from Golden et al. (1979), and a distance of 300 feet., noise from heavy trucks would not exceed background noise levels (58 dBA at 200 feet). Furthermore, the bulk of increased traffic would not occur in the time frame of most concern for Greater sage-grouse (6 PM to 8 AM).

Traffic on unpaved roads also creates dust and may reduce the palatability of sagebrush plants both in and out of the Permit Area boundaries. The increased traffic adjacent to the Sooner Lek could result in lower lek attendance if dust emissions were high. Dust emissions would be less of a problem, however, during the winter (due to increased precipitation/snow cover).

Overhead Lines

According to the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), new power lines should be buried when possible. New overhead lines should be located at least 0.6 miles from the perimeter of occupied Greater sage-grouse leks and should be raptor-proofed. As shown in **Figure 4.9-2**, the power line for the Project would connect with the existing transmission line, which runs along the western boundary of the Permit Area. The new powerline would be located more than 0.6 miles from the nearest leks. Appropriate anti-perching and anti-roosting devices would be placed on power poles and cross-arms. Tertiary transmission lines within the Permit Area would be buried. In cases where transmission line burial is not an option, overhead lines would be constructed to current standards using publications such as those from the Avian Power Line Interaction Committee (APLIC, 2006). This would include cross-arm and transformer design.

Vegetation Removal and Sagebrush Treatment

In accordance with the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), vegetation removal would be minimized and all topsoil and vegetation removal would occur between July 1 and March 14 in areas within 4.0 miles of an

occupied lek. In accordance with the Rawlins Field Office RMP (BLM, 2008c) disturbance restrictions, no vegetation removal would occur within 0.25 miles of occupied Greater sage-grouse leks and would occur only between July 16 and February 28 in Core Area where breeding, nesting, and early brood rearing habitat is present. Furthermore, all requirements regarding the treatment of sagebrush would be followed.

Specific Stipulations

Specific stipulations relevant to the Project are:

- For development drilling or ore body delineation drilled on tight centers, (approximately 100 feet by 100 feet), the area of disturbance would be delineated by the external limits of the development area. Assuming a widely-spaced disturbance pattern, the actual footprint would be considered the area of disturbance.
- The number of active mining development areas (e.g., operating equipment and significant human activity) is not to exceed an average of one site per square mile (640 acres) within the PIAA/DDCT. Monitoring results would be reported annually in the Annual Wildlife Monitoring Report submitted to the BLM, NRC, WDEQ, and WGFD. Pre-disturbance surveys would be conducted as required by the appropriate regulatory agency.

The first two conditions were adequately addressed in the PIAA/DDCT assessment performed (**Appendix B**) and, as mentioned in **Section 4.9.2**, annual monitoring and reporting would continue.

Efforts have been made to meet all stipulations designed for the protection of Greater sage-grouse. In the cases of the conflicting aspects (no surface disturbance within 0.6 miles of occupied leks and no main roads used to transport production and/or waste products located within 1.9 miles of an occupied Greater sage-grouse lek), consideration on the part of WGFD supported exemption from these stipulations in the specific case of the Project, as the current road layout is anticipated to create less disturbance than if new roads meeting these stipulations were required. Therefore, though these specific aspects of the Project may impact Greater sage-grouse leks near the Permit Area, the currently proposed approach is considered to cause the least impact. Furthermore, annual monitoring and reporting would occur in order to adequately track the presence and productivity of Greater sage-grouse in the Permit Area.

4.9.5.4 Raptors

Impacts to raptors during Construction could include loss and/or modification of nesting and foraging habitat, nest abandonment and decreased reproductive

success due to human presence and Construction activities, direct mortality from collisions with infrastructure or vehicles, and reduction in prey populations.

Several species of raptors have been observed in the Permit Area including: Swainson's hawk, red-tailed hawk, northern harrier, golden eagle, kestrel, prairie falcon, turkey vulture, and ferruginous hawk. The bald eagle occurs only as a sporadic migrant and only forages on-site occasionally. The nearest known bald eagle nest to the Permit Area is more than five miles away from the Permit Area. The ferruginous hawk is the only raptor that is known to nest within the Permit Area; there are currently no active nests within the Permit Area (**Section 3.8.3.3**). Ferruginous hawks have been shown to be sensitive to human disturbance, especially during periods of courtship, nest building, incubation, and brood rearing (Collins and Reynolds, 2005). Nest abandonment and loss of eggs or fledglings could occur with human disturbance during the early nesting period. These adverse effects could occur with an increase in land-disturbing activities, such as road and building construction as well as increased traffic. As discussed in **Section 4.9.1.9**, it is recommended by the USFWS, Wyoming Ecological Services Field Office that, for the protection of raptors in general and ferruginous hawks particularly, there should be a spatial buffer of one mile around any nest, in which no temporary or permanent surface occupancy should occur. Furthermore, a seasonal activities buffer is recommended from March 15 to July 31 for ferruginous hawks. Additionally, according to the Rawlins Field Office RMP (BLM, 2008c), no surface occupancy should occur within 1,200 feet of active ferruginous hawks nests, and surface disturbance or disruptive activities are prohibited within one mile of ferruginous hawk nests from March 1 through July 31.

Based on 2010 nesting raptor surveys, only one active raptor nest (AFH25921004) was found within the one-mile buffer zone, and three active nests were just outside the one-mile buffer. Nest AFH25921004 is occupied by a pair of ferruginous hawks annually. Two of the active ferruginous hawk nests are on artificial nest platforms, and one newly inhabited nest was found on a transmission line pole/nest platform adjacent to the existing transmission line (FH24930201). Another dilapidated, inactive nest (FH25921601) was noted to be within the Permit Area; this nest has not been active within the last four years, and is nearly completely gone. An additional active ferruginous hawk nest was found during 2011 BLM field surveys. This nest is located on the western border of the Permit Area. **Figure 4.9-3** shows the status of the nests sited in 2010 in the Permit Area and in or near the one-mile buffer zone. The nest sited by the BLM in 2011 is also shown.

As is shown in **Figure 4.9-3**, the one-mile buffer around nest AFH25921004 only intersects the Permit Area boundary at the northeast corner. No construction activity is expected to occur in this area. The nest found by the BLM in 2011 is located in the path of an existing transmission line and two-track road. A UIC Class I Well located about 2,010 feet southeast of this nest was installed as a test

well in 2010. A pipeline from this well is planned to be constructed along the existing road. This surface disturbance would be in conflict with the 1,200-foot restriction for active ferruginous hawk nests. However, the location of the pipeline was chosen in order to minimize disturbance in previously undisturbed areas. The seasonal activity restriction would be met for the construction of the pipeline. A new transmission line would be constructed that connects to the pre-existing powerline running along the western boundary of the Permit Area; however, this is not near any active nests (**Figure 4.9-3**). Overhead transmission lines could impact raptors by encouraging perching and nesting on these lines. As discussed in **section 4.9.1**, appropriate anti-perching and anti-roosting devices would be placed on power poles and cross-arms to discourage roosting by raptors. Tertiary transmission lines would be buried in order to minimize risks to raptors and large birds. In cases where transmission line burial is not an option, overhead lines would be constructed to current standards using publications such as those from the APLIC (2006). This would include cross-arm and transformer design. This design would minimize potential mortality due to electrocution.

As discussed above, only approximately two percent of the Permit Area would be disturbed during Construction. Therefore, raptor prey populations are not anticipated to be affected due to the low percentage of habitat disturbance in the Permit Area and the contiguous, suitable prey habitat outside of the Permit Area.

As of the time of publication, the NRC SEIS reported that there are no active nests in the Permit area, and as a result, impacts to raptors are expected to be minimal (NRC, 2011a).

4.9.5.5 Waterfowl and Shorebirds

Just two waterfowl species (mallard, Canada goose) have been observed during bird and wildlife surveys. Waterfowl and shorebird use of the Permit Area is very limited. Wetlands, ponds, riparian zones and other potential waterfowl and waterbird habitat are almost nonexistent. No significant impacts are expected for these birds during the Construction phase.

The NRC SEIS (Section 4.6.1.1.1.2) states that due to the lack of surface water in the region, the habitat is not suitable for important functions of the few waterfowl and shorebird species found in the area. Any impact would be insignificant (NRC, 2011a).

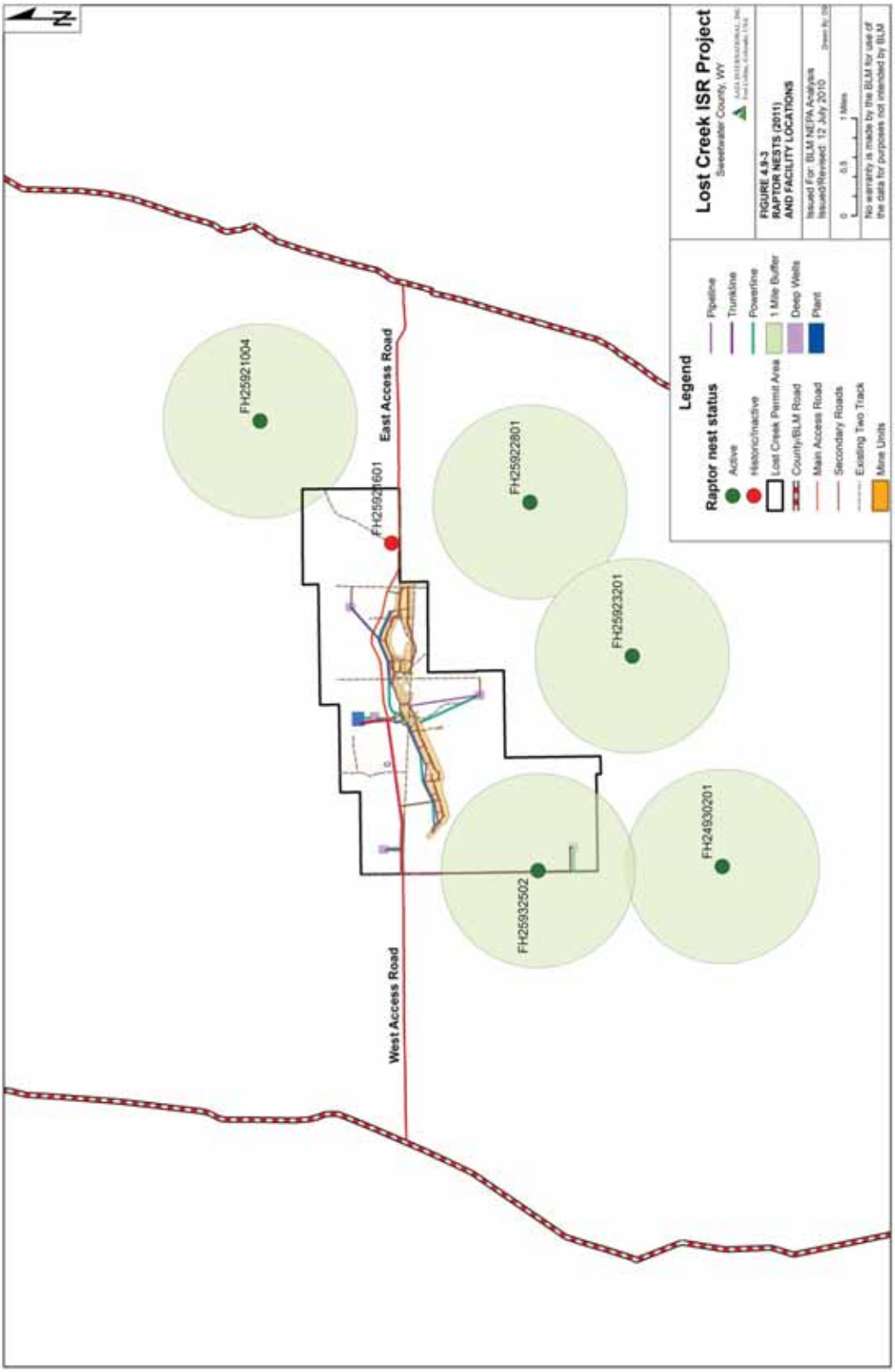
4.9.5.6 Migratory Birds of High Federal Interest

Level I MBHFI species documented in the Permit Area were the ferruginous hawk, Greater sage-grouse, Brewer's sparrow, and sage sparrow. The mountain plover and burrowing owl have been noted in adjacent areas. Level II species documented in the Permit Area include the sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow (**Section 3.8.3.6**).

Anticipated impacts to the ferruginous hawk were previously discussed in this section, as were Greater sage-grouse impacts. Potential impacts to other MBHFI species include loss of habitat, displacement due to human activities, and mortality due to vehicle collisions. The breeding Brewer's sparrow and sage sparrow were found throughout the Big Sagebrush Shrubland habitats of the Permit Area. Breeding sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow were also located within the Permit Area. Lowland Big Sagebrush Shrubland vegetation provided the greatest species diversity for MBHFI species use. Only a small portion of this habitat would be disturbed (less than one percent of the Permit Area during Construction), and where possible, Project activities would be located outside of this habitat type. Therefore, population level effects due to habitat loss for MBHFI species are not expected.

Good potential mountain plover nesting habitat is not present in the Permit Area and no mountain plover have been observed on-site during extensive field studies. Therefore, it is unlikely that mountain plovers nest within the Permit Area.

Section 4.6.1.1.1.2 of the NRC SEIS discusses the impacts to migratory birds, both direct and indirect. Direct impacts include vehicle collisions and increase human activity which may deter birds from the Permit Area. Indirect impacts include loss of habitat and displacement of birds. While these impacts may affect a few individuals, there would likely be no significant impact on entire species due to the small Project relative to the surrounding region (NRC, 2011a).


N
FH25921004
East Access Road
FH25922601
FH25922801
FH25923201
FH24930201
FH25932502
West Access Road
Legend
Raptor nest status
Active
Historic/Inactive
Lost Creek Permit Area
County/BLM Road
Main Access Road
Secondary Roads
Existing Two Track
Mine Units
Pipeline
Trunkline
Powerline
1 Mile Buffer
Deep Wells
Plant
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.9-3
RAPTOR NESTS (2011)
AND FACILITY LOCATIONS
Issued For: BLM NEPA Analysis
Issued/Revised: 12 July 2010
0
0.5
1 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM

4.9.5.7 Threatened and Endangered Species

Federally Listed or Candidate Species

No federally or state listed sensitive species, T&E species, or designated critical habitats occur in the Permit Area; therefore, no adverse impacts from Construction or any other phase of the Project are anticipated. The bald eagle (formerly listed as threatened, currently delisted) and black-footed ferret (endangered) are the only federally listed, previously listed, or candidate wildlife species that may potentially occur in the local vicinity (USFWS, 2008). The bald eagle may occur as a sporadic migrant, and may forage on-site occasionally. The nearest known bald eagle nest to the Permit Area is more than five miles away. The black-footed ferret is found in active prairie dog colonies. However, there are no active white-tailed prairie dog colonies in the Permit Area and the nearest active prairie dog colonies are one to two miles south and southwest of the Permit Area. Therefore, no impacts are anticipated to the black-footed ferret or the bald eagle.

BLM Special Status Species

Pygmy Rabbits

One species of concern that may be uniquely impacted is the Pygmy rabbit, which has a preferred habitat limited to the Lowland Big Sagebrush Shrubland (**Section 3.8.3.8**). Construction of infrastructure in Lowland Big Sagebrush Shrubland may result in a decrease in available and suitable habitat within the Permit Area. However, Project facilities and activities would be limited on Lowland Big Sagebrush Shrubland and avoided when possible (approximately one percent disturbance of this habitat type is expected to occur in the Permit Area during Construction). Limited direct mortality of Pygmy rabbits would be expected where Project activities disturb Lowland Big Sagebrush Shrubland habitats. The overall impact to Pygmy rabbit population in the area is expected to be minimal due to the relative small area of disturbance and the proposed protection measures discussed in **Section 4.9.1**.

The NRC SEIS states in Section 4.6.1.1.1.5 that a few individual Pygmy rabbits, due to their burrowing habits in and near the construction site, could be lost during the construction phase. However, since there is a large area of untouched habitat, the impacts to the species as a whole would be small (NRC, 2011a).

Wyoming Pocket Gophers

Project Construction would result in long-term direct impacts to the Wyoming pocket gophers within the Permit Area. Wyoming pocket gopher active burrow complexes were located throughout the Lost Creek Permit Area (**Section 3.8.3.8**). Burrow complexes were located within very small open and grassy pockets within

the Upland Big Sagebrush Shrubland habitat. Project Construction would result in ground and vegetation disturbances, ground compaction, and fragmentation of sagebrush habitat. At most, eight percent of vegetation within the Permit Area would be disturbed during Construction. Wyoming pocket gopher burrow complexes can be expected to disappear in the disturbed areas for the life of the Project. Because of the very similar surrounding habitat conditions, Wyoming pocket gophers are expected to exist throughout the Permit Area and outside the Permit Area; thus, a population-level effect is not expected for the surrounding areas. It is also possible that Wyoming pocket gophers would recolonize the Permit Area after Reclamation.

4.9.5.8 Reptiles and Amphibians

Reptiles observed during general surveys included the greater short-horned lizard, prairie rattlesnake, and western terrestrial garter snake. No amphibians were observed within the Permit Area. No Great Basin spadefoot toad vocalizations were heard during auditory surveys completed for this species during the spring and early summer of 2010 and 2011. This species is not thought in be present in the Permit Area (**Section 3.8.3.9**).

Potential impacts to reptiles and amphibians during construction would include habitat loss or alteration, incremental habitat fragmentation, and direct and/or indirect mortalities. Since only a small percent of the total Permit Area would be disturbed, herpetofauna are expected to disperse somewhat from the disturbed areas within the Permit Area as Construction activities approach, minimizing the occurrence of direct casualties. However, direct mortality could occur due to vehicle traffic or equipment use. These direct casualties are not expected to have a population-level effect.

4.9.6 Operation

The Operation phase includes ISR of uranium from the mine units and subsequent processing in the Plant.

4.9.6.1 General Impacts on Wildlife

The primary Operational impacts on wildlife are displacement/stress to wildlife from human activity and direct and/or indirect mortalities. There is also a potential for exposure to toxic chemicals and compounds during the Operation phase. Habitat alteration and incremental habitat fragmentation are expected to be minimal as no additional habitat disturbance would occur (**Section 4.8**).

During Operation, spills around wellheads and leaks from pipelines could expose wildlife to toxic chemicals. LCI's leak detection systems and SPCC plan to

remove affected soils and capture release fluids would reduce impacts. If spills or leaks are handled using BMPs, impacts to wildlife would be minimal.

Wildlife use of areas adjacent to ISR operations is anticipated to increase as animals become habituated to the activity. Because wildlife may be in proximity to Project buildings, roads, and mine units, some impacts to wildlife would be expected to occur from direct conflict with vehicular traffic and the presence of on-site personnel. Traffic volume during the Operation phase would likely be on the same order as for Construction; however, there would be less transport of heavy equipment and more transport of wastes and yellowcake slurry off-site (**Section 4.3**). These activities could reduce species use within the Permit Area, resulting in a concentration of species in the surrounding habitat. Increased predation and competition for forage may also occur. Noise from Operation activities is expected to be less than that generated from Construction phase activities (**Section 4.12**). Also, considering the size of the comparable surrounding habitat, these impacts would be minimal because they would affect only a few individuals and would not threaten the continued existence of any particular species in the Permit Area.

4.9.6.2 Big Game

During the Operation phase, there would be little, if any, new habitat disturbance. Increases in mortality from motor vehicle collisions are expected to remain at a minor level during Operation. Additional impacts during Operation include the potential for exposure to toxic chemicals during incidental spills, and avoidance of the Permit Area due to human activity. However, the potential for these impacts would be minimized due to protective efforts discussed in **section 4.9.1**.

The NRC SEIS states in Section 4.6.1.2.2 that the Operation would have fewer impacts than the Construction on big game in the Permit area (NRC, 2011a).

4.9.6.3 Greater Sage-Grouse

Potential impacts to Greater sage-grouse during Operation could include increased disturbances due to human presence and Operation activities and direct mortality from fencing and the Storage Ponds.

During the Operation phase, there would be little, if any, new habitat disturbance. Potential impacts to Greater sage-grouse during all phases of the Project from surface disturbance, seasonal timing, transportation, noise, and other disturbances were assessed in accordance with the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011), and were previously discussed.

Fences used to restrict cattle and wild horses from entering the mine unit pattern areas would not restrict Greater sage-grouse. Cattle may, however, be displaced to adjacent lands shared by Greater sage-grouse. Cattle graze on grasses and

forbs that provide crucial nesting and brooding habitat for the birds. An increased concentration of both Greater sage-grouse and cattle may cause adverse effects to habitat (Perry, 2010). However, considering few cattle would be displaced by the Project (**Section 4.2.4.1**) and the large amount of analogous habitat surrounding the Permit Area, the potential impact from shifts in grazing patterns is low.

Fences installed around the pattern areas of the mine units (**Section 2.1.2.6**) could pose a direct adverse effect to Greater sage-grouse because collisions have been anecdotally reported to cause injury and mortality. After the WGFD conducted a study on this matter, it was found that the highest risk fences are those that: are constructed with steel t-posts; are constructed near leks; bisect winter concentration areas; and/or border riparian areas (Christiansen, 2009). The fences would not be within a quarter mile of the leks nor would they be adjacent to riparian areas. Wintering Greater sage-grouse prefer dense sagebrush stands that extend above snow cover and provide escape and thermal cover to the birds. Locations from 30 individual radio-equipped females were documented during the winter of 2010; however, no detailed on-the-ground surveys for winter Greater sage-grouse use have been completed in the Permit Area. Based on habitat conditions, the Lowland Big Sagebrush Shrubland habitat areas likely provide important Greater sage-grouse winter habitat (Naugle et al., 2006; WGFD, 2003). As discussed in **Section 4.9.1.10,** in order to mitigate Greater sage-grouse collisions with fences, fence markers would be installed on new fence lines to increase the visibility of the lines. New fences would also be monitored for evidence of Greater sage-grouse strikes.

Fences may also be a hazard to Greater sage-grouse because they offer potential raptor perches, which may increase predation. As discussed in **Section 4.9.1.2,** anti-perch measures on fence lines would be taken to reduce excessive predation of Greater sage-grouse. Fences would be used around Storage Ponds (**Section 2.1.2.6**). If Greater sage-grouse use the ponds as a regular water source there is an exposure potential. However, the amount of freeboard, and water depth maintained for the two ponds should make it difficult for Greater sage-grouse to drink from the ponds. Hazards associated with the quality of the Storage Ponds along with protection efforts are discussed in detail below in the section discussing waterfowl and shorebird impacts. The Storage Ponds would be designed to minimize access to all wildlife, including Greater sage-grouse. The Storage Ponds would be monitored daily for wildlife mortality. If evidence of mortality is present, additional measures may be taken to prevent access.

The NRC SEIS states in Section 4.6.1.2.2 that the Operation phase could disrupt the reproductive stage of Greater sage-grouse nesting near the Project infrastructure. This could have some localized significant impacts to Greater sage-grouse, but would likely not affect the entire population in the region (NRC, 2011a).

4.9.6.4 Raptors

During the Operation phase, there would be little, if any, new habitat disturbance. Noise associated with traffic and the potential for mortalities from collisions with vehicles or overhead lines would remain potential adverse effects. As discussed in **Section 4.9.1**, overhead transmission lines would have anti-perch devices. Header houses, fences, well heads and other operational infrastructure would also employ anti-perch technology to minimize damage to facilities and ensure the health and safety of the raptors.

During Operation, routine maintenance of the UIC Class I well located southeast of the nest found by the BLM in 2011 would be necessary and would require minimal traffic on the existing two-track road. This disturbance would be in conflict with the 1,200-foot restriction for active ferruginous hawk nests and may have an impact on this nest.

The NRC SEIS states in Section 4.6.1.2.2 that the Operation phase could disrupt the reproductive stage of raptors nesting near the Project infrastructure. This could have some significant impacts to raptors, but would likely not affect the entire population in the region (NRC, 2011a).

4.9.6.5 Waterfowl and Shorebirds

The only fluid-holding structures would be the Storage Ponds, which would be used during the Operation phase and are described in detail in Section OP 2.9.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b). The Storage Ponds would be fenced to prevent access by wildlife on the ground and for safety reasons (**Section 2.1.2.6**). Based on the anticipated poor quality of the water in the Storage Ponds (**Table 4.9-2**), fencing and deterrents would be used to prevent waterfowl from inhabiting the ponds and becoming exposed via ingestion. If local sagebrush endemic passerine bird species were to use the Storage Ponds as a regular water source, there would be an exposure potential. The amount of freeboard, and water depth maintained for the two Storage Ponds should make it difficult for land birds (such as Greater sage-grouse), passerine birds, and wading birds (such as herons) to drink from the Storage Ponds. An exception might be swallows, if present in the area, that drink water on the wing. Waterfowl are not expected to reside on the Storage Ponds for more than a few days. A study of waste water ponds in central Idaho noted that waterfowl resided from one to 25 days, with an average residence time at the ponds of six days (Halford et al., 1982).

As described in detail in Section OP 2.9.4 of the WDEQ-LQD Permit to Mine (LCI, 2011a), the water quality of the Storage Ponds would be checked quarterly, to ensure unanticipated changes in the water quality are detected, and whenever a process change may result in a significant change in water quality. As noted in Section OP 5.2.3.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b), the concentration of selenium would be less than or equal to 0.02 mg/L, the level at

which selenium concentrations can become detrimental to some wildlife. The location of the Storage Ponds adjacent to the Plant, and associated human activity (including daily checks of the Storage Ponds), is anticipated to reduce the attractiveness of the Storage Ponds to wildlife. Deterrents, such as flagging and predator silhouettes or decoys, would also be used. The growth of algae and plankton would be monitored, and if necessary, an herbicide approved for use in pond settings would be used to reduce or eliminate such growth, thereby reducing the potential for bioaccumulation of selenium. If the level of selenium in the Storage Ponds cannot be maintained at a level of less than or equal to 0.02 mg/L selenium, the Storage Ponds would be covered to prevent access by birds and/or the affected water would be drained. Safe limits for birds for other constituents were explored and discussed in detail in the WDEQ-LQD Permit to Mine (LCI, 2011b). Briefly, Maximum Threshold Limits (MTLs) for poultry regarding aluminum, arsenic, fluoride, manganese, selenium, and vanadium are equal or greater than the anticipated maximum concentrations for these analytes in the Storage Ponds (**Table 4.9-2**).

Table 4.9-2 Estimated Water Quality of the Storage Ponds

Analyte	Estimated Range (mg/L)	
Major Constituents	**Low**	**High**
Aluminum	ND	0.2
Ammonia as Nitrogen	ND	4
Bicarbonate as HCO_3	1,200	2,500
Calcium	50	300
Carbonate as CO_3	ND	25
Chloride	200	1,000
Magnesium	4	50
pH	7	9
Potassium	10	200
Ra-226 (pCi/L)	200	1,500
Silica	14	20
Sodium	150	2,000
Sulfate	50	500
TDS	1,600	6,500
Uranium as U_3O_8	1	15
Trace Parameters	**Low**	**High**
Arsenic	0.002	0.020
Barium	ND	ND
Boron	ND	ND
Cadmium	ND	ND
Chromium	ND	ND
Copper	ND	ND
Fluoride	0.2	0.5
Lead	ND	ND
Manganese	0.04	0.5
Mercury	ND	ND
Molybdenum	ND	ND
Nickel	ND	ND
Selenium	0.01	0.2
Vanadium	ND	0.01

4.9.6.6 Migratory Birds of High Federal Interest

As discussed before, the Lowland Big Sagebrush Shrubland vegetation was found to provide the greatest species diversity for MBHFI species use. During the Operation phase, there would be little, if any, new habitat disturbance. Migratory birds and other wildlife could be affected by exposure to constituents in Storage Ponds, but perimeter fencing and netting would limit impacts. Therefore, population level effects due to habitat loss or increased competition are not expected for MBHFI species.

The NRC SEIS discusses that migratory birds could be exposed to toxic chemical in the storage ponds. However, the protection measure put in place would limit their interaction with this water and result is minimal impacts (NRC, 2011a).

4.9.6.7 Threatened and Endangered Species

Federally Listed or Candidate Species

No federally or state listed sensitive species, T&E species, or designated critical habitats occur within the Permit Area; therefore, no adverse impacts from Operation or any other phase of the Project are anticipated.

The NRC SEIS also makes this comment that the lack of these species eliminates the potential impacts (NRC, 2011a).

BLM Special Status Species

Pygmy Rabbits

During the Operation phase, there would be little, if any, new habitat disturbance. The overall impact to Pygmy rabbit populations in the area is expected to be minimal due to the limited number of individuals affected, the relatively small area of disturbance, and the proposed protection measures.

Wyoming Pocket Gophers

Impacts to Wyoming pocket gophers would be smaller during the Operation phase to those in the Construction phase. During the Operation phase, there would be little, if any, new habitat disturbance. Ongoing activities during the Operation phase would continue to make site conditions unfavorable for recolonization of Wyoming pocket gophers. However, undisturbed areas in the Permit Area and areas outside the Permit Area with similar habitat type may still support Wyoming pocket gophers; therefore, a population-level effect is not predicted.

4.9.6.8 Reptiles and Amphibians

During the Operation phase, there would be little, if any, new habitat disturbance. The overall impact to reptile and amphibian populations in the area is expected to be minimal due to the relatively small area of disturbance and the proposed protection measures described in **Section 4.9.1**.

4.9.7 Reclamation

4.9.7.1 General Impacts on Wildlife

Reclamation includes the progressive Mine Unit Reclamation and Final Reclamation stage. During Mine Unit Reclamation, additional disturbance would occur during some activities, e.g., when wells are abandoned and pipelines are removed from reseeded areas. However, this 're-disturbance' of the same areas, e.g., a pipeline corridor, is not counted twice in the assessment of the acres disturbed.

There should be no additional habitat acreage disturbance during Reclamation. Short-term land disturbance would occur during decommissioning of supporting facilities and roads, as soils are excavated, buried piping is recovered and removed, and structures are demolished and removed. Revegetation would restore habitat previously altered during Construction and Operation. After removal of structures such as the Plant and Storage Ponds, the surface would be regraded and topsoil replaced. Disturbed areas would be seeded with native vegetation once the buildings are removed. No loss of additional vegetative communities is expected beyond those previously disturbed during Construction and Operation. The removal of piping would impact vegetation that has reestablished itself, although this, too, would be temporary once the disturbed soil is reseeded. Wildlife habituated to the Operation would be temporarily displaced, but are expected to return after Reclamation is completed and vegetation and habitat are reestablished. As the areas are reseeded with the permanent seed mix, there could be changes in the proportion of various species, including an increase in weeds. This alteration of habitat could potentially affect habitat desirability. However, actions would be taken to mitigate weed invasion (**Section 4.8.1**). Overall, impacts would be considerably less for this phase than for Construction and Operation.

Contamination of soils could result from leaks and spills during Reclamation. However, detection and response techniques, and eventual survey and treatment (if necessary) of all impacted soils and sediments, would limit the magnitude of overall impacts to terrestrial wildlife.

Similar to construction activities, reclamation activities are expected to create added noise and traffic (in comparison with Operation) as buildings are taken down and hauled away. During this time, wildlife could come in conflict with heavy equipment, or may move elsewhere on the property to avoid higher-than-normal noise. However, these impacts would be short-term in nature.

4.9.7.2 Big Game

No impacts are expected for mule deer and elk. No additional impacts are expected for pronghorn from Reclamation. Furthermore, detrimental impacts occurring in past phases would be further minimized as recovered land is vegetated to pre-construction conditions. The fences would be removed after ISR operations are complete and vegetation has become reestablished in accordance with permit requirements (Section RP 4.5.4 of the WDEQ-LQD Permit to Mine [LCI, 2011a]) unless otherwise approved and agreed upon with the landowner (BLM). Increases in mortality from motor vehicle collisions due to increases in traffic are expected to remain at a minor level during Reclamation. Additional impacts during Reclamation are the potential for exposure to toxic chemicals during incidental spills, and avoidance due to human activity. However, protection efforts discussed in **Section 4.9.1** would minimize risks.

The NRC SEIS states the impacts to big game species during the Reclamation phase would be similar to the impacts suggested in the Construction phase (NRC, 2011a).

4.9.7.3 Greater sage-grouse

Short-term impacts to Greater sage-grouse from noise and disturbance during the influx in activity from the removal of infrastructure during Reclamation are possible. A potential indirect impact from Reclamation is the stripping of topsoil and vegetation, which could allow noxious weeds to seed before native grasses and sagebrush. Therefore, weed control is an important issue for Reclamation and protection of existing habitats for Greater sage-grouse. As discussed in **Section 4.8.1**, BLM-approved weed prevention measures, such as prompt reseeding with native vegetation, cleaning of equipment, and minimizing soil disturbance, would be implemented.

The NRC SEIS reports that Greater sage-grouse impacts during Reclamation phase could be significant in the short-term. After reseeding and restoring the land to a functioning ecosystem, the impacts would be significantly reduced (NRC, 2011a).

4.9.7.4 Raptors

No additional acres would be disturbed during reclamation for the removal and decommissioning of Project infrastructure beyond those impacted in Operation and Construction. If the BLM and other land owners were to agree to retain any upgraded roads associated with the Project after Reclamation, there may be potential long-term impacts to raptors from the road and associated traffic.

However, all other Project related facilities would be removed and the preexisting state of the landscape would be, at a minimum, restored and likely enhanced; therefore, adverse effects to raptors during the Reclamation phase are expected to be negligible.

The NRC SEIS states the impacts to raptors during the Reclamation phase would be similar to the impacts identified for the Construction phase (NRC, 2011a).

4.9.7.5 Waterfowl and Shorebirds

No further impacts to this group are expected during Reclamation.

4.9.7.6 Migratory Birds of High Federal Interest

Impacts to MBHFI species are expected to be similar in the Reclamation phase as in the Construction phase. However, effects would be minimized as recovered land is vegetated to pre-construction conditions.

4.9.7.7 Threatened and Endangered Species

Federally Listed or Candidate Species

No federally or state listed sensitive species, endangered or threatened species, or designated critical habitats occur within the Permit Area; therefore, no adverse impacts from Reclamation or any other phase of the Project are anticipated.

The NRC SEIS also states that the lack of these species eliminates the potential impacts (NRC, 2011a).

BLM Special Status Species

Pygmy Rabbits

Impacts to Pygmy rabbits during Reclamation would be short-term habitat disturbance, which would occur as structures are demolished and removed and the ground surface is recontoured. Upon completion of decommissioning, revegetation, and recontouring, habitat would be reestablished.

Wyoming Pocket Gophers

Impacts would be limited during Reclamation. Based on surrounding habitat conditions, and the fact that Wyoming pocket gophers were captured throughout the areas that would be disturbed during Construction and Operation, it is expected that Wyoming pocket gophers are present in appropriate habitats within the larger Permit Area, and also surrounding areas. Re-colonization from

surrounding, undisturbed areas may occur if habitat conditions following the Reclamation phase provide adequate soil and vegetation conditions. Loss of the Wyoming pocket gopher population within the disturbed area would not impact local populations and would not cause a trend towards Federal listing of the species.

4.9.7.8 Reptiles and Amphibians

Impacts to reptiles and amphibians are expected to be similar in the Reclamation phase as in the Construction phase. However, effects would be minimized as land is vegetated to pre-construction conditions.

4.9.8 Wildlife Impacts from Other Alternatives

4.9.8.1 No Action Alternative

Under the No Action Alternative, there would be no ISR facility construction associated with the Project, and therefore no habitat disturbance associated with Construction, Operation, and Reclamation would occur. The area would continue to provide vegetation communities and wildlife habitat typical of the region. Land would continue to be used for rangeland and grazing leases would continue. Impacts from other existing activities, such as cattle grazing, mineral exploration, recreation and hunting would continue.

4.9.8.2 Not Fencing the Pattern Areas

There would be a slight reduction in the acres of vegetation and habitat disturbance if the fences around the patterns areas are not constructed. However, the protection measures in the pattern areas, specifically reseeding, would be adversely impacted as the new vegetation growth in the reseeded areas would be preferred by livestock and wild horses. Also, collisions of wildlife with fences and increased predation due to perching on fences would not occur.

4.9.8.3 Drying Yellowcake On-site

This alternative would have minimal additional impacts on habitat resources at the Permit Area, as the dryer would be within the Plant. Since a vacuum dryer would be installed, impacts to wildlife in the Permit Area from toxic emissions would not be expected. There would be an added potential for harmful leaks to occur; however, this potential would be mitigated through proper operational precautions and risk management.

4.10 Wild Horses

4.10.1 Agency-Required Measures

The management practices for wildlife (**Section 4.9**) would be beneficial to wild horses as well as wildlife and are established in conjunction with the BLM, WGFD and USFWS guidelines and regional recommendations (BLM, 2008b; WGFD 2008c; and WGFD 2009). In addition to the measures discussed in **Section 4.9**, the BLM would require installation of pitless cattle guards under the gates to the mine units. The purpose of these cattle guards is to deter wild horses from entering a mine unit should the gate to that mine unit be left open inadvertently. Alternately, an automatic closure would be put on the gate.

The management practices would also help minimize impacts to plant communities and associated forage and habitat. Standard construction, erosion control, and other agency-required measures described in other sections would also help to minimize impacts to wild horses.

4.10.2 Monitoring of Wild Horse Impacts

An annual record of all wild horse mortality due to fence entanglements, vehicle collisions, and other factors would be completed to help minimize adverse impacts to wild horses.

4.10.3 Impact Significance Criteria

Habitat loss or alteration, incremental habitat fragmentation, displacement of, and stresses on, wild horses, and direct or indirect mortalities were considered in order to assess the significance of impacts on wild horses. The availability of adjacent habitat and the size of the horse population were also considered.

These criteria are in accordance with the Rawlins RMP Management Goals, which aim to protect the health and viability of herds while retaining the free-roaming nature of wild horses.

4.10.4 Impacts from the Proposed Action

Wild horses rely on the same available habitats for survival as wildlife big game; as a result, direct habitat impacts would generally be similar to Project impacts to big game in the region (**Section 4.9**).

4.10.4.1 Construction

The Construction phase includes the Initial Construction and progressive Mine Unit Development. Initial Construction would require about one year. Most of the disturbance during Initial Construction would be long-term, i.e., lasting for the duration of the Project, because it would include vegetation removal from the areas on which Project facilities would be built. During Mine Unit Development, the impacts would be similar to those during Initial Construction, but the facilities being constructed would be smaller, e.g., header houses, and the facilities would be in place for the life of the mine unit, but not the life of the Project. **Section 4.8.2.1** includes a more detailed discussion.

During the Construction phase, potential impacts to wild horses include loss and/or modification of habitat, increased disturbances due to human presence, and direct mortality (from vehicle collisions, entanglement in new fences or cattle guards, or getting stuck in trenches).

During Initial Construction, approximately 95 acres (rounded to closest 5 acres) would be disturbed (two percent of the total Permit Area). Approximately 80 percent of this disturbance is in the Upland Big Sagebrush Shrubland, with the rest, about 20 percent, in the Lowland Big Sagebrush Shrubland (**Table 4.5-1**).

These 95 acres of disturbed land represent a long-term direct impact of a small percentage of available habitat within any of the HMAs (**Figure 3.9-1**). Since only a small percent of the total Permit Area would be disturbed, wild horses are expected to disperse from the Permit Area as Construction activities approach. During Initial Construction, approximately ten acres within the Permit Area would be restricted from wild horses due to fencing around the Plant (**Section 2.1.2.6**).

During Mine Unit Development, the habitat disturbance would be similar to that during Initial Construction, but the facilities being constructed would be smaller, e.g., header houses, and the facilities would be in place for the life of the mine unit, but not the life of the Project. The total area of vegetation disturbance (primarily vegetation crushing in the pattern areas) during Mine Unit Development of all mine units is on the order of 240 acres. All but about 85 percent of this disturbance is in the Upland Big Sagebrush Shrubland, with the rest, about 15 percent, in the Lowland Big Sagebrush Shrubland. Approximately 50 acres of disturbance would occur for the first mine unit, and 95 acres for the next two mine units (**Section 4.8**). The pattern areas within these mine units would be fenced to restrict wild horses from entering (**Figure 2.1-5** and **Section 2.1.2.6**). The ISR process is iterative; new mine units are brought into production as older mine units are reclaimed. Therefore, not all of the disturbance would occur at once, and the disturbance is clustered, which would help minimize disruptions to wild horses.

Increased noise from Construction equipment could cause wild horses on-site to relocate; however, the equipment noise is expected to be indistinguishable from the wind noise at the Permit Area boundary nearest to the Construction activity (**Section 3.11**). Therefore, noise from Construction activities would not affect wild horses outside of the Permit Area and is not expected to impact horses in many parts of the Permit Area that are further from the Construction activities.

Increased traffic in the Permit Area could impact wild horses due to an increase in noise and an increased chance of direct casualties due to vehicle collisions. During Construction, increased heavy equipment would be transported to the Permit Area. The volume of traffic associated with the Project is expected to be relatively small; and, due to the concentrated nature of the resource, the comparatively small workforce associated with the Project; and the restricted time of work hours, impacts to wild horses from increased traffic would be negligible. The increased traffic would create dust that may settle on vegetation, making it temporarily less palatable and creating a short-term reduction in forage available to the wild horses.

Increased human presence due to Construction may affect wild horse use of areas adjacent to the Permit Area (e.g., the stock pond south of the East Access Road). Although these indirect impacts are possible, wild horses are transitory and would likely find nearby suitable habitat free from areas of human activity and disturbance. More detrimental impacts could occur if the disturbed area included a source of water for the wild horses, but, as discussed in **Section 3.5**, the Permit Area has no standing water for nearly the entire growing season, and no wetlands were identified. Forage losses due to Construction would be mitigated via staged reclamation of disturbed areas, providing grass and forb forage within a few years of habitat disturbance. Impacts to wild horses would be minimal because these species are highly mobile, the area of disturbance is relatively small compared to adjacent similar habitats, and on-site water sources are not present. Therefore, impacts are not expected to threaten the continued existence of the wild horse population in the Permit Area and surrounding habitat.

Section 4.6 of the NRC SEIS summarizes the potential impacts to wildlife in the Permit Area and includes an analysis of wild horses. Since wild horses are mobile and only a small percentage of the land would be influenced by the Construction, Operation, and Reclamation associated with this Project, no significant impacts to the population are expected (NRC, 2011a).

4.10.4.2 Operation

The Operation phase of the Project includes the production from the mine units. During the Operation phase, there would be little, if any, new habitat disturbance.

The primary impacts of Operation on wild horses are habitat alteration and incremental habitat fragmentation, displacement/stress from human activity, and

direct and/or indirect mortalities. There is also a potential for exposure to toxic chemicals and compounds during the Operation phase.

Approximately 300 acres within the Permit Area would be fenced to keep out cattle and wild horses. While this fencing may affect the movement of horses, requiring them to travel around the fenced areas, the fencing is not expected to increase fragmentation of herds, due to the relatively small area fenced. Temporary mud pits would be fenced if they are located outside of the fenced portion of the mine units. Inside the fenced portion of the mine units, mud pits would not be fenced, in part due to the limited time the pits are open and the level of activity around the pits while they are open. Temporary mud pits (within the fenced pattern area or individually fenced if not within the pattern area) have not been the cause of significant mortality to big game at other ISR operations. (Most other ISR operations are in areas with more domestic than wild horses.) Therefore, the mud pits are not anticipated to impact wild horses.

During Operation, spills around wellheads and leaks from pipelines could expose wild horses to toxic chemicals. LCI's leak detection systems and SPCC plan to remove affected soils and capture release fluids would eliminate or reduce such impacts.

Similarly to the Construction phase, increased traffic creates dust that could land on the adjacent vegetation, reducing the quality of available forage in the short-term, and creating a higher competition for the remaining plant resources.

Wild horse use of areas adjacent to ISR operations is anticipated to increase as animals become habituated to mining activity. Because wild horses may be in proximity to Project buildings, roads, and mine units, some impacts to the horses, such as collisions with fences, would be expected to occur.

Traffic volume during the Operation phase would likely be on the same order as for Construction; however, there would be less transport of heavy equipment and more transport of wastes and yellowcake slurry off-site (**Section 4.3**). These activities could reduce wild horse use within the Permit Area, resulting in a higher concentration of animals in the surrounding habitat. Noise from Operation activities is expected to be lower than that generated during Construction activities (**Section 4.12**). Also, considering the size of the comparable surrounding habitat, impacts would are expected to be minimal because only a few bands of wild horses would be affected in each HMA. Operational impacts are not expected to threaten the continued existence of the wild horse population in the Permit Area and surrounding habitats.

Section 4.6 of the NRC SEIS summarizes the potential impacts to wildlife in the Permit area and includes an analysis of wild horses. Since wild horses are mobile and only a small percentage of the land would be influenced by the Construction,

Operation, and Reclamation associated with this Project, no significant impacts to the population are expected (NRC, 2011a).

4.10.4.3 Reclamation

There should be no additional habitat disturbance during Mine Unit or Final Reclamation. Short-term land disturbance would occur during decommissioning of supporting facilities and roads, as soils are excavated, buried piping is recovered and removed, and structures are demolished and removed. Revegetation and recontouring would restore habitat previously altered during Construction and Operation. Once the structures were removed, the area of the Plant and Storage Ponds would be regraded to pre-construction contours, and then topsoil would be reapplied and seeded with native vegetation.

No loss of additional vegetative communities is expected beyond those previously disturbed during Construction and Operation. The removal of piping would impact vegetation that has reestablished itself, although this, too, would be temporary once the disturbed soil is reseeded. Wild horses would be temporarily displaced, but are expected to return after Reclamation is completed and vegetation and habitat are reestablished. As the areas are reseeded with the permanent seed mix, there could be changes in the proportion of various species, including an increase in weeds. The presence of weeds could potentially affect habitat desirability and forage availability. However, actions would be taken to mitigate weed invasion. Wild horses are mainly grazers, increased grazing intensity could occur on newly seeded areas. Fences would be removed after ISR operation is complete and vegetation has become reestablished in accordance with permit requirements (Section RP 4.5.4 of the WDEQ-LQD Permit to Mine [LCI, 2011b]) unless otherwise approved and agreed upon with the landowners (BLM and the State of Wyoming). Overall, impacts from Reclamation would be considerably less than those associated with Construction and Operation.

Soil contamination could result from leaks and spills during Reclamation, and wild horses could then be exposed to the contaminated soils. However, detection and response techniques, and survey and treatment (if necessary) of all impacted soils, would limit the magnitude of overall impacts to wild horses.
The Reclamation activities are expected to create temporary increases in noise and traffic (in comparison with the Operation phase) as buildings are taken down and hauled away. During this time, wild horses could come in conflict with heavy equipment, or may move elsewhere on the property due to higher-than-normal noise. However, these impacts would be short-term in nature.

Section 4.6 of the NRC SEIS summarizes the potential impacts to wildlife in the Permit area and includes an analysis of wild horses. Since wild horses are mobile and only a small percentage of the land would be influenced by the Construction, Operation, and Reclamation associated with this Project, no significant impacts to the wild horse population are expected (NRC, 2011a).

4.10.5 Wild Horse Impacts from Other Alternatives

4.10.5.1 No Action Alternative

Under the No Action Alternative, there would be no ISR facility construction associated with the Project, and therefore no habitat disturbance associated with Construction, Operation, and Reclamation would occur. The area would continue to provide vegetation communities and habitat typical of the region. Land would continue to be used for rangeland available to wild horses within the HMAs. Impacts from other existing activities, such as cattle grazing, mineral exploration, recreation and hunting would continue.

4.10.5.2 Not Fencing the Pattern Areas

There would be a slight reduction in the acres of vegetation and habitat disturbance if the fences around the patterns areas are not constructed. However, the protection measures in the pattern areas, specifically reseeding, would be adversely impacted as the new vegetation growth in the reseeded areas would be preferred by livestock and wild horses. Also, without the fencing in place, collisions or entanglement of wild horses with fences would not occur. Without fencing there would be a higher likelihood of wild horse exposure to toxic substances and other operational hazards, such as collision with well heads.

4.10.5.3 Drying Yellowcake On-Site

This alternative would have minimal additional impacts on habitat resources at the Permit Area, as the dryer would be within the Plant. There would be an added potential for harmful leaks to occur; however, this potential would be mitigated through proper operational precautions and risk management.

4.11 Air Quality

4.11.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 2.10 and OP 5.1.1 of the WDEQ-LQD Permit to Mine (LCI, 2011b), the WDEQ-AQD Permit, Section 7.5 of the NRC Technical Report (LCI, 2010), Sections 2.1.1.1.6.1 and 6.4 of the NRC SEIS (NRC, 2011a), and Condition 12.8 of the NRC License (NRC, 2011b). Emissions and potential impacts from radon gas are discussed in **Section 4.17**.

LCI would use BMPs to reduce fugitive dust and emissions. These BMPs include:

- Per the Air Quality Permit issued by WDEQ-AQD (Permit CT-7896), LCI would necessarily reduce fugitive dust emissions using standard dust control measures (e.g., water or chemical dust suppressant application on roads controlled by LCI on a schedule "sufficient to control fugitive dust from vehicular traffic", reduced speed limits, encourage employee carpooling, etc.);
- Reduce maximum fugitive dust by coordinating dust-producing activities;
- Use fossil-fuel vehicles that meet applicable emission standards;
- Reclaim or revegetate disturbed areas;
- Reduce diesel particulate matter emissions using measures such as particle traps and other technological or operational methods;
- Ensure that diesel-powered construction equipment is properly tuned and maintained;
- Use ultra-low sulfur diesel fuel;
- Use newer, cleaner equipment;
- Avoid leaving equipment unnecessarily idling or operating;
- Standardize delivery procedures to minimize material loss (as well as address health and safety concerns);
- Use efficient construction and demolition practices;
- Ensure vapor control equipment (e.g., laboratory hoods) is operating correctly to both reduce emissions and protect personnel: and
- Per the Air Quality Permit issued by WDEQ-AQD (Permit # CT-7896), a scrubber would install and maintain a scrubber for used during loading of the HCl storage tank.

Many of the above BMPs address minimizing use of or burning fossil fuels more efficiently. These practices would effectively reduce GHG emissions as well.

4.11.2 Monitoring of Air Quality Impacts

Specific monitoring is not required per the provisions of the WDEQ-AQD Air Quality Permit. Dust would be the most visible component of the emissions from the Project; therefore, attention to visibility conditions would be necessary to ensure the environmental protection measures required by the permit are applied timely for best effect. Several air monitoring networks exist in the region of the Permit Area, as outlined below.

There are three State and Local Air Monitoring Sites (SLAMs) in Sweetwater County; the sites are located in Rock Springs, Moxa, and Wamsutter. The closest SLAM to the Permit Area is in Wamsutter (approximately 25 miles south-southwest of the Permit Area), which records NOx, ozone, and continuous particulate concentrations (PM_{10} tapered element oscillating microbalance (TEOM)) and houses a camera system and meteorology monitors. The Wamsutter site is upwind, as is the Rock Springs site (approximately 80 miles southwest of the Permit Area), which records $PM_{2.5}$ and PM_{10} concentrations. The site in Moxa (approximately 110 miles west-southwest of the Permit Area) has the same capabilities as the Wamsutter site and also monitors SO_2. There are no SLAMS in Carbon County, the nearest downwind county. However, there are SLAMs in Natrona County and Albany County (approximately 100 miles northeast and approximately 150 miles southeast of the Permit Area, respectively). Both of these downwind sites collect only $PM_{2.5}$ and PM_{10} concentrations. The nearest downwind site measuring gaseous emissions is in Campbell County (approximately 200 miles northeast (WDEQ, 2010b).

The purpose of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network is to establish current visibility and aerosol conditions along with characterization of broad regional trends and visibility conditions using monitoring data collected in or near Class I Areas across the United States. Wyoming has five IMPROVE locations which include: Yellowstone National Park (approximately 200 miles northwest of the Permit Area), Bridger Wilderness Area (approximately 100 miles northwest of the Permit Area), North Absaroka Wilderness Area (approximately 180 miles northwest of the Permit Area), Thunder Basin National Grasslands (approximately 200 miles northeast of the Permit Area), and Cloud Peak Wilderness Area (approximately 180 miles north of the Permit Area) (WDEQ, 2010b). There are no IMPROVE sites downwind of the Permit Area in Wyoming.

The purpose of the National Atmospheric Deposition Program (NADP) is to measure atmospheric deposition and study its effects on the environment. Deposition is measured at various sites, nationwide, through the National Trends Network (NTN). There are currently eight active NTN sites in Wyoming. The nearest NTN site to the Permit Area is in South Pass City (approximately 60 miles west-northwest of the Permit Area. The nearest upwind site is in Murphy Ridge, Utah (approximately 180 miles southwest of the Permit Area). The nearest

downwind site is in Newcastle (approximately 200 miles northeast of the Permit Area) (NADP, 2011).

Finally, there are three active Clean Air Status and Trends Network (CASTNET) sites in Wyoming: Centennial, Pinedale, and Yellowstone National Park. These sites have been designed to provide data to assess trends in air quality, atmospheric deposition, and ecological effects due to changes in air pollutant emissions. The closest site to the Permit Area is in Centennial (approximately 100 miles southeast of the Permit Area. There are no nearby upwind CASTNET sites and the closest downwind site is in Wind Cave National Park in South Dakota (approximately 200 miles northeast of the Permit Area) (EPA, 2011a).

4.11.3 Impact Significance Criteria

The airborne emissions of the Project are identifiable, and emission levels are estimated to evaluate the potential impacts on ambient air quality from the different phases of the Project, i.e., Construction, Operation, and Reclamation. Potential impacts on air quality from the Project are evaluated in consideration of the WAAQS, NAAQS, PSD, and Regional Haze Regulations. The WAAQS and NAAQS set legally enforceable upper limits for specific air pollutant concentrations. If an area meets the standards, it is considered to be in "attainment". PSD requirements provide maximum allowable increases in concentrations of pollutants for areas already in compliance with the NAAQS. PSD standards are, therefore, expressed as allowable increments in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for three pollutants: NO_2, SO_2, and PM_{10}. One set of allowable increments exists for Class II areas, which cover most of the US. A much more stringent set of allowable increments exists for Class I areas, which are specifically designated areas where the degradation of ambient air quality is severely restricted. Regional Haze Regulations were developed to maintain and improve visibility in PSD Class I areas.

The Project was also evaluated in consideration of whether it would be a major source in accordance with WDEQ regulations and whether any Hazardous Air Pollutants (HAPs) would be present. The potential impacts of those portions of the emissions that are greenhouse gases and contribute to climate change are more difficult to quantify and depend on relative comparisons to other sources. Therefore, the potential impacts of greenhouse gases and climate change from the Project as a whole are evaluated by comparing Project greenhouse gases (GHGs) emissions to statewide emissions.

4.11.4 Air Quality Impacts from the Proposed Action

The Project is expected to be a source of airborne emissions throughout the life of the Project. Emissions would include:

- fugitive dust;
- combustion engine exhausts;
- particulates and gaseous emissions from materials used in Project activities, such as drilling (e.g., drilling mud) and ore processing (e.g., salt); and
- radon gas.

The significance of the impacts of fugitive dust, engine exhausts, particulates, and other gaseous emissions on the ambient air quality from the Project depends on the emission levels of the Proposed Action, the existing air quality in the region of influence, and the threshold to separate significant from non-significant effects. This section discusses predicted emissions from each phase of the Project in relation to relevant air quality regulations and potential impacts with consideration of site-specific conditions. Emissions and potential impacts from radon gas are discussed in **Section 4.17**. The only potential non-radiological HAP emission is hydrogen chloride, which is used for ore processing in the Plant and is discussed in **Section 4.11.4.2**.

PSD applies to new major sources or major modifications at existing sources for pollutants when the area the source is located is in attainment or unclassifiable with the NAAQS. The Permit Area and surrounding land is classified as in attainment for NAAQS and WAAQS, and does not include any PSD Class I or Sensitive Class II areas. The nearest PSD Class I areas, Bridger Wilderness, Fitzpatrick Wilderness, and Mt Zirkel (WDEQ, 2011b), are located about 60, 100, and 90 miles, respectively, to the northwest and south (Mt. Zirkel) of the Lost Creek site. The Popo Agie Wilderness area is the closest Sensitive Class II area and is located about 58 miles to the northwest of the Lost Creek site (NRC, 2011a).

WDEQ-AQD issued an air quality permit for the Project on January 4, 2010. The Project is not considered a “major source” as defined in Chapter 6, Section 3 of the Wyoming Air Quality Standards and Regulations (WDEQ, 2010a). Therefore, air quality modeling is not necessary. Air emissions from the proposed Lost Creek ISR Project would comply with the conditions of the WDEQ-approved construction air permit and the required WDEQ minor source operating permit. Due to the wind and relative instability of the air, emissions would generally be quickly dispersed (**Section 3.10**). As such, it is not expected that the predicted Project emissions would impact attainment for ambient air quality standards in the region surrounding the Permit Area. Furthermore, emissions are not expected to impact air quality in the Class I or Class II areas in the vicinity of the proposed Lost Creek ISR Project, as the areas are located at least 50 miles from the Permit Area and are upwind the majority of the time (**Figure 3.10-4**).

4.11.4.1 Construction

Air quality impacts during Initial Construction would come primarily from ground-clearing activities and transportation of materials and personnel. The primary emissions would be dust and emissions from combustion engines, which would power equipment ranging from light trucks to heavy equipment. Emissions other than dust or engine exhausts would be minimal.

Mine Unit Development is included under construction, although the development of the mine units is progressive (one mine unit may be under development while another mine unit is in operation). During Mine Unit Development, there would be some air quality impacts from emissions and dirt-moving activities during header house and pipeline installation. However, the quantity of dust from these activities would be a small fraction of that from road traffic.

According to Section 4.7.1.1 of the NRC SEIS, potential impacts to air quality in the region during Construction result from fugitive dust and combustion emissions from the vehicles and equipment used. It is believed that all of these emissions would not result in concentrations above the air quality standards, and that the only potentially significant impact would be the visual impact the fugitive dust emissions could have (NRC, 2011a).

Dust

Localized, short-term and intermittent visible dust would be possible in the immediate vicinity of the Permit Area (i.e., when vehicles travel on unpaved roads). These impacts would be reduced, but not eliminated, by road treatments required per the WDEQ-AQD permit (WDEQ, 2010a). To estimate the maximum annual amount of dust generated from Project traffic, calculations using EPA Emission Factors for unpaved and paved roads were made. These calculations do not include any reduction for road treatment. The equations and assumptions for these calculations can be found in **Appendix D**.

Most of the dust, generated from all vehicles, originates from travel on unpaved roads. The greatest amount of dust, assuming no road treatment, would be generated from employee and contractor vehicles during Initial Construction (approximately 170 tons per year of PM_{10}). Mine Unit Development would also generate dust emissions, but less than during Initial Construction due to the reduced vehicular traffic (e.g., less than half the number of commuting vehicles with some vehicles remaining on-site).

Combustion Engines

Emissions would originate from a variety of engines on employee vehicles, tractor/trailers delivering equipment and supplies, scrapers and other earth moving equipment, welding machines, drilling rigs, and other equipment used for

Construction. Most of the combustion emissions from the employee vehicles are expected to be from gasoline engines and from the heavier equipment are expected to be from diesel engines.

Table 4.11-1 includes the estimated engine emissions during Initial Construction. Estimating the number of vehicles and type of equipment is difficult because of overlapping uses of the equipment for different Project phases. In addition, to simplify the estimate, it is assumed that some activities all occur during the initial seven-month period. For example, it was assumed that all of the UIC Class I wells would be drilled during the initial seven-month Construction period. However, one of the wells was installed in 2008 to provide the necessary subsurface information to determine the feasibility of deep well disposal, and it is unlikely that the other four would be drilled in the same year, due in part to rig availability and expense. In addition, only those wells needed would be drilled.

Table 4.11-1 Estimated Engine Emissions during Initial Construction (tons/year)

Drilling Activity	NO_x	CO	SO_2	PM_{10}	CO_2	Formaldehyde	VOCs
Commuting Traffic [1]	0.66	8.6	-- [2]	<0.01	279	--	--
Truck Deliveries [3]	5.24	0.48	--	<0.1	251	--	<0.1
Construction Equipment [4]	2.5	0.55	0.17	0.18	94	0.00068	0.20
Total Estimate	**8.40**	**9.63**	**0.17**	**0.18**	**624**	**0.00068**	**0.20**

[1] Using emission factors from EPA (2005) for a single vehicle multiplied by the expected number of vehicles in **Table 4.3-1**, for initial construction this was estimated to be 33 trucks/SUVs.

[2] Dashes (--) indicate information not provided in reference.

[3] Using emission factors from Federal Highway Administration (2005) for combination (tractor/trailer) diesel trucks built in 2002 on rural freeways for all parameters except CO_2; using emission factors from EPA (2004b) for CO_2 from moderate, heavy duty diesel vehicles. Mileage for calculating emissions assumed two 500-mile round trips (1,000 miles total) per week for seven months. Emissions were then multiplied by the expected number of vehicles in **Table 4.3-1,** for initial construction this was estimated to be five tractor/trailers.

[4] Table D.3-2 of Appendix D of NRC SEIS (NRC, 2011a).

It should also be noted that this estimate includes emissions from activities that do not occur exclusively on-site. In particular, the emissions attributable to off-site employee traffic and truck deliveries are included. Another important consideration is that the definition of Initial Construction for this estimate includes the installation of the Plant and associated facilities, but not Mine Unit Development, which is considered separately. This was done because the equipment needed for installation of the Plant and associated facilities, such as scrapers and dozers, is not the same as that needed for installation of the mine units, such as drill rigs and backhoes. Estimated engine emissions during Mine Unit Development are included in **Table 4.11-2**. The estimate is provided on an annual basis because the work would progress throughout each year mine units are being installed, which occurs over about five years.

Other Particulate or Gaseous Emissions

Construction activities may also generate airborne particulates other than dust or those generated during combustion. Examples of such particulates during the Initial Construction might be welding fumes or dust from grinding on steel, and examples of such particulates during Mine Unit Development might be drilling mud or cement dust during the installation of wells. However, because of the relatively small size of the Project facilities, these emissions are estimated to be negligible and the primary concern would be potential health impacts to workers in the immediate vicinity of the emission-generating activity.

Table 4.11-2 Estimated Annual Engine Emissions during Mine Unit Development (tons/year)

Drilling Activity	NO_x	CO	SO_2	PM_{10}	CO_2	Formaldehyde	VOCs
Commuting Traffic [1]	0.3	3.9	-- [2]	<0.01	126	--	--
Truck Deliveries [3]	3.6	0.33	--	<0.1	186	--	<0.1
Mine Unit Well Drilling & Support Equipment [4]	17	4.2	0.44	0.66	800	0.0013	0.66
Total Annual Estimate	**20.9**	**8.43**	**0.44**	**0.66**	**1112**	**0.0013**	**0.66**

[1] Using emission factors from EPA (2005) for a single vehicle multiplied by the expected number of vehicles in **Table 4.3-1;** for mine unit development, this was estimated to be 15 trucks/SUVs.

[2] Dashes (--) indicate information not provided in reference.

[3] Using emission factors from Federal Highway Administration (2005) for combination (tractor/trailer) diesel trucks built in 2002 on rural freeways for all parameters except CO_2; using emission factors from EPA (2004b) for CO_2 from moderate, heavy duty diesel vehicles. Mileage for calculating emissions assumed two 500-mile round trips (1,000 miles total) per week. Emissions were then multiplied by the expected number of vehicles in **Table 4.3-1,** for mine unit development this was estimated to be two tractor/trailers.

[4] Table D.3-1 of Appendix D of NRC SEIS (NRC, 2011a).

4.11.4.2 Operation

Air quality impacts during the Operation phase would come primarily from transportation of personnel and materials, and the primary emissions would be dust and emissions from combustion engines on lighter vehicles, such as SUVs, and heavier equipment, such as drill rigs. In addition to dust and to emissions from combustion engines, small amounts of particulates from materials used in Project activities, such as ore processing (e.g., salt) would be emitted.

Section 4.7.1.2 of the NRC SEIS discusses the potential impacts to air quality during the Operation phase. Several concerns involve fugitive dust, combustion emissions from the vehicles and equipment used, and the release of radon during Operation. It is believed that all of these emissions would generate concentrations

below the air quality standards, and that the only potentially significant impact would be the visual impact the fugitive dust emissions could have (NRC, 2011a).

Dust

Significantly fewer personnel vehicles are needed during Operation than during Construction, so the quantity of dust generated would be less than that during Construction. Trucks used for resin shipments are estimated to generate 4.3 tons of dust per year; and delivery trucks are estimated to generate 2.7 tons per year.

Combustion Engines

Most of the emissions during Operation would originate from a variety of engines in employee vehicles, and tractor/trailers delivering equipment and supplies. Most of the combustion emissions from employee vehicles are expected to be from gasoline engines and those from heavier equipment are expected to be from diesel engines. The quantities would be significantly less than those generated by the Mine Unit Development activities.

Other Particulate or Gaseous Emissions

Airborne particulates may include minor amounts of salt and soda ash releases during deliveries to and use at the Plant. An analysis of soda ash emissions shows that approximately 13.5 pounds of particulate would be released per year. The analysis assumes that 5.2 pounds of particulate is created per ton used, and 521.1 tons of soda ash would be used each year. Although 1.35 tons of particulate is created each year, a standard passive bag house filter would capture 99.5 percent of the material (using emission factors from EPA's AP-42, Compilation of Air Pollutant Emission Factors, Volume 1 (EPA, 2006), resulting in a total emission of 13.5 pounds. A similar analysis of salt emissions, using a passive bag house filter, indicates that approximately 17.5 pounds of salt would be emitted per year, a minor contribution to the Project PM_{10} emissions, which are primarily dust.

Liquid chemicals may be used in controlled amounts during groundwater restoration and for laboratory procedures. Venting of pressure at the mine units and supporting facilities would occasionally produce a low volume of non-radioactive gaseous emissions, such as CO_2, oxygen, and water vapor. These can come out of solution from the lixiviant or from the underground environment.

The only potential HAP emission is hydrogen chloride (HCl), which is used for ore precipitation at the Plant (Section 2.1.4). Permit # CT-7896, issued to LCI by WDEQ-AQD, includes specific conditions for use of a scrubber during loading of the HCl storage tank; therefore, no discernible impact is anticipated.

Table 4.11-3 shows the estimated annual emissions during Operation, which is expected to be approximately seven years in duration.

Table 4.11-3 Estimated Annual Emissions during Operation (tons/year, unless otherwise noted)

Drilling Activity	NO_x	CO	SO_2	PM_{10}	CO_2	Formaldehyde	VOCs	Soda Ash (lbs/yr)	Salt (lbs/yr)
Commuting Traffic [1]	0.06	0.78	-- [2]	<0.01	25.4	--	--	--	--
Truck Deliveries [3]	5.39	0.50	--	<0.1	258	--	<0.1	--	--
Plant Deliveries & Drilling[4]	--	--	--	--	--	--	--	13.5	17.5
Total Annual Estimate	**5.45**	**1.28**	**--**	**0.1**	**283**	**--**	**<0.1**	**13.5 lbs**	**17.5 lbs**

[1] Using emission factors from EPA (2005) for a single vehicle multiplied by the expected number of vehicles in **Table 4.3-1;** for mine unit development, this was estimated to be three trucks/SUVs.

[2] Dashes (--) indicate information not provided in reference.

[3] Using emission factors from Federal Highway Administration (2005) for combination (tractor/trailer) diesel trucks built in 2002 on rural freeways for all parameters except CO_2; using emission factors from EPA (2004b) for CO_2 from moderate, heavy duty diesel vehicles. Mileage for calculating emissions assumed two 500-mile round trips (1,000 miles total) per week. Emissions were then multiplied by the expected number of vehicles in **Table 4.3-1,** for mine unit development this was estimated to be three tractor/trailers.

[4] Using emission factors from EPA's AP-42, Compilation of Air Pollutant Emission Factors, Volume 1 (EPA, 2006) and usage information discussed above.

4.11.4.3 Reclamation

Reclamation would occur after completion of each mine unit (Mine Unit Restoration) as well as at the end of the project (Final Reclamation). Restoration of each mine unit is expected to take approximately one year, while Final Reclamation would take approximately three years. Potential air quality impacts during reclamation would include fugitive dust and emissions from combustion engines from many of the same sources identified for Construction. Impacts during Mine Unit Reclamation would be similar to those during Mine Unit Development, though of smaller quantities. During Final Reclamation, emission levels could increase in the short term, especially for particulate matter from activities such as dismantling buildings and equipment and grading the surface as part of Reclamation activities. Potential air quality impacts from Final Reclamation are initially expected to be similar to Initial Construction impacts and would decrease significantly as reclamation proceeds. **Table 4.11-4** shows the upper limit of emissions during reclamation for the final year of the Project, where Mine Unit Restoration would overlap with Final Reclamation. Emissions would be far less during the remainder of reclamation.

According to Section 4.7.1.1 of the NRC SEIS, potential impacts to air quality in the region from the Reclamation phase result from fugitive dust and combustion emissions from the vehicles and equipment used. It is believed that all of these emissions would result in air concentrations below the air quality standards, and that the only potentially significant impact would be the visual impact the fugitive dust emissions could have (NRC, 2011a).

Table 4.11-4 Estimated Annual Engine Emissions during Reclamation (tons/year)

Drilling Activity	NO_x	CO	SO_2	PM_{10}	CO_2	Formaldehyde	VOCs
Commuting Traffic [1]	0.24	3.1	-- [2]	<0.01	101	--	--
Truck Deliveries [3]	8.98	0.83	--	0.11	430	--	0.11
Construction Equipment Needed for Reclamation of One Mine Unit & Plant Facilities[3]	17	3.6	1.1	1.2	620	0.0045	1.3
Total Annual Estimate	**26.2**	**7.53**	**1.1**	**1.31**	**1151**	**0.0045**	**1.41**

[1] Using emission factors from EPA (2005) for a single vehicle multiplied by the expected number of vehicles in **Table 4.3-1;** for reclamation, this was estimated to be 12 trucks/SUVs.
[2] Dashes (--) indicate information not provided in reference.
[3] Using emission factors from Federal Highway Administration (2005) for combination (tractor/trailer) diesel trucks built in 2002 on rural freeways for all parameters except CO_2; using emission factors from EPA (2004b) for CO_2 from moderate, heavy duty diesel vehicles. Mileage for calculating emissions assumed two 500-mile round trips (1,000 miles total) per week. Emissions were then multiplied by the expected number of vehicles in **Table 4.3-1,** for reclamation this was estimated to be five tractor/trailers.
[3] Table D.3-6 of Appendix D of NRC SEIS (NRC, 2011a).

4.11.4.4 Greenhouse Gases and Climate Change

With respect to evaluation of the cumulative impacts on air quality of energy-related projects with overlapping potentially affected areas, e.g., coal mining and oil and gas drilling, there are often concerns not only on the impacts of mining of the materials, but also on the impacts of the complete fuel cycle for those materials, especially as it relates to greenhouse gases and climate change. Conversely, there may also be concerns about the impacts of climate change on the Project.

No practical methods exist to evaluate the contribution to climate change in a particular place from a single project. The Center for Climate Strategies generated a report for the WDEQ, showing the inventory and future greenhouse gas emissions for the State of Wyoming (CCS, 2007). Carbon dioxide is expected to be emitted at much higher levels than other GHGs during all phases of the

Project. Comparing the annual emissions of CO_2 from the Project to the statewide CO_2 estimated annual emissions, the Project would produce less than 0.01 percent of the net total greenhouse gases produced in Wyoming (NRC, 2011a). The percentages for other GHGs would be even less. The potential impacts of CO_2 and the other GHGs from the Project would thus be negligible. Evaluating the contribution to climate change from the complete nuclear fuel cycle indicates a low impact compared to other energy-related projects (IAEA, 1999).

Due to the negligible CO_2 contribution, and the natural decreases and increases in temperature in this part of Wyoming, attributing part of the climate change to the Project is speculative. In turn, the projected temperature change would have little, if any, impact on the Project (GCRP, 2009). With respect to an increase in precipitation, the natural variability is greater than 10 to 15 percent per year. Therefore, presuming the projected precipitation change was incremental over the next century, the impact on the Project would be negligible (GCRP, 2009).

In Section 4.7 of the NRC SEIS, the amount of greenhouse gases emitted as a result of this Project is calculated to be a small fraction of the total projected emissions from the entire state of Wyoming and is considered insignificant (NRC, 2011a).

4.11.5 Air Quality Impacts from Other Alternatives

4.11.5.1 No Action Alternative

Under the No Action Alternative, there would be no change in the air quality at the Permit Area or at any surrounding receptor sites. The Permit Area currently meets the NAAQS for attainment status, and it is expected that this area would continue to meet the NAAQS. As noted in **Section 3.10**, current activities in the vicinity, including ranching, hunting, and grazing, do produce some emissions.

4.11.5.2 Other Action Alternatives

The impacts on air quality from the Other Action Alternatives (Not Fencing the Pattern Areas and Drying Yellowcake On-Site) would not increase the impacts of the Proposed Action in terms of duration, significance and scale.

4.12 Noise

4.12.1 Agency-Required Measures

The required environmental protection measures are summarized below from Section OP 2.8 of the WDEQ-LQD Permit to Mine (LCI, 2011b), and Sections 3.8, 4.8.1.1, 4.8.1.2, 4.8.1.3, 4.8.1.4, 4.8.2, and 4.8.3 of the NRC SEIS (NRC, 2011a). The required environmental protection measures are primarily associated with wildlife and public and occupational health, which are discussed in **Sections 4.9** and **4.17**, respectively. The discussion in this section focuses on off-site human receptors.

The noisiest aspects of the Project would be during Initial Construction and Final Reclamation, due to the heavy equipment that would be in use. To reduce the noise generated, these activities would primarily occur during daylight hours (between 7 a.m. and 5 p.m.), and the 70 dBA 24-hour average sound-energy guideline to protect hearing (EPA, 1978) would not be exceeded. Once mining operations begin, i.e., pumping and injection of production solutions, the operations would continue around the clock, but continuously operating equipment (e.g., pumps) would be located inside buildings. During a routine night shift, only one employee would be in the field in a light truck to monitor equipment. Use of protective devices, such as mufflers and personal hearing protection, would be used to maintain noise levels in work areas in the immediate vicinity of the equipment below Occupational Health and Safety Administration (OSHA) regulatory limits.

4.12.2 Noise Monitoring

Because Project noise is not expected to cause any substantial impact, no monitoring is planned.

4.12.3 Impact Significance Criteria

The 55-dBA guideline, which was established by the EPA's Office of Noise Abatement and Control to protect against activity interference and annoyance (1978), was used to assess the significance of noise impacts on the human environment. The Rawlins RMP does not specifically state any pertinent factors concerning noise with respect to activities such as those of the Proposed Action.

4.12.4 Noise Impacts from the Proposed Action

Unlike conventional open-pit mine sites, impacts from increased noise levels are minimal at ISR project sites because major dirt-moving equipment is used for

only a short period of time as large-scale excavations are not conducted. Noise impacts were assessed by comparing background noise levels with projected noise levels on-site and off-site during Construction, Operation, and Reclamation. The proximity of sensitive receptors was considered in the impact analysis. The closest residence, church, or school (i.e., Bairoil) is about 15 miles from the northeast Permit Area boundary and would be more than 16 miles from the nearest mine unit or the Plant.

4.12.4.1 Construction

During Initial Construction, noise would be created due to the use of heavy equipment (e.g., dozers, graders, and cranes). Construction would occur for about seven months at the beginning of the Project, and would be concentrated near the Plant. Average noise levels 50 feet from the heavy construction equipment are on the order of 75 to 110 dBA, as shown in Table 4.2-1 of the GEIS (NRC and WDEQ, 2009). Beginning at a distance of 50 feet, noise levels diminish by six dBA for each doubling of the distance from the source (Golden et al., 1979). The Plant is about 1,000 feet from the closest Permit Area boundary (**Figure 1.1-3**), and, given the ambient wind noise (**Sections 3.10** and **3.11**), the equipment noise would be indistinguishable from the wind noise at that boundary.

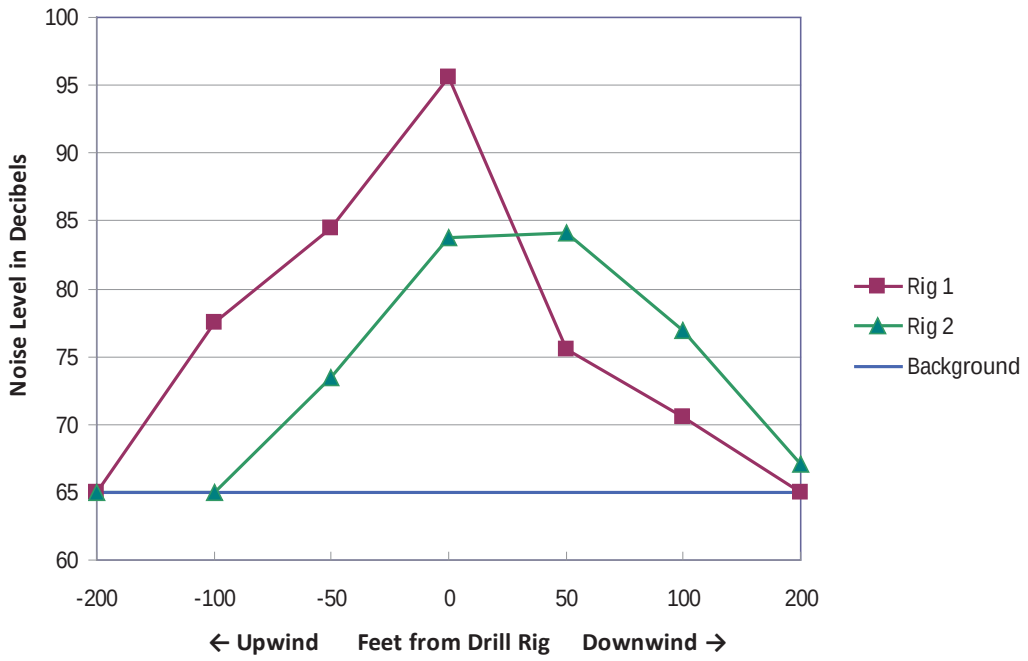
There would be negligible adverse effects from on-site noise to the nearest off-site receptors due to the considerable distance from the Plant to the nearest populated area. Workers commuting to the site and the transport of materials, via truck, would be the sources of off-site noise impacting off-site receptors, and these would be distributed among the three access routes to the Permit Area. Less than ten deliveries per day would be required during the Construction phase, and heavy trucks would only pass occupied residences once they reached US-287. This is a well-traveled road, and the increase in heavy truck traffic and commuters caused by the Project would be approximately two percent (**Sections 3.2** and **4.3**). This incremental increase is not expected to be noticeable. Due to the limited need for materials transport and the existing noise created by the highway, adverse effects from noise by the Project would be negligible.

During the Construction for Mine Unit Development, smaller equipment would generally be needed, with a corresponding decrease in the noise generated. On-site measurements of the noise from equipment that would be commonly used at the site confirm that the noise levels reduce quickly with distance from the equipment, particularly given the generally windy conditions (**Figure 4.12-1** and **Table 4.12-1**).

The above assessment of Construction impacts is in agreement with that in the NRC SEIS and includes more specific on-site noise measurements. Section 4.8.1.1 of the NRC SEIS discusses noise generation during Construction. Specifically, noise is generated from the construction equipment and the increased traffic to and from the site. The SEIS suggests that the smaller roads would be

more impacted than the larger, heavily travelled roads by the increase in traffic, and that the construction noise impacts would largely depend on distance from the source of the sound (NRC, 2011a).

Figure 4.12-1 Drilling Rig Noise versus Distance



4.12.4.2 Operation

Overall, noise levels during Operation would be expected to be lower than during Construction. Noise generated during the Operation phase would be mostly attributed to operation of pumps inside the header houses.

During Operation, periodic truck traffic for material transport, worker commuting, and traffic for maintenance and inspections would also contribute noise off-site. Less than one delivery per day would be required, and the associated increase in truck traffic on US-287 would be less than 0.1 percent, which would not be noticeable. Therefore, on-site sources would result in negligible noise increases to off-site receptors during this phase. No exceedance of any applicable noise criteria for off-site receptors or for on-site personnel is expected during the Operation phase.

The above assessment of Operation impacts is in agreement with that in the NRC SEIS and is based on more specific on-site noise measurements. Section 4.8.1.2 of the NRC SEIS discusses noise generation as a result of the Operation phase. Specifically, noise is generated from the increased traffic to and from the site and

the processing equipment. The SEIS suggests that the smaller roads would be more impacted than the larger, heavily travelled roads by the increase in traffic, and that the processing noise impacts would largely depend on distance from the source of the sound (NRC, 2011a).

Table 4.12-1 Field Measurements of Equipment Noise in the Permit Area

Equipment	Location	Comment	Noise Level in Decibels		
			Low	High	Average
Background	Northwest HiVol Station	HiVol station off and no other equipment running; light breeze	60.1	70.1	65.7
Pulling Unit (swabbing)	100 feet upwind	Light breeze blowing east; unit running	60.0	70.0	65.0
	50 feet upwind	Light breeze blowing east; unit running	60.0	68.0	65.0
	At operators station at end of truck	Light breeze blowing east; unit running	66.0	77.0	70.0
	50 feet downwind	Light breeze blowing east; unit running	64.0	70.0	67.0
	100 feet downwind	Light breeze blowing east; unit running	64.0	67.0	65.0
Eu 6500is Honda Generator	100 feet upwind	Light breeze blowing east; unit running	65.0	65.0	65.0
	50 feet upwind	Light breeze blowing east; unit running	65.0	65.8	65.2
	At unit	Light breeze blowing east; unit running			80.9
	50 feet downwind	Light breeze blowing east; unit running	65.0	66.1	65.3
	100 feet downwind	Light breeze blowing east; unit running	65.0	65.1	65.0
110KeV 75 HP Generator	100 feet upwind	Light breeze blowing east; unit running	65.0	65.1	65.1
	50 feet upwind	Light breeze blowing east; unit running	65.0	65.0	65.0
	At fender of unit	Light breeze blowing east; unit running			76.6
	50 feet downwind	Light breeze blowing east; unit running	65.0	65.3	65.0
	100 feet downwind	Light breeze blowing east; unit running	65.0	65.2	65.1
John Deere 710J Backhoe (idling)	100 feet upwind	Light breeze blowing east; unit running	65.0	65.0	65.0
	50 feet upwind	Light breeze blowing east; unit running	65.0	65.1	65.1
	At unit	Light breeze blowing east; unit running			81.5
	50 feet downwind	Light breeze blowing east; unit running	65.0	65.7	65.4
	100 feet downwind	Light breeze blowing east; unit running	65.0	65.0	65.0
Water Truck (idling)	100 feet upwind	Light breeze blowing east; unit running	65.0	65.1	65.0
	50 feet upwind	Light breeze blowing east; unit running	65.0	65.8	65.1
	At front left fender	Light breeze blowing east; unit running			76.6
	50 feet downwind	Light breeze blowing east; unit running	65.0	65.2	65.1
	100 feet downwind	Light breeze blowing east; unit running	65.0	65.0	65.0

* Measurements were performed on February 6, 2009, using a Metrosonics Model db-4000EZ Dosimeter, which accurately measures noise between 40 and 140 dBA with a resolution of 0.1 dBA. The instrument was checked against a calibrated standard both before and after the spot surveys were completed and found to be within 0.1 dB of the standard. The standard had been calibrated within the past year by the manufacturer.

4.12.4.3 Reclamation

During Mine Unit Reclamation and Final Reclamation, noise impacts are anticipated to be similar to Construction for Mine Unit Development and Initial Construction, respectively. During Mine Unit Reclamation, equipment would be used for well abandonment rather than well drilling, with similar or lower noise impacts. Truck traffic and heavy equipment activity would be similar to the Construction phase due to transportation of waste material to disposal sites and decommissioning of structures.

The above assessment of Reclamation impacts is in agreement with that in the NRC SEIS and is based on more specific on-site noise measurements. In Section 4.8.1.4 of the NRC SEIS, noise generated from Reclamation is expected to be the same, or less than, the noise generated during Construction, due to the earth moving and deconstruction of the site, and the impacts are not expected to be significant (NRC, 2011a).

4.12.5 Noise Impact from Other Alternatives

4.12.5.1 No Action Alternative

Under the No Action Alternative, baseline levels of noise would remain and not be increased. Baseline noise levels at the site are described in **Section 3.11**.

4.12.5.2 Other Action Alternatives

The impacts on noise from other alternatives (Not Fencing the Pattern Areas and Drying Yellowcake On-Site) would not be appreciably different than those from the Proposed Action. The dryer would be located inside the Plant, so no additional noise from the dryer operation would be anticipated. Traffic noise would be reduced because fewer shipments of dried yellowcake would be needed, as compared to yellowcake slurry shipments.

4.13 Historic and Cultural Resources

Discussion of specific locations and characteristics of archaeological resources are confidential; disclosure of site locations are prohibited under 43 CFR 7.18. Therefore, the information in this section is presented in general terms.

4.13.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 2.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Section 3.9 of the NRC SEIS (NRC, 2011a), and Condition 9.8 of the NRC License (NRC, 2011b).

The best mitigation for known sites is avoidance whenever possible. If avoidance of a site is not possible, regulatory requirements exist for mitigation of the impacts to a site. Because the locations of the sites eligible for the NRHP are already known, the potential impacts on those sites have been evaluated, and appropriate mitigation measures have been prepared.

Site 48SW16604, which is one of three sites determined eligible for the NRHP, would be disturbed by Project activities. Therefore, a treatment plan was developed in consultation with the BLM, NRC, Wyoming SHPO, the Eastern Shoshone Tribe and the Northern Arapaho Tribe (Appendix E of the NRC SEIS [NRC, 2011a]). Implementation of the treatment plan would mitigate the adverse effects to site 48SW16604.

Mitigation also includes procedures to be taken after unanticipated discovery of archaeological resources. As noted in Section OP 2.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and the memorandum of agreement among NRC, BLM, Wyoming SHPO, the Eastern Shoshone Tribe and Northern Arapaho Tribe (Appendix E of the NRC SEIS [NRC, 2011a]), LCI would halt work in the immediate area of any such discovery and stabilize the location, so further degradation would not occur. An archaeologist would 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.

4.13.2 Monitoring of Historic and Cultural Resources Impacts

The restrictions to keep archaeological information confidential are intended to prevent intrusion for curiosity or looting. Therefore, information on archaeological site boundaries is maintained on controlled maps, and monitoring of Project activities near the NRHP sites must be done by an archaeologist.

4.13.3 Criteria for Significance Evaluation and Impacts

Cultural resources are regarded as significant if they are enrolled in, or meet the eligibility criteria of, the NRHP. NRHP eligibility criteria are enumerated in Title 36 CFR Part 60 and are described as follows:

The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that:

- are associated with events that have made a significant contribution to the broad patterns of our history; or
- are associated with the lives of persons significant in our past; or
- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- have yielded, or may be likely to yield, information important in prehistory or history.

To qualify for NRHP eligibility, a property must meet two separate types of requirements. It must exhibit integrity of location, design, materials, and related criteria, and it must meet one or more of the four additional criteria. The National Historic Preservation Act makes it clear that a site need not be of national historic significance to be considered eligible (Advisory Council on Historic Preservation, 2006). Sites of local, state, and regional importance may also be listed and, thus, are significant in the legal sense. The phrasing of the National Historic Preservation Act of 1966 (as amended) is critical with respect to actual management of cultural resources. A site does not have to be included on the NRHP to receive protection under the law, but must simply meet the requirements of eligibility (Kinneer et al., 2007).

Under NEPA, impacts to cultural resources may be direct (the result of an action that occurs at the same time and place), indirect (the result of an action that occurs at a later time or in a different place), or cumulative (incremental, resulting from accrued past, present, and reasonably foreseeable future actions). Under Section 106 of the National Historic Preservation Act, an adverse effect is any impact that alters the attributes that qualify the site for inclusion on the NRHP by diminishing the integrity of the site. Possible adverse impacts might include physical damage or destruction, alternation, deterioration, or modification of original setting. An adverse effect on a cultural property would constitute a significant impact unless mitigation measures are undertaken to reduce or counter the harm that an undertaking would cause.

4.13.4 Historic and Cultural Resources Impacts from the Proposed Action

Direct impacts on cultural resources would come from the surface disturbance in the footprint of the Project infrastructure. During the life of the Project, a total of approximately 345 acres of the land surface would be disturbed, which is eight percent of the 4,254 acres in the total Permit Area. The surface disturbance would occur during the Construction phases. There should be no additional surface disturbance during the Operation and Reclamation.

Indirect impacts could result from erosion of soils after surface disturbance and vegetation removal. The erosion could result in deposition of material onto archaeological sites or removal of soil and subsequent exposure of sites. The increased number of people accessing the Permit Area could also lead to intrusion onto or looting of sites.

One prehistoric archaeological site recorded in the Project Area, 48SW16604, would incur adverse effects. Site 48SW16604 lies within an area where construction related to the well field, an access road, and a pipeline would occur. It is anticipated that the entire site would be subjected to surface scraping. As described in **Section 4.13.1**, above, mitigative excavation would take place prior to initiation of these activities, and the impacts would therefore not be significant.

Section 4.9 of the NRC SEIS (NRC, 2011a) discusses the potential impacts to the historic and cultural resources in the Permit area. The largest potential for impacts occurs during the Construction phase, when resources could potentially be excavated or damaged. There is also a potential for the construction process to temporarily restrict access to these resources. Management practices that would be used during construction with regards to discovery of historical or cultural artifacts serve to protect these resources, which would result in a smaller potential for significant impacts to the resources (NRC, 2011a).

4.13.5 Historic and Cultural Resources Impacts from Other Alternatives

4.13.5.1 No Action Alternative

Under the No Action Alternative, there would be no impacts to the cultural resources related to the Project, although on-going activities, such as livestock grazing, could disturb surface archaeological sites. The No Action Alternative would not create significant impacts to cultural properties.

4.13.5.2 Other Action Alternatives

Not Fencing the Pattern Areas

The fences are included within the mine unit boundaries; therefore, this alternative would not reduce potential impacts on archaeological resources. This alternative would not avoid site 48SW16604, and adverse effects to that site would occur. Impacts to site 48SW16604 would not be regarded as significant because mitigation would take place prior to the time that impacts are sustained.

Drying Yellowcake On-Site

The dryer would be located within the Plant; therefore, this alternative would create no additional impacts on the archaeological resources at the Permit Area. This alternative would not avoid site 48SW16604, and adverse effects to that site would occur. Impacts to site 48SW16604 would not be regarded as significant because mitigation would take place prior to the time that impacts are sustained.

4.14 Visual and Scenic Resource Impacts

4.14.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections 3.10, 4.10.1.1, 4.10.1.2, 4.10.1.3, 4.10.1.4, 4.10.2 and 4.10.3 of the NRC SEIS (NRC, 2011a).

The following protection measures are planned to minimize the Project impacts on visual and scenic resources.

- building materials and paint would be chosen to blend with the natural environment, according to BLM guidelines;
- all structures have been designed to be low profile, in order to minimize the number of vantage points from which they would be visible;
- the site would remain clean and well-maintained according to operational protocols; and
- Any necessary night lights would be designed to reduce light pollution.

4.14.2 Monitoring of Visual and Scenic Resource Impacts

Since impacts to visual and scenic resources would be negligible, no monitoring is currently planned. The Annual Report submitted to NRC and WDEQ would document any changes to the status of the visual resources, as necessary.

4.14.3 Impact Significance Criteria

The significance of the impacts was evaluated by determining if the visual changes would be consistent with the BLM visual resource classification of the area, discussed in the Rawlins RMP in the Visual Resource Management Section. The Permit Area is within a BLM-designated VRM Class III area and proximal to a VRM Class IV area. The management objective for Visual Resource Management Class III areas is to, “Partially retain the existing character of the landscape. The level of change to the landscape should be moderate. Management activities may attract the attention of the casual observer but should not dominate the view of the casual observer. Changes should repeat the basic natural elements found in the predominant natural features of the characteristic landscape” (BLM, 1984).

4.14.4 Visual and Scenic Resource Impacts from the Proposed Action

As outlined below, the nature of the Project impacts would be consistent with the visual resource classification of the area. Project facilities would be discernible during the day, but would not be a dominant landscape feature to observers outside the Permit Area. Night time operations would be minimal.

4.14.4.1 Construction

During the seven months of Construction, there would be short-term visual impacts due to on-site equipment for the construction of the Project facilities and road improvements. This equipment will likely contrast with the forms, lines, colors, and textures present in the area, but will only be on-site during Construction, not posing a long-term impact on the visual resources of the area. Construction activities would result in an increase of vehicles and traffic in the area. (The increased potential for dust is discussed in **Section 4.11**). Vegetation disturbance would also take place during Construction. As discussed in **Section 4.8.4.1**, the total disturbance acreage during Construction would be on the order of 345 acres, which would be scattered throughout the Permit Area. Construction activities would occur during the day, so other than occasional lights for safety and security, night time impacts would be minimal.

Section 4.10.1.1 of the NRC SEIS examines the impacts to the visual and scenic resources from Construction. The impacts are primarily related to construction equipment, the infrastructure being built, land alterations, emissions, and lighting. According to the SEIS, the topography is such that most of the infrastructure would not be visible from more than one kilometer away. Additionally, the short-term nature of Construction activities limits the time that the equipment and land disturbances would be impacting the visual resources. As such, the impacts to visual and scenic resources are not expected to be significant (NRC, 2011a).

4.14.4.2 Operation

After Construction, the majority of visual impacts would occur from the facilities used during the Operation phase, in particular, the Plant. In general, ISR uranium mines can retain the form and line of the existing landscape better than open pit or surface mines because less earthwork is necessary. Header houses, wellheads, and roads would contribute to the visual impacts, but less so than the Plant. Header houses may be visible from the Sooner Road, which is about two miles from the site, and the closest road other than the Project access roads. However, the header houses, which would be about 12 feet in height at the roof apex and painted to blend with the landscape, would only have a weak effect on the form and line of the landscape from the key observation points (**Appendix E**). The wellheads, which would be on the order of four feet in height or less, would not be noticeable from Sooner Road because they would have weak to no effect on

the form, line, color, or texture of the landscape from that distance. Due to the height and abundance of sagebrush throughout the Permit Area (**Section 3.7**), as well as the rolling topography, the on-site roads would not be visible unless the angle of view is directly in-line with the road. The Plant would be the largest building on-site, about 160 feet wide, 260 feet long, with a wall height of 22 feet and a peak roof height of 29 feet.

Figure 4.14-1 is a photograph taken slightly less than 0.25 miles from an existing ISR project in Nebraska and helps to visualize how the Permit Area will look. However, there are important differences between this project in Nebraska and the Project. First, the Plant at the Nebraska site is taller than the Plant would be at the Permit Area because of different configurations of the ion exchange columns. Second, the vegetation is primarily grassland at the Nebraska site, rather than the shrubland at the Permit Area. **Figure 4.14-2** is a photograph of the Project Area taken from the Sooner road (4.4 miles from the proposed Project). Even though there are two white trailers (approximately 4 miles from the photographer and approximately 10 feet in height and 20 feet in length) in this photograph, one cannot locate them without magnifying the photograph. The trailers are visible from the location of the photograph, but are difficult to locate without prior knowledge of their location.

Because of the varying topography of the area, and the presence of the Continental Divide Trail and the Rawlins-Ft. Washakie Stage Road in the vicinity of the Permit Area, a viewshed analysis was conducted for the Plant using a Spatial Analyst add-on to ArcGIS 9.3. The height of the Plant was estimated to be ten meters and the viewshed was limited to approximately 25 miles from the Plant. **Figure 4.14-3** shows the result of the viewshed analysis, illustrating areas within 25 miles that are visible from the Plant and from which the Plant would be reciprocally visible. The analysis allows identification of any local potential visual receptor sites such as the Sooner Road, Wamsutter Crooks Gap Road, the Continental Divide Trail, the Rawlins-Ft. Washakie Stage Road, and dispersed recreational areas.

Figure 4.14-1 Photograph of Existing ISR Project in Nebraska, July 2010

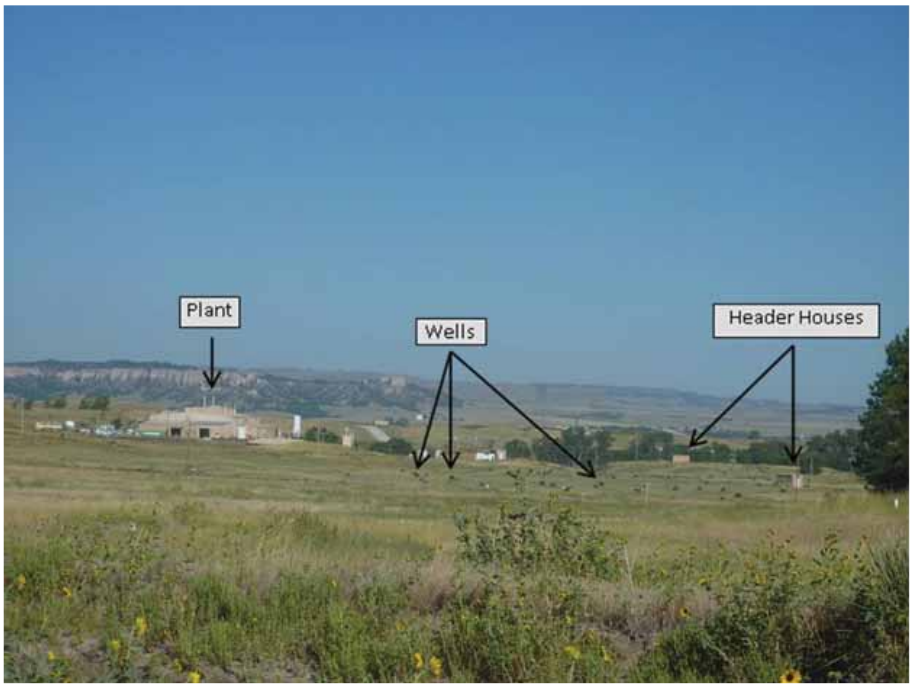


Figure 4.14-2 Photograph of Project Area from Sooner Road, October 2011

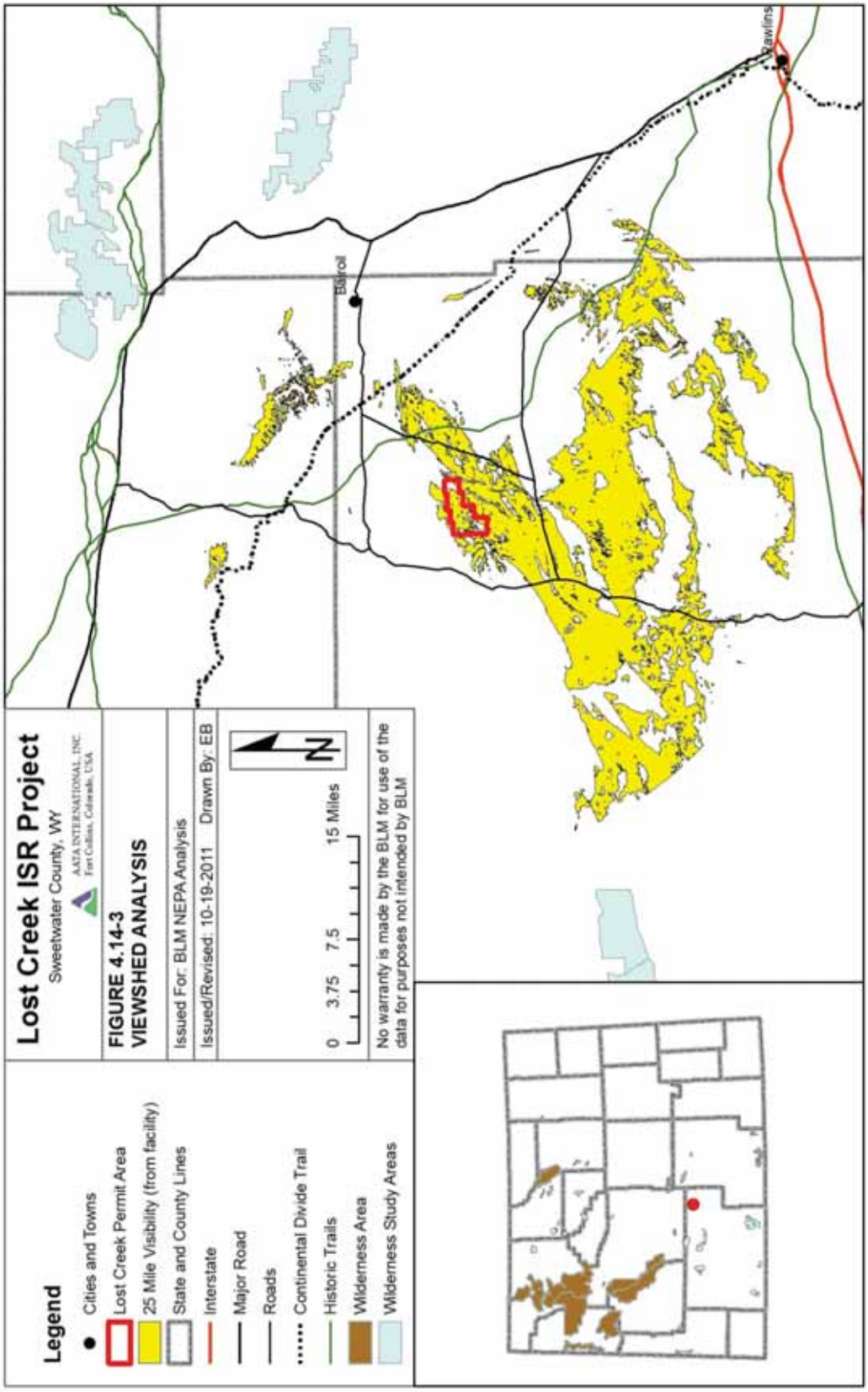
Figure 4.14-3 illustrates that the largest potential impacts from the Plant to the local visual resources lie in the southwesterly to southeasterly directions. The Plant would be viewable from the Mineral Exploration Road (County Road 63), Sooner Road (BLM 3215), and Wamsutter Crooks Gap Road (County Road 23). The Plant would potentially be visible from the Continental Divide Trail, but in only very limited areas (less than 0.5 miles in total). However, at a distance of about 8 miles away, the Plant would not dominate the landscape from the closest viewpoints along the Continental Divide Trail. The plant would be visible for 6.9 miles along the Rawlins-Ft. Washakie Stage Road. Of this total distance, approximately half (3.5 miles) is within 6.5 miles of the Plant, and half (3.4 miles) is over 17 miles from the proposed Project (**Figure 4.14-3**). These distances limit the impact that Plant can have on the view from the road. The Plant would not be visible from Bairoil (the closest town) or Jeffery City (the next closest town).

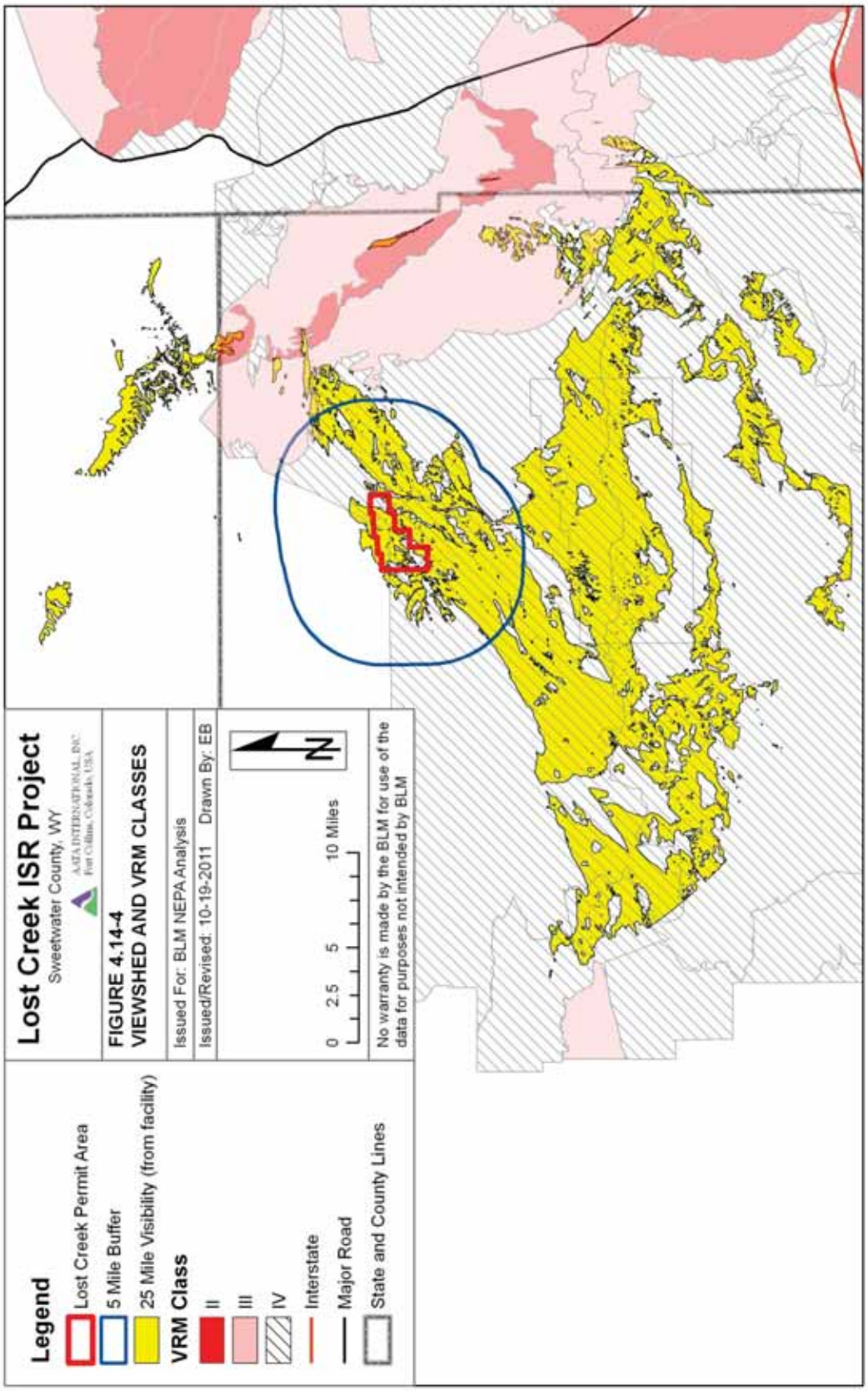
Figure 4.14-4 illustrates that most of the areas where visual resources may be impacted are within the Visual Resource Inventory Class IV. Although VRI classes do not establish management direction, Class IV represents areas with the least amount of visual value.

A Visual Contrast Rating Worksheet was completed for an observation point on the Sooner Road (**Appendix E**).

As during Construction, night time activities would be minimal. Therefore, other than occasional lights for safety and security, there should be only minimal visual impact.

In Section 4.10.1.2 of the NRC SEIS, the NRC discusses that the size or color of most of the infrastructure reduces the potential for a significant impacts and the visual impacts associated with the Operation phase would be less than the Construction phase. (NRC, 2011a).


Lost Creek ISR Project
Sweetwater County, WY
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
FIGURE 4.14-3
VIEWSHED ANALYSIS
Issued For: BLM NEPA Analysis
Issued/Revised: 10-19-2011 Drawn By: EB
0 3.75 7.5 15 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Cities and Towns
Lost Creek Permit Area
25 Mile Visibility (from facility)
State and County Lines
Interstate
Major Road
Roads
Continental Divide Trail
Historic Trails
Wilderness Area
Wilderness Study Areas
Bairoil
Rawlins


Legend
Lost Creek Permit Area
5 Mile Buffer
25 Mile Visibility (from facility)
VRM Class
II
III
IV
Interstate
Major Road
State and County Lines
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.14-4
VIEWSHED AND VRM CLASSES
Issued For: BLM NEPA Analysis
Issued/Revised: 10-19-2011 Drawn By: EB
0 2.5 5 10 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM

4.14.4.3 Reclamation

The Reclamation of the Project would not introduce any new visual impacts. When Reclamation begins, the impacts are anticipated to be similar to those during the Construction because there would be an influx in construction equipment (for decommissioning and demolition of certain facilities) and in traffic due to the increase in personnel. The visual impact would decline as decommissioning progresses. The Project would not cause modifications to scenery or topography that would persist after Reclamation. It is unlikely that any Reclamation activities would occur at night, so, other than occasional lights for security and safety, no impacts are anticipated.

In Sections 4.10.1.3 and 4.10.1.4 of the NRC SEIS, the Reclamation phase is compared to the Construction phase, stating that since the two phases require similar equipment and short time frames, the overall visual impact of the phase would be minimal (NRC, 2011a).

4.14.5 Visual and Scenic Resource Impacts from Other Alternatives

4.14.5.1 No Action Alternative

The No Action Alternative would present no change to the visual resources of the area.

4.14.5.2 Other Action Alternatives

If no fences were installed around the pattern areas, there would be a slight reduction to the visual impact of the Project. However, fences are not likely to be more visible than the wellheads, which may be visible, but would not dominate the landscape or distract potential observers from the natural landscape. In addition, the types of fences around the pattern areas are typical of most fences in the vicinity. Since the dryer for the Drying Yellowcake On-site alternative would be inside the Plant, there would be minimal additional impact to the visual resources.

4.15 Socioeconomic Conditions

4.15.1 Agency-Required Measures

While there are no agency-required measures related to socioeconomic conditions, LCI and LCI's contractors and subcontractors would be encouraged to deliver construction materials "Free on Board" to the County in which the materials would be used to help ensure that the sales tax would be properly allocated and paid to the County where construction and related impacts would occur.

In addition, LCI has commitments and initiatives to minimize socioeconomic impacts. LCI would support local hiring and procurement to the extent practicable and would continue working with Sweetwater and Carbon Counties on topics of interest.

4.15.2 Monitoring of Socioeconomic Impacts

Significant socioeconomic impacts are not anticipated, so no monitoring is planned.

4.15.3 Impact Significance Criteria

In accordance with the Rawlins RMP Management Goals, the Proposed Action provides an opportunity to develop a national energy source on BLM-administered lands while not interfering substantially with development of other resources, such as tourism, and provides for mitigation of impacts to development of other resources (e.g., grazing and wildlife). The following criteria were used to assess the significance of socioeconomic impacts to ensure the continued viability of the local and regional communities:

- An increase of the local and regional population that would strain the ability of communities and/or counties to provide adequate housing and services;
- Increasing demands on government expenditures that would inhibit the maintenance and/or provision of infrastructure and services;
- An increase in the local or regional cost of living;
- A reduction in socioeconomic viability of local and regional communities; and conversely,
- An increase in government revenues that would offset increased demands for services; and
- An improvement in socioeconomic viability due to indirect economic activity (e.g., purchase of local goods).

Socioeconomic impacts would occur during all phases of the Project, and LCI has met with county and local governments to help ensure a cooperative effort to sustain and improve the economies and conditions. The potential impacts to demographics, economic trends and characteristics, and infrastructure and services are discussed in the following sections by subject. Each subject is then described by Project phase unless the socioeconomic impact is similar throughout the Project phases or is generally evaluated over the life of the Project.

4.15.4 Demographic Impacts from the Proposed Action

4.15.4.1 Construction

The local population is anticipated to increase as a result of increased employment opportunities generated both directly and indirectly by the Project. Direct employment during Initial Construction is anticipated to peak at 74 employees.

It is assumed the majority of the workforce would come from outside the region. Although many towns are within the region, much of the workforce is anticipated to reside in larger, more economically diversified population centers, such as Rawlins and Casper. The duration of Construction would be less than one year. If the majority of the Construction workforce is from outside of the region, demographics would change. If the majority of the Construction workforce is from within the region, demographic impacts would be negligible.

Indirect employment is estimated by assuming an employment multiplier. Assuming an employment multiplier of 0.7 for the milling/mining industry (NRC, 2011a), an estimated 51 to 52 additional jobs would be generated (i.e., 74 positions multiplied by 0.7).

The total of direct and indirect employment would range from 125 to 126 positions. Assuming an average of 2.5 people per household, the population of the region would increase by 312 to 315 people (i.e., 125 to 126 positions multiplied by 2.5). However, since a portion of the Construction workforce already resides in the region, the population increase would be less than this estimate. In an extreme case, if the population did increase by 312 to 315 people, in Rawlins alone, the population would increase by 3.8 percent. Realistically, migrants would be dispersed throughout other communities in the region as well.

The assessment of Initial Construction impacts in this EIS is similar to that of the Construction assessment in the NRC SEIS with more focus on whether the workforce would come from outside or within the region. Section 4.11.1.1 of the NRC SEIS discusses how in the short-term, the influx of Construction employees would likely not significantly impact the demographics of the region. Since the

Construction phase is for a short time, the long-term impact would be negligible, and the overall impact would be small (NRC, 2011a).

During Mine Unit Development, direct employment is expected to average 106 employees. Of these 106 employees, about 54 are anticipated to have been employed during Initial Construction. The remaining 52 employees would be technical staff trained in health physics, chemistry, geology, hydrogeology, and engineering and would likely come from outside the region. As during Initial Construction, the Mine Unit Development workforce is anticipated to reside in larger population centers that offer more amenities and economic diversity.

Because the majority of the workforce would work through Initial Construction and Mine Unit Development, the demographic change during Mine Unit Development would be less than during Initial Construction. Overall, the number of employees would increase by 32 employees from Initial Construction (74 employees) to Mine Unit Development (106 employees). However, as noted in the paragraph above, 52 of the average 106 employees would likely be hired from outside of the region for their technical skills. Therefore, it is deduced that as little as 32 people to as many as 52 people would be new, direct employees of the Project during Mine Unit Development. Assuming an employment multiplier of 0.7 for the milling/mining industry (NRC, 2011a), an estimated 22 to 37 indirect jobs would be generated (i.e., 32 to 52 positions multiplied by 0.7).

The total of additional direct and indirect employment from Initial Construction to Mine Unit Development would range from 54 to 89 positions. Assuming an average of 2.5 people per household, the population of the Project region would increase by 135 to 222 people (i.e., 54 to 89 positions multiplied by 2.5). In an extreme case, if the population did increase by 135 to 222 people in Rawlins alone, the population would increase by 1.7 to 2.7 percent. Realistically, migrants would be dispersed throughout other communities in the region as well.

The Mine Unit Development assessment in this EIS is similar to that of the Operation assessment in the NRC SEIS with more focus on whether the workforce would come from outside or within the region. Section 4.11.1.2 of the NRC SEIS (NRC, 2011a) describes how the workforce associated with the Operation phase might change the socioeconomic conditions. However, because of the small number of Operation employees, the impact to demographics is not expected to be significant (NRC, 2011a).

4.15.4.2 Operation

Demographics are not anticipated to change from Mine Unit Development to Operation.

4.15.4.3 Reclamation

Demographics are not anticipated to change from Operation to Mine Unit Reclamation.

Final Reclamation would require a similar, if not the same, workforce of Initial Construction. As such, demographics are not anticipated to change until Project closure. At that time, the Project workforce would likely be drawn to other ISR facilities or other regional extractive industries.

The overall assessment of Final Reclamation in this EIS is similar to the assessment of Reclamation in the NRC SEIS with more focus on where the workforce could go after Project Closure. Section 4.11.1.4 of the NRC SEIS discusses how in the short-term, the influx of Reclamation employees could impact the region. However, since it is for a short time, the long-term impact to demographics would be negligible (NRC, 2011a).

4.15.5 Revenue and Taxation Impacts from the Proposed Action

The Project would contribute to the local economy through taxes generated, job creation, employee wages, and direct and indirect economic activity in the local, regional, and national economies.

4.15.5.1 Gross Domestic Product

The Project would contribute to Wyoming's dominant GDP industry: mining. Using February 2010's market price of U_3O_8 (about $42 per pound), the Project would contribute $360,000,000 to the nation's GDP. The price increased to about $73 per pound at the beginning of 2011, and the price has been about $52 per pound in the first part of 2012. The Project would boost the immediate area's diversity and economic health.

The NRC SEIS does not specifically address the nation's or the State's GDP.

4.15.5.2 Revenue and Taxation

The purchases made by and the taxes collected from the Project would generate revenue. The primary internal costs of the Project would include:

- capital costs associated with obtaining claims and regulatory approvals, including permits, and environmental studies;
- capital costs of facility construction;
- operation and maintenance costs;
- costs of groundwater restoration;

- costs of facility decommissioning, including radiological decontamination; and
- costs of surface reclamation.

These estimated costs are provided in **Table 4.15-1**. The total Project costs are estimated at $225 million, not including local, state and federal taxes. A portion of this would be spent in the local area (Rawlins) for diesel fuel, propane, and miscellaneous supplies and repairs. This would be considered a positive impact to the local economy. The majority of supplies would come from Casper. Oxygen and CO_2 would come from Wyoming or Colorado, and soda ash would come from Green River, Wyoming. Major construction materials would be bid out regionally, with a large portion anticipated to come from the Colorado-Wyoming-Utah region.

Table 4.15-1 Estimated Internal Project Costs

Item	Present Worth (US dollars x 1,000)
Obtaining the right to mine (claims and permits)	13,000
Facility construction	68,000
Operation and maintenance	74,000
Groundwater restoration	13,000
Decommissioning (including decontamination)	12,000
Surface reclamation	3,000

The Project would contribute substantially to the local and state economies in the form of tax revenues generated. Tax revenues from the Project would depend on the production of U_3O_8 and the cost of production. Future tax revenues are dependent on uranium prices, which may considerably fluctuate. To the extent that uranium prices remain at current levels, uranium production would contribute significantly to local tax revenues.

As shown in **Table 4.15-2**, tax revenues generated from the Project would include property taxes and ad valorem (gross products) taxes in Sweetwater County, severance taxes for the State of Wyoming, and federal income taxes. Equipment would be registered at the County Assessor's Office and a discount (50 percent) would be applied to the market value, then 11.5 percent of the adjusted value would be taxed at a rate of 63.088 mills (NRC, 2011a). This property tax revenue would accrue to Sweetwater County. Since the Permit Area is located in Sweetwater County, ad valorem taxes would also accrue in Sweetwater County.

Table 4.15-2 Estimated Tax Revenues Based on Project's Annual Production

Year	U_3O_8 Production [1]	Estimated Federal Income Taxes	Wyoming Severance Taxes	County Ad Valorem Taxes	County Property Taxes
1	45,000				
2	1,000,000		900,000	1,600,000	300,000
3	1,000,000	9,000,000	1,000,000	1,900,000	300,000
4	1,000,000	10,000,000	1,000,000	2,000,000	300,000
5	1,000,000	10,000,000	1,000,000	2,000,000	250,000
6	1,000,000	10,000,000	1,000,000	2,000,000	250,000
7	1,000,000	10,000,000	1,000,000	2,000,000	100,000
8	400,000	3,000,000	700,000	900,000	50,000
9					50,000
Total	**6,445,000**	**52,000,000**	**6,600,000**	**12,400,000**	**1,600,000**

[1] Assuming a realized sales price of 60.00 US dollars per pound U_3O_8

Section 4.11.1 of the NRC SEIS discusses the potential impacts to taxes and revenue. The region would benefit slightly from the small increase in spending from the additional workforce, however, this impact is expected to be small. The State of Wyoming would benefit from mining taxes on the Project, but this is also expected to be fairly small relative to the total State revenue (NRC, 2011a).

A four-percent severance tax of taxable market value would be levied by the State of Wyoming's Mineral Tax Division of the Department of Revenue. Assuming an estimated production of 8,000,000 pounds of U_3O_8 over the life of the Project and a market value of $60 per pound of U_3O_8, the severance tax revenues generated from the Project would equal $19,200,000.

Other tax revenues include sales, use, and lodging taxes. These amounts would represent an increase in local revenues throughout the region. The Project's operation and its employees would contribute to local, regional, and state revenues through the purchase of goods and services and through the taxes levied on such goods and services. Sales taxes and increased demand for goods and services would support the local economy. Additional spending would result from payrolls and other on-going expenditures. Expenditures generally multiply as the monies are circulated throughout the community several times.

Money would be reinvested in the community as the Project replenishes its resources and operates throughout the life of the mine, including costs associated with exploration and evaluation, maintenance, sustaining capital, and routine operation. Increases in taxes and revenues would provide counties and communities with more discretionary dollars to develop infrastructure and support

the population. However, short-term budgetary impacts to local governments would occur, due to population growth and its effects on housing and local infrastructure and services. Receipt of taxes generally lags one year behind production; therefore, affected counties and communities would not receive any funds until two years after the beginning of the Construction phase.

4.15.6 Labor, Employment and Income Impacts from the Proposed Action

Nationally, the Project would reduce dependence on foreign sources of uranium while helping to maintain a viable domestic workforce with the necessary technical skills to recover uranium resources. Due to market conditions over the past 20 years, the technical expertise required to recover uranium has declined. LCI estimates that less than 20 engineers and 20 geologists in the US have adequate experience to successfully and safely operate an ISR uranium facility. A large percentage of these experts are at retirement age.

The Project would increase the number of jobs and employment in the counties of interest without federal assistance. Given the existing economic downturn and associated unemployment, the Project would increase regional construction and service industry jobs. Throughout its life, the Project would support about 106 direct jobs locally and a number of indirect jobs. However, similar to tax revenue, labor and employment would depend on the amount of U_3O_8 produced.

Federal income tax would be collected from the Project's workforce. Since Wyoming does not tax personal income, local, regional, and state income benefits would be related to the purchase of goods and services and through the taxes levied on such goods and services. As previously discussed, sales and use taxes and increased demand for goods and services would support the local economy. Additional spending would result from payrolls and other on-going expenditures. The economic benefit of expenditures related to the Project would magnify as funds are dispersed throughout the communities.

4.15.6.1 Construction

During Construction, the Project would require approximately 50 independent contractors , 24 LCI employees, and other intermittent contract employees at the Permit Area. Once the Plant is constructed, the number of independent contractors would be reduced to 30 drillers in order to focus on Mine Unit Development. In total, the Project would employ 74 people throughout Construction. The estimated direct-hire labor force is presented and described in **Table 4.15-3**. As previously discussed, the total of direct and indirect employment is estimated to range from 125 to 126 positions.

Table 4.15-3 Estimated Labor and Employment

Project Phase/Stage	Labor	Employees
Initial Construction Stage	Drill contractors (10)	30
	LCI construction employees	7
	Other LCI employees (samplers, geologists, supervision, drilling support)	17
	Plant construction contractors	20
	Total	74
Mine Unit Development Stage, Operation Phase, Mine Unit Reclamation Stage	LCI construction employees	7
	LCI employees (Plant & mine units)	69
	Drilling contractors	30
	Total	106
Final Reclamation Stage	LCI employees	11
	Total	11

Local contractors would be hired, as available, and local building materials and building supplies would be used to the extent practicable. Many of the workers are anticipated to come from Casper. Some workers may commute from Casper on a daily basis; others coming from Casper would stay in temporary accommodations during the week and commute back to Casper on the weekend. Construction workers coming from outside the region would likely use local temporary housing (e.g., apartments, hotels, motels, trailers, RVs). Some workers would commute to and from their permanent residence on a daily basis if within a one-hour drive of the Permit Area.

The mean earnings rate for construction workers was $26,239 per year in 2008 (Wyoming Department of Employment, 2009). The mean earnings rate for natural resources and mining workers was $54,183 per year in 2008. Workers would be paid wages typical of the area.

The Initial Construction assessment in this EIS is similar to that of the Construction assessment in the NRC SEIS. Section 4.11.1.1 of the NRC SEIS discusses how in the short-term, the influx of Construction employees could impact the income and employment in the region. However, since it is for a short time and the pay rates would be typical of the region, the long-term impact would be negligible (NRC, 2011a).

During Mine Unit Development, the Project would require an additional 52 LCI employees. In total, approximately 106 people (30 contract drillers and 76 LCI personnel) would be employed. LCI personnel would include: Project and operation managers; a Project engineer; a chief site geologist; a drill foreman; a casing crew; a restoration engineer and crew; a construction foreman and crew; geologists; a secretary; personnel responsible for environmental, health, and

safety related tasks; a plant manager; plant operators; equipment operators; an electrician; a chemist; and lab technicians.

Impacts to income during Operation would be similar to those of Construction. Technical LCI employees would average approximately $45,000, with an estimated total annual payroll of $2,900,000.

The combination of Mine Unit Development, Operation, and Mine Unit Reclamation is similar to that of the Operation phase evaluated in the NRC SEIS. Section 4.11.1.2 of the NRC SEIS describes how the workforce associated with the Operation phase might change the income and employment in the region. However, since it is for a short time and the pay rates would be typical of the region, the long-term impact would be negligible (NRC, 2011a).

4.15.6.2 Operation

The labor, employment, and income impacts during the Operation phase are not anticipated to differ from Mine Unit Development.

4.15.6.3 Reclamation

The labor, employment, and income impacts during Mine Unit Reclamation are not anticipated to differ from the Operation phase.

During Final Reclamation, technical staff would decrease to less than the Initial Construction staff (11 LCI employees). Additional contract employees would be hired as necessary during Project decommissioning. The income levels during Final Reclamation are anticipated to be similar to those during Initial Construction.

The staff would decrease as the Project nears completion. At that time, the Project workforce would likely apply their skills at other ISR facilities or extractive industries.

Final Reclamation in this EIS is similar to that of the Reclamation phase evaluated in the NRC SEIS. Section 4.11.1.4 of the NRC SEIS discusses how, in the short-term, the influx of Reclamation employees could impact the income and employment in the region. However, because of the short duration and pay rates typical of the region, the long-term impact would be negligible (NRC, 2011a).

4.15.7 Cost of Living and Housing Impacts from the Proposed Action

Due to the size and duration of the Project as well as the anticipated population centers of residence for personnel, impacts to the cost of living are not anticipated.

The increase in population directly and indirectly caused by the Project would increase regional housing demand. In the recent past, housing availability has increased in Casper and Rawlins, where the majority of the Project's workforce is anticipated to live.

Since 2007, Wyoming's active residential real estate markets have eased somewhat with increased inventories and lower transactions in many communities (EAD, 2010e). As of January 13, 2010, 504 homes were listed under the Multi-Listing Service in Casper (Glasspoole, T. GRI, CRS Sales Associate/Owner, RE/MAX, The Group. Personal communication. January, 2010.). This total does not include the homes that were for sale by owners, without the aid of a listing agency. The largest rental agency in Casper, Casper Rental Agency, had a total of 173 vacant rental properties on January 12, 2010. Rawlins had at least 88 homes on the market on January 25, 2010 (Shepard, A. Broker/Owner, ERA Shepard & Associates. Personal communication. January, 2010.). This total does not include homes for sale by owners, without the assistance of a listing agency. Rawlins had a total of 30 vacant rental units on January 16, 2010 (based on a count of rentals advertised in the Rawlins Daily Times and information from contacting rental agencies). Additionally, both Casper and Rawlins have a large number of residential lots for sale. Therefore, the minimum number of rentals and homes available as of January 2010 in Casper and Rawlins is 795.

Data were not collected for other communities within driving distance from the Permit Area, such as Wamsutter, Bairoil, and Jeffrey City.

4.15.7.1 Construction

As previously noted, 74 people would be directly employed by the Project during the Initial Construction stage. Indirect and direct employment by the Project would range from 125 to 126 positions. Therefore, as many as 126 housing units would be required during the Initial Construction stage. However, a portion of the workforce already resides in the area.

The Plant construction workforce and intermittent contractors are anticipated to commute from their residences within the region or use local temporary housing (e.g., apartments, hotels, motels, trailers, RVs). The remainder of the Initial Construction workforce (54 personnel) would likely support activities of the Mine Unit Development stage, Operation phase and Reclamation phase; therefore, the majority of the workforce would likely rent or purchase houses.

Initial Construction in this EIS is similar to that of the Construction phase evaluated in the NRC SEIS. Section 4.11.1.1 of the NRC SEIS discusses how in the short-term, the influx of Construction employees could impact the demand for rental units in the region. However, since it is for a short time, the long-term impact would be negligible (NRC, 2011a).

Upon starting Mine Unit Development, the majority of the workforce (54 personnel) would already have established residence in the region during Initial Construction. An additional 32 to 52 technical LCI employees would likely move from outside of the region. Thus, 54 to 89 housing units would be required to support the direct (32 to 52 employees) and indirect (22 to 37 employees) employees of the Project.

The combination of Mine Unit Development, Operation, and Mine Unit Reclamation in this EIS is similar to that of the Operation phase evaluated in the NRC SEIS. Section 4.11.1.2 of the NRC SEIS describes how the workforce associated with the Operation phase might increase the demand for permanent housing in the region. However, since there is a small number of Operation phase employees and the housing development in the region has kept pace with the population changes, the impact is not expected to be significant.

4.15.7.2 Operation

The cost of living and housing impacts during Operation are not anticipated to differ from those during Mine Unit Development.

4.15.7.3 Reclamation

The cost of living and housing impacts during Mine Unit Reclamation are not anticipated to differ from the Operation phase.

The housing required during Final Reclamation would be similar to that required during Initial Construction. The technical staff from Mine Unit Development, Operation, and Mine Unit Reclamation would be reduced and would likely apply their skills at other nearby ISR facilities or extractive industries. Meanwhile, the contract employees hired for deconstruction and decommissioning would likely commute from their residences within the region or use local temporary housing (e.g., apartments, hotels, motels, trailers, RVs). Similar to the reduced technical staff at the beginning of the Final Reclamation stage, the LCI employees and contractors that remain at the time of Project completion would likely apply their skills at other nearby ISR facilities or extractive industries.

Final Reclamation in this EIS is similar to that of the Reclamation phase evaluated in the NRC SEIS. Section 4.11.1.4 of the NRC SEIS discusses how in the short-term, the influx of Reclamation employees could impact the demand for

rental units in the region. However, since it is for a short time, the long-term impact would be negligible (NRC, 2011a).

4.15.8 Impacts to Infrastructure and Services from the Proposed Action

With a population influx, improvements to infrastructure and services may be required sooner than anticipated and, if so, would have budgetary effects on local governments. Increases in taxes and revenues would provide counties and communities with funding to develop and/or maintain infrastructure and to support the increased population.

Due to the taxing system, impacted localities may not receive adequate funds in a timely manner to keep pace with increased demand. As previously noted, receipt of taxes generally lags one year behind production; therefore, affected counties and communities would not receive funds until two years after construction begins. Therefore, the following discussion is based on the impacts from the Project as a whole to specific items (e.g., education) rather than the individual phases of the Project.

Additionally, the distribution of increased tax revenue generated by the Project may not accrue or be proportionately distributed to the localities experiencing increased demand. Tax revenue would accrue mainly in Sweetwater County and in the State, even though the majority of the Project's workforce is anticipated to reside in Carbon and Natrona counties. Similarly, communities experiencing increased infrastructure and service demand may not receive a proportionate level of tax increase as sales tax tends to accrue in the larger population centers with more amenities. For example, even though Sweetwater County communities near the Permit Area would experience increased demand on infrastructure and services, a large portion of goods and services would be purchased in Carbon and Natrona counties. However, the costs associated with increased demand of public facilities and services are expected to be minimal.

4.15.8.1 Education

The Project's peak direct employment would be about 106 employees, with an indirect employment of 74 people. Assuming each employee has a family that would move from outside of the region, the children of about 180 families would be enrolled in the region's school districts. If an average person has a working career of 45 years and school-age children reside in the household for approximately 17 years, then 38 percent of the employee's working career would be associated with school-age children. Assuming each family has 1.86 children (US Census Bureau, 2004), the following equation would be used to estimate the number of school-age children:

180 families	x	1.86 children per family	x	38 % of time	=	127 school-age children

The Project region's school capacity is sufficient for a conservative estimate of an additional 127 students. In 2008, Bairoil enrolled 5 elementary school students; Wamsutter enrolled 83 elementary and middle school students; Rawlins enrolled 1,569 elementary, middle, and high school students; and Casper enrolled 10,786 elementary, middle, and high school students. Thus, an increase of 127 students in these schools would increase student enrollment by 1.0 percent. Impacts to education would likely be minimal because: a portion of the anticipated families already reside in the region; the majority of the families are anticipated to reside in Rawlins or Casper, which would easily accommodate this increase; and the schools that could be impacted (in Bairoil and Wamsutter) already use Rawlins' schools for at least high school if not middle school and high school. In addition, the regional school districts have accommodated more students than those enrolled in 2008. For example, Sweetwater School District One's enrollment was 5,033 students in 2009 and was 6,127 students in 1991 (Wyoming Department of Education, 2010). Carbon County School District One's enrollment was 1,803 students in 2009 and was 2,420 students in 1991. Natrona School District One's enrollment was 11,743 students in 2009 and was 13,100 students in 1994.

According to Section 4.11.1.2.6 of the NRC SEIS, the Operation phase may have a small impact to the number of students in the schools. (The combination of the Mine Unit Development stage, Operation phase, and Mine Unit Reclamation stage is similar to that of the Operation phase evaluated in the NRC SEIS.) However, the number is expected to be so small that the schools would not experience any significant changes (NRC, 2011a).

4.15.8.2 Health Care

Basic medical and emergency services that may be required in the event of an accident would be available at the Permit Area. Potential impacts to local health services, such as hospitals or emergency clinics, would be minimal. Local communities would need a minimal increase in emergency response and medical treatment capabilities due to the small risk of industrial accident of the Project.

Existing emergency response and medical treatment capabilities handle industrial accidents similar to those that could occur at the Permit Area; and a variety of industrial and hazardous materials are transported on Interstate 80 through Rawlins, which is about a 50-mile drive southeast of the Permit Area. Therefore, basic services are already established that can support the Project.

According to Section 4.11.1 of the NRC SEIS, the demand for health services would increase with the influx of new employees. However, the small number of workers would have a small influence on the region (NRC, 2011a).

4.15.8.3 Law Enforcement and Fire Protection

Law enforcement and fire protection services have adequate capacity for the increased population.

4.15.8.4 Communications and Utilities

Communication services have adequate capacity for the increased population.

An overhead electrical power line would be constructed to supply power for the Project at the Permit Area. The power line would connect to the pre-existing transmission line located directly west of the Permit Area. In addition, water supply and some waste disposal facilities for the Project would be developed by LCI due to the lack of such facilities in the vicinity of the Permit Area.

The communities of interest have ample utilities to accommodate the increase in population. However, the Rawlins utility infrastructure is in need of repair. With the population influx, improvements to public water, sewer, and street facilities and services may be required sooner than anticipated and would have budgetary effects on the local government.

4.15.8.5 Recreation

The population increase would directly affect recreational use and participation. Since the current recreational infrastructure and regulatory oversight are adequate to accommodate the population increase, the revenue generated by the increased recreation would benefit the local communities and the State.

In addition, data collection and increased economic activity would enhance cultural, educational, and recreational opportunities. The social, cultural, and environmental data collected for the Project would enhance the understanding and value of the Permit Area and its environs.

As discussed in **Section 4.2**, impacts to recreational land use would be negligible due to the short-term duration of the Project and the small area of disturbance and/or restriction. For instance, hunting, which is the primary recreational activity, would be restricted to areas outside fenced portions of the Permit Area for safety reasons, but would not be permanently affected, and may be improved due to wildlife habitat reclamation and improved transportation routes.

4.15.9 Socioeconomic Impacts from Other Alternatives

4.15.9.1 No Action Alternative

Under the No Action Alternative, the local, regional and national socioeconomics would reflect the baseline conditions described in **Section 3.14**.

4.15.9.2 Other Action Alternatives

Not Fencing the Pattern Areas would minimally reduce the Project's expenditures (thus, revenue and taxation) and employment. The overall socioeconomic impact of Drying Yellowcake On-Site would be limited compared to the socioeconomic impact of the Project as a whole.

4.16 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income. In 1994, President Bill Clinton passed Executive Order 12898 to address environmental justice through federal agencies.

Per this executive order and subsequent guidelines, this section identifies known minority, low-income, and Tribal populations within the socioeconomic study area, evaluates whether or not these populations may have disproportionately high or adverse human health or environmental effects from the Project, and discusses the manner in which all populations would be treated fairly and meaningfully involved.

The results of the following assessment are in general agreement with the Section 4.12 of the NRC SEIS which determined that the environmental and socioeconomic impacts of the Proposed Action would not disproportionately affect the populations of concern. The NRC SEIS also evaluated potential radiological impacts from subsistence consumption of fish and wildlife as part of traditional lifestyles and concluded there would not be any disproportionate impacts (NRC, 2011a).

4.16.1 Agency-Required Measures

The need for protective measures of environmental justice impacts is not anticipated.

4.16.2 Monitoring of Environmental Justice Impacts

Monitoring of environmental justice impacts is not anticipated.

4.16.3 Environmental Justice Impacts from the Proposed Action

4.16.3.1 Identification of Minority, Low-Income, and Tribal Populations

Minority Populations

Consequent to Executive Order 12898, the Interagency Working Group on Environmental Justice was created, comprising twelve federal agencies and several White House offices (EPA, 2010b). The Interagency Working Group

developed guidance on key environmental justice terms. The Interagency Working Group defines a minority as an individual who is a member of the following races and ethnicity: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (Council on Environmental Quality, 1997). A minority population is a population in which: the minority population represents more than 50 percent of the total population; or the minority to general population ratio of the affected area is meaningfully greater than the minority to general population ratio of the larger, general area. A minority population may be either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (e.g., migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

As shown in **Table 4.16-1**, at least 90 percent of the population of each county of interest and the State of Wyoming was white in 2000, with the exception of Fremont County. Fremont County's population was 77 percent white and 20 percent American Indian or Alaskan Native (largely from the Wind River Indian Reservation). The communities of interest were also predominantly white. The white population in Bairoil, Wamsutter, Jeffrey City, and Casper represented 94 to 100 percent of the total population. Rawlins had the lowest percentage (86 percent) of white population; the general remainder of Rawlins' population was either some other race (eight percent) or more than two races (three percent).

As noted in **Section 3.14**, six percent of the State's population was of Hispanic or Latino ethnicity in 2000. About four to five percent of Fremont and Natrona counties' populations were of Hispanic or Latino ethnicity, whereas Sweetwater and Carbon counties' Hispanic or Latino ethnic populations were 9 and 14 percent, respectively. The Hispanic or Latino population in Bairoil, Jeffrey City, and Casper represented no more than five percent of the total population. Wamsutter's and Rawlins' Hispanic or Latino populations were 13 and 21 percent of the total population, respectively.

In 2000, within the socioeconomic study area, the population of minorities was less than 50 percent of the total population. In addition, the minority to general population ratio of the affected area was comparable (within 20 percent) to the minority to general population ratio of the larger, general area. Therefore, disproportionately high or adverse impacts to any minority race or ethnicity are not anticipated.

Low-Income Populations

Low-income populations are identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-

60 on Income and Poverty (Council on Environmental Quality, 1997). The thresholds represent the minimal annual cash income to support various-sized families, and are updated annually to account for inflation.

As shown in **Table 4.16-2**, from zero to 13 percent of families and from four to 17 percent of individuals within the places and areas of interest lived in poverty in 1999. These percentages are similar (within 20 percent) to the State-wide average of 8 and 11 percent for families and individuals below the poverty level, respectively. Based on the data above, low-income populations are not anticipated to be disproportionately affected by the Project.

Table 4.16-1 Populations by Race and Ethnicity, 2000

Place	Race														Ethnicity	
	White		Black or African American		American Indian & Alaska Native		Asian		Native Hawaiian & Other Pacific Islander		Some Other Race		Two or More Races		Hispanic or Latino	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
State of Wyoming	454,670	92	3,722	1	11,133	2	2,771	1	302	0	12,301	2	8,883	2	31,669	6
Sweetwater County	34,461	92	275	1	380	1	240	1	16	0	1,349	4	892	2	3,545	9
Bairoil	97	100	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Wamsutter	245	94	0	0	2	1	0	0	0	0	8	3	6	2	34	13
Carbon County	14,092	90	105	1	199	1	105	1	9	0	808	5	321	2	2,163	14
Rawlins	7,331	86	69	1	125	1	72	1	8	0	707	8	226	3	1,797	21
Fremont County	27,388	76	44	0	7,047	20	106	0	9	0	417	1	793	2	1,566	4
Jeffrey City [1]	104	98	0	0	1	1	0	0	0	0	0	0	1	1	2	2
Natrona County	62,644	94	505	1	686	1	277	0	25	0	1,275	2	1,121	2	3,257	5
Casper	46,680	94	428	1	495	1	245	0	10	0	1,011	2	775	2	2,656	5

* US Census Bureau, 2000
[1] Census Designated Place

Table 4.16-2 Low Income Populations, 1999

Place	Families				Individuals			
	Families Below Poverty Level		Total Families		Individuals Below Poverty Level		Total Individuals	
	#	%	#	%	#	%	#	%
State of Wyoming	10,585	8	131,508	100	54,777	11	493,782	100
Sweetwater County	548	5	10,194	100	2,871	8	37,613	100
Bairoil	2	8	25	100	4	4	97	100
Wamsutter	8	11	70	100	28	11	261	100
Carbon County	411	10	4,180	100	1,879	12	15,639	100
Rawlins	235	10	2,259	100	1,114	13	8,538	100
Fremont County	1,267	13	9,495	100	6,155	17	35,804	100
Jeffrey City [1]	0	0	27	100	7	7	106	100
Natrona County	1,548	9	17,772	100	7,695	12	66,533	100
Casper	1,122	8	13,238	100	5,546	11	49,644	100

* US Census Bureau, 2000
[1] Census Designated Place

Tribal Populations

Table 4.16-1 shows the American Indian and Alaskan Native populations within the socioeconomic study area. Fremont County has 63 percent of the American Indian and Alaskan Native population of the State of Wyoming. A large portion of the tribal population in Fremont County resides at the Wind River Indian Reservation, which is centered approximately 75 miles north-northwest of the Permit Area and would not be directly impacted by the Project. The tribal populations in other places and areas of interest represent less than two percent of the total populations. As such, tribal populations would not be disproportionately or adversely impacted by the Project.

4.16.3.2 Fair Treatment and Meaningful Involvement

To ensure environmental justice, all people are and would be treated fairly and meaningfully involved. Fair treatment is defined as when no group of people bears a disproportionate share of negative environmental consequences resulting from industrial, governmental, and commercial operations or policies (EPA, 2010a). Meaningful involvement is defined as when: people have the opportunity to participate in decisions about activities that may affect their environment and/or health; the public can influence the regulatory agency's decision; public

concerns are considered in the decision making process; and the decision makers seek out and facilitate the involvement of potentially affected people.

Fair treatment and meaningful involvement has been and would continue to be implemented by the following:

- publishing Notices of Intent and Notices of Availability to announce the scoping meeting(s) and document accessibility in the Federal Register and/or the local media (e.g., newspaper, radio, television);
- consulting with other federal agencies, Tribal leaders, the State and local governments, community groups, and similar groups (**Section 6.0**);
- developing stakeholder mailing lists;
- overcoming linguistic, cultural, institutional, and geographic barriers;
- providing public access to pertinent notices, documents, and meetings;
- scheduling meetings at convenient times and places that are local and accessible;
- sharing information through different meeting sizes, formats, media, or other methods;
- soliciting feedback and recommendations through written communication, personal interviews, audio/video recording devices, or other methods; and
- periodically updating stakeholders about the NEPA process.

4.16.4 Environmental Justice Impacts from Other Alternatives

4.16.4.1 No Action Alternative

The No Action Alternative would have no environmental justice impacts.

4.16.4.2 Other Action Alternatives

Differences in environmental justice impacts are not anticipated between the Proposed Action and Other Action Alternatives described in **Section 2.0**.

4.17 Public and Occupational Health

Potential impacts on public and occupation health are discussed on the basis of radiological and non-radiological impacts.

4.17.1 Agency-Required Measures

The required environmental protection measures are summarized below from Appendix D10 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Sections 3.12.1, 3.12.2, 3.12.3, 4.13.1.1, 4.13.1.2, 4.13.1.3, 4.13.1.4, .4.13.2, and.4.13.3 of the of the NRC SEIS (NRC, 2011a), and Conditions 9.7, 10.4, 10.14, 10.15, 10.16, 10.17, 11.6, 12.2, 12.3, 12.5, 12.10, 12.11, and 12.14 of the NRC License (NRC, 2011b).

Efficient ISR operation, including mine unit balancing and monitoring, and up-to-date techniques for ore processing and for waste storage, handling, and disposal, would be used to keep contaminants of concern out of any pathways that could result in impacts to public or occupational health. Employee training for both routine procedures and for unseen circumstances would help reduce the potential for accidents. There are requirements for personnel training, specifying the chain of command, equipment calibration, record keeping, and reporting to both the agencies and workers. Because of the relatively remote location of the Project, mitigation of impacts to the public comes from primarily ensuring visitors to the site receive the appropriate training and monitoring, and are only allowed access to areas outside of the established exclusion zones.

4.17.1.1 Protection Measures for Radiological Impacts

As previously discussed, radiological impacts from the Project are minimal. Mine unit and Plant design are intended to result in effective and efficient mining and ore processing. For example, the water balance details, the mine unit instrumentation, and the Plant design are described in Sections OP 3.6.3.1, OP 3.6.1.1, and OP 4.4 of the WDEQ-LQD Permit to Mine (LCI, 2011b), respectively. Worker training and worker and environmental monitoring would be conducted throughout the life of the Project, to ensure that the practices and procedures developed prior to the Project are properly implemented and effective (Section 5.0 of the NRC Technical Report [LCI, 2010]). In addition to the practices and procedures developed before the Project is started, periodic reporting to and inspections by the NRC are also required throughout the life of the Project.

As discussed in Section 6.0 of the NRC Technical Report (LCI, 2010), the NRC also requires licensed facilities to submit a decommissioning plan for review prior to the reclamation of each Mine Unit and prior to Final Reclamation. The plan would include details of how a radiation safety program, compliant with 10 CFR

Part 20, would be implemented during decommissioning to ensure the safety of workers and the public is maintained and applicable safety regulations are followed. The existing reclamation plan in the NRC Technical Report specifies the necessary surveys prior to reclamation to double check that no unanticipated, elevated radiation levels exist in the area to be reclaimed. The plan also specifies the radiation levels for determining whether decontaminated equipment must be disposed of in a licensed facility or can be reused.

4.17.1.2 Protection Measures for Non-Radiological Impacts

Similar to the protection measures of radiological impacts, measures used for non-radiological impacts depend on proper facility design, operation, and maintenance and on worker training and worker and environmental monitoring. The Wyoming Department of Employment (State OSHA Program) requirements and regulations will be followed. In addition to general practices and procedures, specific requirements for unique situations are also required. For example, protection practices related to facility design and handling and storage of the chemicals that would be used at the Project are detailed in Sections 7.5 and 7.6 of the NRC Technical Report (LCI, 2010).

4.17.2 Monitoring of Public and Occupational Health Impacts

4.17.2.1 Radiological Impacts

The radiological monitoring required by the NRC is detailed and extensive. LCI's radiological monitoring program is included in Section 5.0 of the NRC Technical Report (LCI, 2010). In addition to specifying monitoring locations, parameters, and frequency, there are requirements for personnel training, specifying the chain of command, equipment calibration, record keeping, and reporting to both the agencies and workers.

The required monitoring addresses both workers and the public. With respect to workers, monitoring of the workers, the work place, and the environment is required. For example, monitoring of the workers includes radiation badges and, for specific work circumstances, may also include breathing zone sampling. Examples of work place monitoring include gamma surveys of the ion exchange tanks and smear samples of work surfaces. Examples of environmental monitoring include routine soil sampling and air particulate sampling at specific locations relative to the Plant and Permit Area.

With respect to the public, the radiological monitoring required by NRC specifies monitoring procedures for contractors and visitors to the Project, in addition to establishment of exclusion zones where only specified, trained LCI personnel are allowed. At the Permit Area boundary, monitoring for radon, gamma, and air particulates is required.

4.17.2.2 Non-Radiological Impacts

The monitoring requirements for the non-radiological health impacts of the Project are those typical for industries, such as drilling, which are regulated by OSHA. In particular, reporting of all accidents, investigating the circumstances causing the accident, and implementing improved practices where necessary are essential to monitoring the effectiveness of the Project's health and safety practices. The regular inspections of work areas, as described in Section 2.9 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Section 5.0 of the NRC Technical Report (LCI, 2010), would also help ensure the Project's health and safety practices are effective.

4.17.3 Impact Significance Criteria

Radiological impacts were evaluated on the basis of potential exposures to workers and the public during the Project phases compared to naturally occurring and anthropogenic exposures. Both worker and public radiological exposures are addressed in NRC regulations in 10 CFR Part 20, which requires licensees to implement an NRC-approved radiation monitoring and protection program.

The non-radiological impacts were evaluated on the basis of relative hazards of the work processes (e.g., drilling) and materials (e.g., chemicals). Although the Project is a mining operation, the industrial safety aspects associated with the Project are regulated by the Wyoming Department of Employment (State OSHA Program) because most of the Project activities are more similar to other industries (e.g., drilling and manufacturing) than traditional mining.

4.17.4 Public and Occupational Health Impacts from the Proposed Action

The Project would use ISR technology to extract uranium from permeable, uranium-bearing sandstones. Once extracted, the uranium would be recovered by means of ion exchange, elution, and precipitation/filtration to ultimately produce yellowcake slurry. The operation plan for the Proposed Action is presented in **Section 2.0**.

There are no permanent residents within 15 miles of the Permit Area, significantly reducing the possibility of public impacts. Potential public health impacts, however, were evaluated to ensure the health of occasional near/on-site members of the public, such as hunters and ranchers. In addition, the workforce for the ISR operation would be relatively small, especially as compared to the work force needed for surface mining of uranium and conventional mill operation, reducing the possibility of occupational impacts.

4.17.4.1 Radiological Impacts

The purpose of this section is to evaluate the potential impacts for radiological exposures above the levels of naturally occurring exposures. Naturally occurring exposures are due to the presence of radioactive materials in the earth. (For example, radon-222 is a radioactive gas that escapes into ambient air from the decay of uranium found in most soils and rocks.) As a result, radioactive materials are also found in drinking water and foods. Cosmic radiation from outer space is another natural source of radiation. There are also anthropogenic sources, such as medical diagnostic procedures using radioisotopes. The National Council for Radiation Protection (NCRP) estimates the annual average dose to the public from all natural background radiation sources (terrestrial and cosmic) is 310 millirems (mrem), and the annual average dose to the public from all sources (natural and anthropogenic) is 620 mrem (NCRP, 1987).

Construction

None of the activities during Construction involve worker exposure to uranium ore and associated radiological parameters, with the possible exceptions of short-term exposure drilling of the deep wells and potential movement of soil with elevated radionuclide concentrations. With respect to the deep wells, the locations were selected on the basis of minimizing interference with production of known uranium resources. Therefore, interception of uranium ore during drilling, and subsequent movement of the material to the surface via the drilling process, is unlikely. With respect to movement of soil with elevated uranium concentrations, the results of the site-wide gamma scan and soil sampling (**Section 3.15**) do not indicate the presence of radionuclides in excessive quantities in Construction areas at the surface due to the presence of ore (e.g., an outcrop) or prior exploration activities. Practices to prevent worker exposure to inhalation of fugitive dust, e.g., dust masks, and to minimize creation and transport of dust, e.g., application of magnesium chloride (**Section 4.11**), that are implemented for air quality concerns would reduce the potential for transport of radionuclides in soil if they were encountered.

Exclusion of the public from Construction zones, following standard health and safety regulations and practices, along with practices to minimize creation and transport of dust, would preclude radionuclide exposure to the public during Construction.

During Mine Unit Development, the drilling of wells in the pattern areas increases the potential for exposure to radionuclides as the water and drill cuttings from the ore zone are brought to the surface and circulated through the mud pit. However, the relative volume of the water and cuttings from the ore zone, which is on the order of a few feet thick, relative to the overall volume of drill cuttings from a given well, which is several hundred feet deep, is minimal. In addition, periodic monitoring of mud pits is required by NRC.

Section 4.13.1.1 of NRC SEIS discusses that workers would most likely be exposed during well construction, disturbing surface soils, and fugitive dust, but that concentrations would be low, and any health impacts for employees and the general public would be low (NRC, 2011a).

Operation

During the Operation phase, radon would be released from the solutions at the mine units and vented from the Plant building to the atmosphere during routine operation or when vessels are opened for maintenance. Experience from other ISR projects shows that these releases would only be a small fraction of the natural background dose contribution and would not result in a significant off-site impact. Potential public exposures to radiation could occur from the same radon releases. The MILDOS-AREA computer code (ANL, 1998) was used to estimate potential exposures and doses to human receptors and populations surrounding the Permit Area, and the results are summarized below. Details on input parameters, exposure pathways, as well as the results of the MILDOS modeling are presented in the NRC Technical Report (LCI, 2010). The potential for exposures due to accidental releases during the Operation phase was also evaluated as part of the Technical Report, and the results are also summarized below.

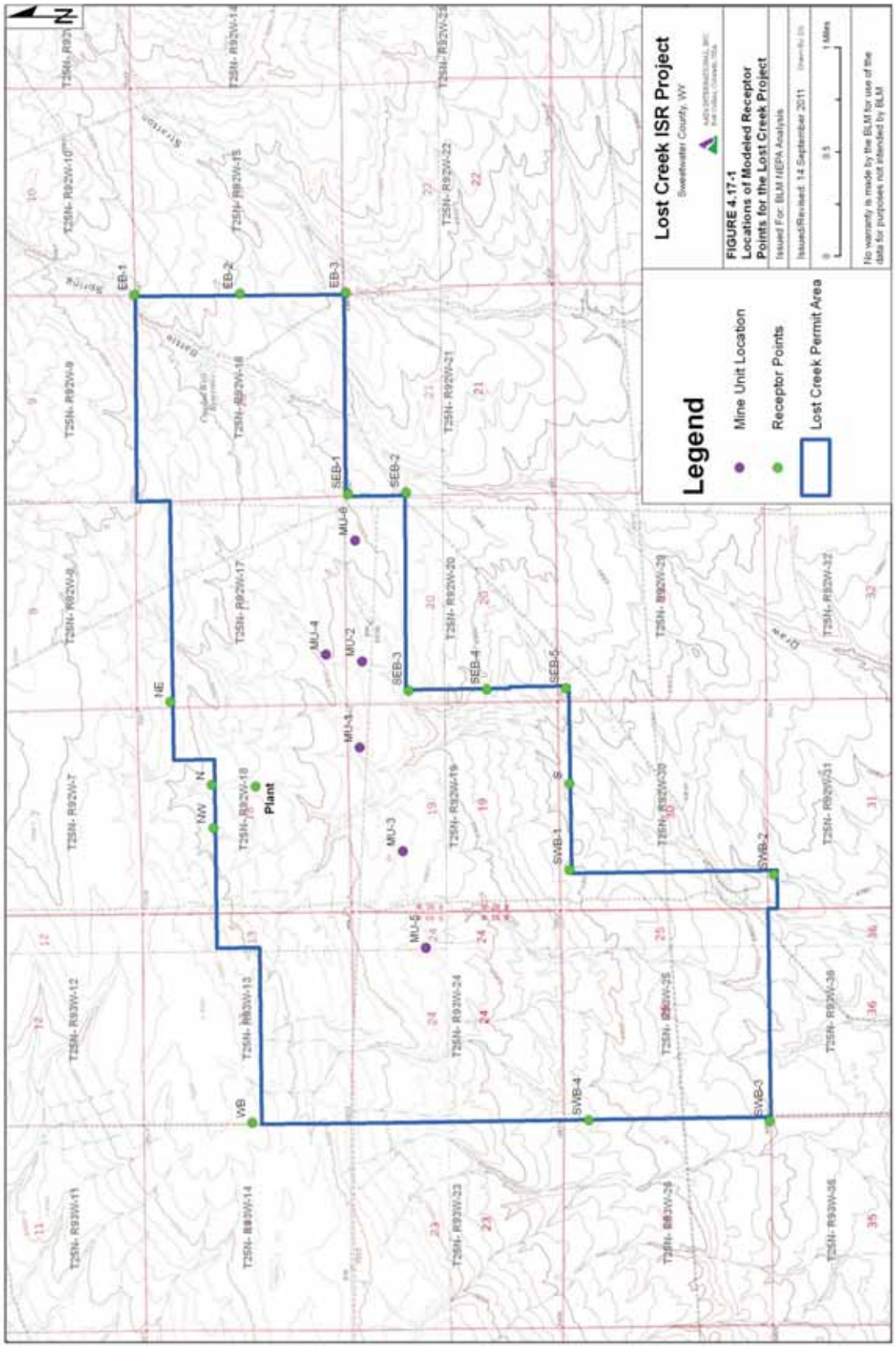
Section 4.13.1.2 of the NRC SEIS summarizes how employees and the public can become exposed during normal operations and accidents. The expected doses during normal operations are below the regulated limits, and any impacts from this exposure would not be expected. Additionally, the mitigation efforts to prevent accidents and the response plans if an accident does occur minimize the threat from spills and reduce the potential impact (NRC, 2011a).

Operational MILDOS Modeling Results

Since there are no permanent residents in the vicinity of the Permit Area, radon doses were modeled at 17 locations around the perimeter of the Permit Area boundary (**Figure 4.17-1**). The map shows modeled receptor locations, as well as centroids of each mine unit. MILDOS calculations and output use metric units; this discussion refers to English and metric length units for the sake of consistency.

MILDOS modeling indicates that releases from the site lead to a maximum calculated total effective dose equivalent (TEDE) to a potential resident at the SEB1 boundary location of 3.01 mrem, which is well below the 100-mrem-per-year limit of Title 10 CFR Part 20 (**Figure 4.17-2**). No other boundary location exceeds 2 mrem in a given year and most are below 1 mrem. The vast majority of the calculated doses at the SEB1 location are from venting during operation, which occurs at the centroid of the mine unit. Most mine units are upwind of the SEB1 location.

There are no towns of any size within 15 miles of the Permit Area. While there are no standards for population dose, it is interesting to compare population doses from the Project, calculated from MILDOS, to the natural background for the same region. The average US resident receives 360 mrem per year (NRCP, 1987). When applying this average US effective dose to the MILDOS population (8,985 residents), the natural background population dose (TEDE) would be approximately 3,200 person-rem per year, which is over 170,000 times higher than that of the calculated maximum 0.019 person-rem-per-year population dose within 50 miles of the Permit Area.


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 4.17-1
Locations of Modeled Receptor Points for the Lost Creek Project
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0
0.5
1 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Mine Unit Location
Receptor Points
Lost Creek Permit Area
EB-1
EB-2
EB-3
SEB-1
SEB-2
SEB-3
SEB-4
SEB-5
SWB-1
SWB-2
SWB-3
SWB-4
MU-1
MU-2
MU-3
MU-4
MU-5
MU-6
NE
N
NW
W
SW
S
Plant
T25N- R92W-7
T25N- R92W-8
T25N- R92W-9
T25N- R92W-10
T25N- R92W-11
T25N- R92W-12
T25N- R92W-13
T25N- R92W-14
T25N- R92W-15
T25N- R92W-16
T25N- R92W-17
T25N- R92W-18
T25N- R92W-19
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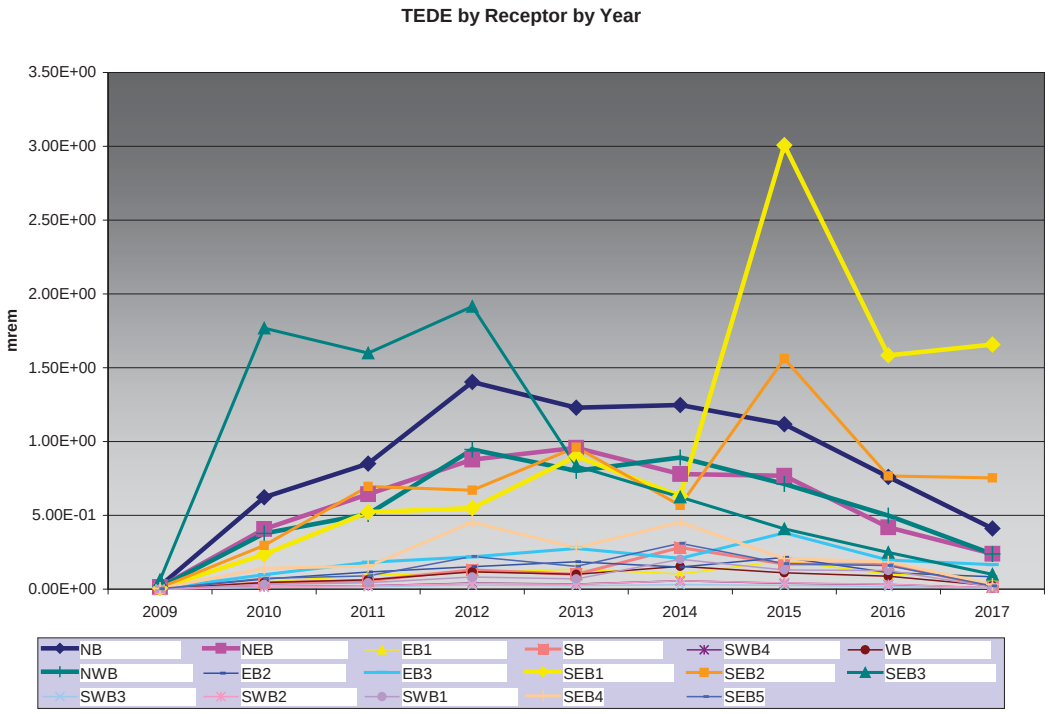
T25N- R92W-36

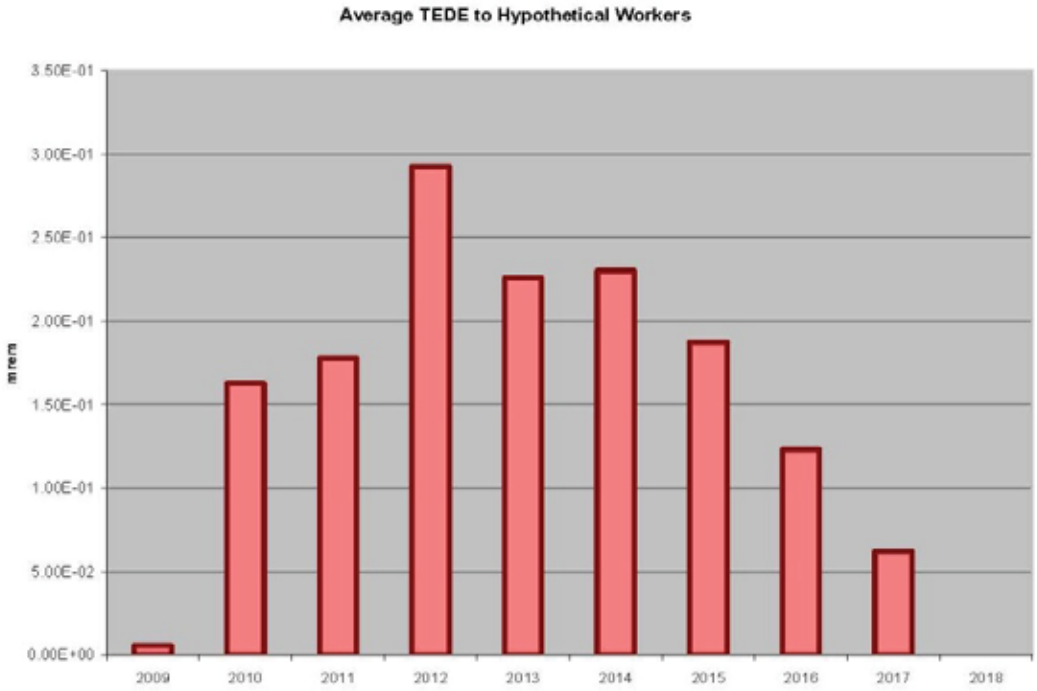
Figure 4.17-2 TEDE at Boundary Receptor Points



MILDOS is not commonly used to calculate occupational doses, because such doses are calculated using results of personnel monitoring during facility operation. However, a hypothetical worker location was used in MILDOS to calculate doses through the operation of the Plant. The worker location was modeled once for 328 feet (100 meters) to the north, east, south and west of the ion exchange facility. For each worker receptor location, a dose was calculated, multiplied by 0.22 to represent an occupational year (2,000 work hours in an 8,760-hour year), and averaged. The maximum worker dose would be 0.3 mrem in 2014, which is well below the occupational standard of five rem (**Figure 4.17-3**). This value is likely an overestimate for a worker at the specified locations, because MILDOS includes contributions from pathways, such as ingestion of vegetation, which would not apply to the Permit Area. During operation of the facility, workers at the site would be monitored and occupational doses calculated in accordance with the NRC License.

There are no current dosimetric standards for protection of biota. However, it has been assumed by the International Commission on Radiological Protection that if humans were protected, then biota in the same exposure environment would also be protected.

Figure 4.17-3 MILDOS-Calculated Doses to a Hypothetical Worker 328 feet (100 meters) from the Plant, Averaged over Direction



Accidental Releases

The precautions put into place for the Project are intended to reduce the risk of accidents and associated releases as much as possible. Even so, the consequences of various on-site accidents and transportation accidents were evaluated as part of the NRC Technical Report (LCI, 2010). Specifically, Sections 4.1.2, 7.4.1, and 7.4.2 include evaluations of the consequences of releases from areas in the Plant with the higher concentrations of radioactive material, such as the yellowcake slurry storage tanks. Similarly, Section 7.2.7 includes evaluations of the consequences of off-site transportation accidents.

Reclamation

Exposures to workers could occur during disassembly of equipment used to convey production fluids from the mine units and equipment used in the Plant. Decontamination of equipment could also result in exposures, and for equipment that cannot be decontaminated, packaging of the equipment for transport to a designated disposal facility could also result in exposure if not done in accordance with specified practices and procedures.

Sections 4.13.1.3 and 4.13.1.4 of the NRC SEIS discuss that while there is a potential for some exposure during the reclamation efforts, the mitigation efforts and the clean-up of the area reduces these, and the impact on public and worker health is expected to be minimal (NRC, 2011a).

4.17.4.2 Non-Radiological Impacts

Increased traffic from the Project would increase the amount of gaseous emissions and airborne particulates. Potential impacts from these emissions are discussed in **Section 4.11**.

Construction

During Construction, most of the potential non-radiological impacts are related to mechanical hazards, such as operation of heavy equipment and drilling, and to exposure of emissions from engines on vehicles and equipment. Potential impacts include injuries or irritation of the eyes, nose, or respiratory system.

Section 4.13.1.1 or the NRC SEIS discusses the potential exposure to emissions from diesel exhaust fumes, but explains that the short exposure time and the quick dispersal into the atmosphere lead to minimal impacts (NRC, 2011a).

Operation

During the Operation phase, there are potential chemical exposures. Chemicals used in bulk quantities at the Permit Area would include sodium chloride, sulfuric acid, oxygen, hydrogen peroxide, CO_2, sodium carbonate, hydrochloric acid, as wells as fuels (diesel and gasoline), and smaller quantities of chemicals may be needed for laboratory procedures. As with radioactive materials, the precautions put into place for the Project are intended to reduce the risk of accidents and associated releases as much as possible. Even so, the consequences of various on-site accidents and transportation accidents were evaluated as part of the NRC Technical Report (LCI, 2010). Specifically, Sections 7.5 and 7.6 include evaluations of the consequences of releases from areas in the Plant in which chemicals would be stored and used, such as the hydrochloric acid storage tanks. Similarly, Section 7.4.7 includes evaluations of the consequences of off-site transportation accidents.

Section 4.13.1.2.3 of the NRC SEIS discusses the potential impacts from working with the chemicals present on-site. Any spills would have a minimal impact on the public off-site, but a potentially higher impact on workers if proper clean-up is not accomplished shortly after the spill. However, with the spill prevention and mitigation measures the impact from these spills is reduced since if one occurs, it would be properly addressed (NRC, 2011a).

Reclamation

The primary concerns during Reclamation would be similar to those during Construction, including operation of heavy equipment and exposure to engine emissions.

Section 4.13.1.4 of the NRC SEIS discusses the potential health impacts that could occur during Reclamation. The NRC suggests that as cleaning efforts progress in the Permit area, the likelihood for health impacts decreases, and that overall, the impact would be minimal (NRC, 2011a).

4.17.5 Public and Occupational Health Impacts from Other Alternatives

4.17.5.1 No Action Alternative

The No Action Alternative would generate no impact on public and occupational health.

4.17.5.2 Other Action Alternatives

The alternative of Not Fencing the Pattern Areas increases the potential for access to the pattern areas. The primary concern is that cattle or wild horses would damage the well heads, resulting in a release of production fluid, i.e., a radiological exposure. Procedures that are in place for detecting releases, repairing equipment, and implementing appropriate remediation measures would reduce the potential for exposure to radiological materials. With respect to non-radiological hazards, fencing the pattern areas reduces the potential access for someone unfamiliar with the pattern area hazards (e.g., trip and fall hazards in the header houses).

The alternative for Drying Yellowcake On-Site increases the potential radiation exposure to workers in the Plant. The potential exposure is not during operation of the dryer, because the vacuum system is designed to prevent release of radiological particulates. The potential exposure could occur during maintenance and reclamation of the dryer or during an accidental release, and this exposure would be similar to that of the Proposed Action. In addition, before a dryer could be installed, an NRC license amendment would be required, which would include further detail on dryer operation, monitoring, and decommissioning. The vacuum dryer and associated equipment would not be significantly more complex than the other processing equipment in the Plant; therefore, the potential increase in non-radiological impacts would be minimal. Because the dryer would be located within a restricted area of the Plant, there would be no potential for public exposure during routine operations.

4.18 Waste Management

During the Project, gaseous/airborne, liquid, and solid effluents would be generated from the processes associated with ISR operations. All of 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. Waste streams from different phases of the Project and waste management practices for the Project are described in **Section 2.1**. The waste management control practices are also described in Section OP 5.0 of the WDEQ-LQD Permit to Mine (LCI, 2011b) and Section 4.0 of the NRC Technical Report (LCI, 2010).

4.18.1 Agency-Required Measures

The required environmental protection measures are summarized below from Sections OP 5.2, 5.3 and RP 4.2 of the WDEQ-LQD Permit to Mine (LCI, 2011b), Sections 2.1.1.1.6.2 and 2.1.1.1.6.3 of the NRC SEIS (NRC, 2011a), and Conditions 9.6, 9.9, 11.1(D), and 12.6 of the NRC License (NRC, 2011b).

The monitoring programs for non-radioactive emissions and particulates and for radon are described in **Sections 4.11 and 4.17**, respectively.

Liquid and solid wastes would be reduced by reusing/recycling materials whenever possible. The primary measures that would be employed to mitigate waste management impacts would be reduction of wastes and proper storage, handling, and disposal of wastes. Similarly, instrumentation and inspection of process facilities for timely identification and remediation of leaks and spills would reduce the potential for generating large volumes of wastes that would need to be disposed of at a licensed facility. In addition, by disposing of solid non-hazardous wastes at licensed facilities off-site, solid wastes would not be present in the Permit Area after the Project is completed. (For example, at conventional open pit mines, building rubble is often disposed of on-site.) The exception is that well casings may remain in place; however, the casing must be cut off below grade and a deed notice completed to document the well locations (WDEQ-LQD NonCoal Rules, Chapter 11, Section 8(h)(i) [WDEQ, 2005b]).

4.18.2 Monitoring of Waste Disposal Impacts

Gaseous Emissions and Airborne Particulates

The monitoring programs for non-radioactive emissions and particulates and for radon are described in **Sections 4.11 and 4.17**, respectively.

Liquid and Solid Wastes

The Storage Ponds and UIC Class I wells would be routinely inspected, maintained and tested to ensure that any impact-generating potential is kept to minimum. The septic system would be maintained in accordance with the Sweetwater County permit. The UIC Class I wells would be monitored in accordance with the requirements of the UIC permit. An evaluation of the well performance would be included in the Annual Report submitted to NRC and WDEQ.

Monitoring of solid wastes would include inspection to ensure proper storage, selection of licensed disposal contractors, and periodic audits of labels, manifests, and disposal practices.

4.18.3 Impact Significance Criteria

The criteria used to evaluate the impacts of waste management activities are the availability of appropriate treatment options and disposal facilities, the capacity of those disposal facilities (e.g., whether the volume of Project wastes would overtax the facilities), and efficiency of the disposal option (e.g., disposal versus reuse). The impacts of the waste management facilities on specific resources are evaluated in the respective resource sections (e.g., the impacts of the Storage Ponds on wildlife are discussed in the **Section 4.9**).

Section 4.14 of the NRC SEIS addresses waste management impacts. Wastes identified include liquid waste, both radiological and non-radiological, and solid wastes. However, due to the contents, quantity, and management measures, the impact from waste is expected to be small (NRC, 2011a).

4.18.4 Waste Disposal Impacts from the Proposed Action

The following discussion is separated on the basis of the type of effluent, i.e., gaseous/airborne, liquid, or solid effluent, and then on the basis of the phase of the Project, i.e., Construction, Operation, and Reclamation.

4.18.4.1 Gaseous Emissions and Airborne Particulates

As described in **Section 2.1**, non-radioactive and radioactive airborne effluents are anticipated during the Project; however, the relative quantities vary among the Construction, Operation, and Reclamation phases of the Project.

Non-Radioactive Emissions and Particulates

Most non-radioactive emissions and particulates would be generated during Construction, when the most earth moving would occur and heavy machinery would be used for building the Plant. The impacts are, however, short-term.

Compared with the Construction phase, fewer amounts of non-radioactive effluents are expected during the Operation phase and, thus, less impact is anticipated. Impacts during the Reclamation phase are short-term; and the amount of emission and particulates generated would be less than those from Mine Unit Development but more than those from Operation. Detailed discussions of non-radioactive emissions and particulates generated during the Project, as well as their potential impacts, are presented in **Section 4.11**.

Radioactive Emissions

Almost all of the expected radioactive emissions would occur during the Operation phase. There would be minimal radioactive emission, if any, during Construction, and limited amount during Reclamation. Radon would be the radioactive gaseous emission from ISR production and processing, as it is naturally present in the orebody and concentrated in the lixiviant solution. Radon would be released occasionally from the mine unit wells as gas is vented from the injection and production wells. Radon would also be released during ion exchange resin transfers and subsequent processing steps, as described in more detail below. Detailed discussions of radioactive emissions generated during the Project, as well as their potential impacts, are presented in **Section 4.17**.

4.18.4.2 Liquid Wastes

Most of the liquid wastes (in terms of both type and amount [**Table 2.1-1**]) would be generated during Operation. **Table 4.18-1** summarizes the types of liquid wastes generated during the Project phases.

Table 4.18-1 Summary of Liquid Wastes Generated during Different Phases of the Project

Liquid Waste	Construction	Operation	Reclamation
Native Groundwater	Yes	Yes	No
Storm Water Runoff	Yes	Yes	Yes
Waste Petroleum Products and Chemicals	Yes	Yes	Yes
Domestic Sewage	Yes	Yes	Yes
11(e)(2) Byproduct Materials	No	Yes	Yes

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

In Construction, groundwater is recovered during well installation, sample collection, and pump testing conducted prior to Operation or from portions of the Permit Area not affected by ISR operations. This "native" groundwater has not been exposed to any ISR process or chemicals. During well development, sample collection, and pump testing, this water would 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. Because of the relatively small quantities of water discharged at any given time, no impacts are anticipated.

Storm Water Runoff

Throughout the Project, the storm water discharge permits applicable per the WYPDES would be maintained. The associated SWPPP would be implemented as part of LCI's compliance with applicable WDEQ-WQD rules. A copy of the SWPPP is included as Attachment ADJ-3 of the WDEQ-LQD Permit to Mine (LCI, 2011b), and a copy would be in an accessible area at the site. /Because of the limited precipitation at the Permit Area, no impacts are anticipated.

Waste Petroleum Products and Chemicals

LCI would generate about 40 to 80 gallons of waste petroleum products per month, which would be periodically collected by a commercial business for recycling or energy recovery purposes. With respect to hazardous wastes, LCI would be a Conditionally Exempt Small Quantity Generator (CESQG), per EPA definition. About five to ten gallons of waste chemicals not immediately associated with laboratory operations would be generated per year. These waste chemicals would be periodically collected by a commercial business for recycling or disposal in a licensed disposal facility. As a CESQG, LCI could send the hazardous waste to the Sweetwater County District #1 Landfill in Rock Springs (**Section 4.18.4.3**). However, if recycling or reuse alternatives are available, those alternatives would be used to reduce the potential waste disposal impact.

Waste chemicals typically associated with the laboratory 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. An estimated five to ten gallons of these waste chemicals would be disposed of per year. The impacts of the UIC Class I wells are discussed in **Section 4.7**.

Domestic Sewage

Domestic liquid waste would be disposed of in an approved septic system that meets the requirements of the WDEQ-WQD. A permit would be obtained for the septic system prior to construction of the system. The septic system would receive waste from the restrooms, shower facilities, and miscellaneous sinks located within the office. The septic system, which is also permitted by Sweetwater County, would be maintained by a licensed contractor. Given the lack of shallow groundwater at the site, the remote location, and the relatively small work force, impacts to the Permit Area would be limited.

In addition, chemical toilets may be temporarily placed at mine units and other drilling areas. The chemical toilets would be maintained by a licensed contractor, and no impacts are anticipated in the Permit Area.

Liquid 11(e)(2) Byproduct Materials

The three 11(e)(2) byproduct materials (liquid process wastes, 'affected' groundwater generated during well development, and groundwater generated during aquifer restoration) would be treated and disposed of on-site through the Storage Ponds and UIC Class I wells. Because of the controlled on-site disposal procedures, no impacts from the liquid process wastes, other than those associated with the UIC Class I wells, are anticipated in the Permit Area. The Storage Pond impacts and the UIC Class I well impacts are discussed in **Section 4.7**.

The WDEQ has issued a permit to the applicant to drill, operate, and complete the UIC Class I wells in specific geologic formations. The permit specifies well construction, testing and operating conditions the applicant must follow to ensure adequate protection of the public and environmental health and safety. The permitted disposal rate is 250 gpm, based on a 50 gpm rate for each well. The maximum anticipated disposal rate based on the water balance for the Project is 115 gpm. Therefore, even allowing for redundancy, there is sufficient disposal capacity for the Project.

4.18.4.3 Solid Wastes

Table 4.18-2 summarizes the solid wastes generated during the Project phases. Most solid wastes generated during Construction would be non-hazardous (**Table 2.1-1**); no 11(e)(2) byproduct materials would be produced during Construction.

Table 4.18-2 Summary of Solid Wastes Generated during Different Phases of the Project

Solid Waste	Construction	Operation	Reclamation
Non-Hazardous Wastes	Yes	Yes	Yes
Hazardous Wastes	Yes	Yes	Yes
11(e)(2) Byproduct Materials	No	Yes	Yes

Non-Hazardous Solid Wastes

During Construction, most solid wastes would be typical construction debris, including scrap metal, paper, wood, and plastic. Based on empirical assessments of non-residential construction debris (Franklin Associates, 1998), an estimated average weight to volume conversion rate of 100 for such debris (California Department of Resources Recycling and Recovery, 2001), and a construction area of 100,000 square feet, about 150 cubic yards of construction debris would be generated. (The Plant covers about 41,600 square feet, but because of the variety

of facilities, such as the Storage Ponds, a larger square footage was assumed.) During Operation, about 55 cubic yards of non-hazardous solid wastes would be generated each year (LCI, 2011b). During Reclamation, an estimated 1,400 cubic yards of non-hazardous materials would be generated (NRC, 2011a).
The non-hazardous materials would be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at a licensed waste disposal facility. As noted in the NRC SEIS, "The closest location for disposal of non-hazardous solid wastes is the Carbon County landfill north of Rawlins, Wyoming". . . "The municipal waste and the construction and demolition waste cells at the Carbon County landfill are not at or near capacity" (NRC, 2011a). The Rawlins Landfill has an anticipated life expectancy of 50 years, based on its current rates of waste disposal. The landfill does not accept liquid, industrial, or hazardous wastes. All wastes received at the landfill are disposed there, and no wastes are transferred to other facilities.

Hazardous Solid Wastes

Hazardous wastes, such as solvents, paints, used oil, batteries, and fluorescent bulbs, would be a significantly smaller percentage of the solid wastes generated during the Project than non-hazardous wastes. The closest location for disposal of hazardous solid wastes is the Rock Springs Landfill. As noted in the NRC SEIS, the facility has the capacity and is also in the process of permitting additional capacity that would expand the life of the landfill about 30 years (NRC, 2011a).

Solid 11(e)(2) Byproduct Materials

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 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.

No solid 11(e)(2) byproduct materials would be generated during Construction. Approximately 80 to 100 cubic yards of solid 11(e)(2) by-product materials would be generated each year during Operation (LCI, 2011b), including maintenance and housekeeping items, such as cleaning equipment, replacement components, filters, protective clothing, solids removed from process pumps and vessels, and any soils or other materials that cannot be decontaminated. The annual amounts would be somewhat higher during reclamation of the mine units as the equipment from the mine units is taken out of service. The total estimated amount of 11(e)(2) byproduct material from the Project, including Reclamation, is estimated to be 4,000 cubic yards (NRC, 2011a).

Where possible, equipment would be decontaminated for disposal as non-11(e)(2) byproduct material or for reuse. Equipment that cannot be decontaminated and process wastes would be placed in clearly labeled, covered containers and

temporarily stored in restricted areas with clearly visible radioactive warning signs. The materials would be temporarily stored on-site in containers called 'super-sacs'. Sacs that are full would be sealed and stored in secure areas in the Plant or outdoors in covered roll-off containers approved by the US DOT for transport of Low Specific Activity material until sufficient volume is generated for shipment to a facility that is licensed for treatment and/or disposal. Safe handling, storage, and disposal of decommissioning wastes are addressed in Sections 4.0 through 6.0 of the NRC Technical Report (LCI, 2010), and these procedures would be reviewed and updated, if necessary, in the decommissioning plan which must be submitted to NRC for review and approval prior to initiation of decommissioning activities. Because of the controlled off-site disposal procedures, no impacts from the non-hazardous solid waste disposal are anticipated in the Permit Area.

The solid 11(e)(2) byproduct materials would be disposed off-site, at a facility licensed by the NRC to accept such wastes, by personnel qualified to dispose of such wastes. At present, LCI does not have an agreement with such a facility; however, prior to the start of operations, LCI would enter into a written agreement with a disposal site as required by the NRC. A licensed facility may be a uranium mill tailings impoundment, and the closest would be the Pathfinder Shirley Basin Facility in Wyoming. Other NRC-licensed facilities that can accept byproduct material for disposal include: the Rio Algom Ambrosia Lake facility near Grants, New Mexico; the Energy Solutions site in Clive, Utah; the White Mesa facility in Blanding, Utah; and the Waste Controls Specialists site in Andrews, Texas.

4.18.5 Waste Disposal Impacts from Other Alternatives

The No Action Alternative would not generate any of the ISR wastes and thus no impacts would be created. With respect to waste management, there are no significant differences in the anticipated impacts, or in the monitoring and mitigation, between the Proposed Action and the Other Action Alternatives described in **Section 2.2.** Slightly less solid waste, specifically fencing materials, would be generated if the pattern areas were not fenced. However, the difference in volume of solid waste, if the fencing material was disposed of rather than reused, is minimal compared to the overall Project.

Processing wet yellowcake into a dry powder is not expected to change the nature or magnitude of waste disposal impacts as a vacuum dryer would be used. In a vacuum dryer, the heating system is isolated from the yellowcake so no radioactive materials are entrained in the heating system or its exhaust. The drying train would operate under a negative pressure to avoid atmospheric emissions, and drying would take place at relatively low temperatures. Emissions from the drying chamber would be normally treated through a bag filter to remove yellowcake particulates, and air from the bag filter dust collection system would typically be routed to the dryer offgas line and scrubber. A small volume of liquid effluent from the vacuum dryer would be cooled and condensed for

disposal as 11(e)(2) byproduct material in the UIC Class I wells; however, the volume would be minimal compared to the total volume of material from the Project. During loading of the dried yellowcake into a drum, the typical shipping container, the drum would also be kept under negative pressure via a drum hood with a suction line. The packaging area also has a bag filter dust collection system to protect personnel and to minimize yellowcake release. The vacuum drying equipment would need to be decommissioned in accordance with NRC requirements. Filters and dryer equipment that could not be decommissioned would be disposed of as solid 11(e)(2) byproduct material; however, the volume would be minimal compared to the total volume of material from the Project.

4.19 Mitigation Measures

Mitigation includes specific means, measures, or practices that would reduce or eliminate effects of the Proposed Action or alternatives. The agency-required measures, LCI's commitments and initiatives, and monitoring presented in the previous subsections of **Section 4.0** would provide adequate protection of resources and mitigation of impacts from the Proposed Action and alternatives. No additional mitigation measures are identified.

4.20 Residual Impacts

Residual impacts are adverse effects that remain after mitigation measures have been applied. Since the agency-required measures, LCI's commitments and initiatives, and monitoring presented in the previous subsections of **Section 4.0** would provide adequate protection of resources and mitigation of impacts from the Proposed Action and alternatives, no additional mitigation measures were proposed in **Section 4.19** (Mitigation Measures). Since no additional mitigation measures have been proposed, no residual impacts discussion is required. All impacts would remain as previously described in the subsections of **Section 4.0**.

4.21 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are actions that disturb or remove a resource to the point that it can only be renewed over a long period of time (centuries). A resource is irreversibly committed when it cannot be restored or returned to its original or pre-disturbance condition and when it, its productivity or its utility would be consumed, committed, or lost forever.

An irretrievable commitment of a resource directly removes the resource from availability or renders its productivity or utility lost for a period of time (e.g., closure of an area to resource extraction). An irretrievable commitment is the loss of opportunities for production or use of a renewable resource for a short to medium period of time (years). A resource is irretrievably committed when a decision results in the loss of production or future use of the resource.

The removal of uranium from the subsurface would be an irreversible and irretrievable commitment of resources. While the uranium is irreversibly removed from the ground, it is also irretrievably committed to present-day uses rather than potential uses at some undetermined future time. Other irretrievably committed resources of the Proposed Action and alternatives include building materials, electricity, fuels, office supplies, and other products consumed during the Project.

While surface disturbing and disruptive activities of the Proposed Action and alternatives are considered an irretrievable commitment of resources during the Project life, the environmental protection measures required for the Proposed Action and alternatives would reduce or eliminate the magnitude of this irretrievable commitment of resources. In the long-term, however, the resource commitment of surface disturbing and disruptive activities would be retrievable.

4.22 Relationship between Short-Term Uses and Long-Term Productivity

The Proposed Action and alternatives would result in the potential for loss in long-term productivity; however, the required environmental protection measures for the Proposed Action and alternatives would minimize the effect of short-term uses on long-term productivity.

The extracted uranium would support present-day objectives and not contribute to the national long-term productivity or production and use of uranium. Currently, the national nuclear energy industry (including domestic uranium production) is expanding to meet increasing energy demands, increased interest in energy security, and increased demand for alternative energy sources. At present, the US is importing most of the uranium used to fuel existing nuclear reactors in the country. Recent national programs, statutes, and initiatives include:

- the Nuclear Power 2010 program of the US Department of Energy;
- the Energy Policy Act of 2005;
- the American Recovery and Reinvestment Act of 2009;
- the Nuclear Energy Research Initiative;
- Nuclear Energy University Programs; and
- Generation IV Nuclear Energy Systems.

The State of Wyoming is historically, culturally, and economically tied to the mining industry. With its long-standing mining background and the largest uranium reserves in the US, Wyoming is well-equipped to play a leading role in the nation's uranium production. Uranium mining in Wyoming would not only help to diversify the nation's energy sources, it would offset the boom and bust cycles of other Wyoming natural resource development industries through diversification.

The short-term extraction of uranium would limit the long-term productivity of mineral resource extraction in the Permit Area at some point in the future. The uranium mineral resource remaining after the Proposed Action would be minimal since the Proposed Action anticipates at least an 80-percent recovery rate of the resource. However, other mineral resources could be discovered in economic quantities and recovered within the Permit Area in the future.

Present-day removal of uranium may indirectly improve long-term productivity by reducing the radioactivity of material associated with extracted uranium, thereby benefitting the health of humans and the environment by minimizing potential exposure.